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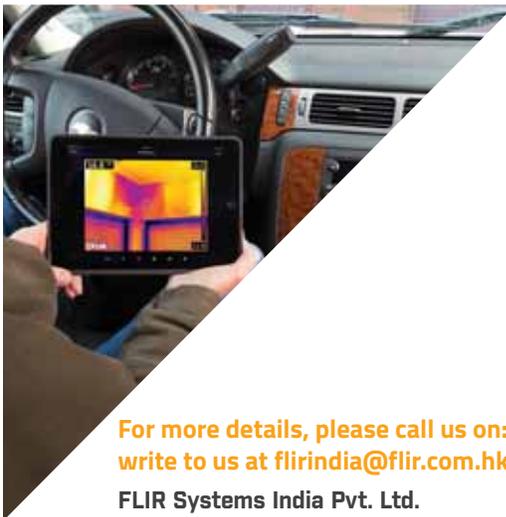


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Publisher's Letter

Hello and welcome once again to *Cooling India*.

The overall perishable food production in India is over 400 million metric tonnes. However, 15-50 per cent of this perishable food is lost due to lack of proper cold chain. Though the cold chain industry in India is still in its infancy, it is likely to grow by 15 per cent over the next 5 years. It is estimated that cold chain market in India valued at \$167.24 bn in 2016 will reach \$234.49 bn by 2020. Here we present to you an in-depth analysis on what's in store for cold chain industry in India.

Apart from handling the agricultural produces, cold chain remains the critical link for proper storage and transportation of pharma and healthcare, dairy and confectionary, and processed foods. Temperature-controlled transportation plays the most critical role in this context. Charles D'Costa, Chief Sales Officer – Cold Chain, DHL SmarTrucking India elucidates how an automated temperature-controlled trucking service could help to ensure that temperature-sensitive goods are handled in compliance with all relevant regulations.

Air pollution is a global issue. Reports suggest that about 92 per cent of the world's population lives in places where the WHO air quality guidelines levels are not met. California continues to have the most cities on the list of most polluted cities thanks to devastating wildfires and increasing vehicular movement. India is no exception to this problem. Today, 13 of the world's 20 cities with the highest annual levels of air pollution are in India. Jack Broadbent, who is responsible for directing the Air District's programs to achieve a healthy breathing environment for every Bay Area resident, explains how the US can help India in the area of air quality.

Again, power consumption in data centres is a global problem as data centres consume around 200-TWh each year. In data centres, about 40 per cent of the total electrical energy is consumed for cooling the IT equipment. Dr. D.B. Jani from Gujarat Technological University, Ahmedabad enlightens the strategies to improve energy efficiency and reducing energy consumption in data centres.

We hope you'll enjoy reading this issue as always! Please write to me at pravita@charypublications.in.


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100/- Per Copy
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Printed by Pravita Iyer and Published by Pravita Iyer on behalf of Chary Publications Pvt Ltd., and Printed at Print Tech, C-18, Royal Ind. Est., Naigaum Cross Road, Wadala, Mumbai 400031 and Published at 906, The Corporate Park, Plot 14&15, Sector - 18, Vashi, Navi Mumbai - 400 703.

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USGBC releases 2018 Sustainability Report

Informa and the US Green Building Council (USGBC) announced the release of the 2018 Greenbuild Sustainability Report, highlighting valuable metrics and key benchmarks regarding the impact on sustainable sourcing, community involvement, and carbon footprint reduction at the 2018 Greenbuild International Conference and Expo, held last November at McCormick Place in Chicago. The event achieved an overall 86 per cent waste diversion rate.

“We’re thrilled to have made such great strides for event sustainability,” said Sherida Sessa, Greenbuild Brand Director, Informa. “We had a lot of ‘firsts’ in 2018 and tried new approaches that worked well. Our hope is that these achievements will be adopted through the events industry. Greenbuild’s education is about sustainability in the built environment, but the way the event is produced leads to these sustainability wins.” The comprehensive report details the sustainability initiatives implemented for the 2018 event, through a review of all objectives, goals and best practices. Case studies provide detailed overviews of sustainability strategies and initiatives including waste diversion, attendee and stakeholder engagement, sourcing and donation of materials, performance tracking improvements, and community engagement. Highlights include the elimination of single-use plastics, 28,000 pledges cast by attendees, and more than 20,000 pounds of carbon offset.

“Greenbuild continuously seeks to set the standard for event sustainability. This is only possible through the support of partners and vendors as well as our Greenbuild Host Committee,” said Kim Heavner, Vice President, conference and events at USGBC. “For the second year, we incorporated the TRUE Zero Waste Rating System, and elevated our tracking processes while capturing our waste reduction efforts.” ■

ENGIE Refrigeration uses eco-friendly refrigerant

ENGIE Refrigeration celebrates a new record-breaking order. For a large French corporation in the pharmaceutical and chemical sector, the refrigeration specialist from Lindau is implementing the biggest water-cooled QUANTUM chiller yet, with eight highly efficient compressors that use the eco-friendly refrigerant R-1234ze. The customer will thus benefit from a refrigeration solution with especially high operational reliability.

Refrigeration systems in the pharmaceutical and chemical industry are among the most sensitive areas of application anywhere, as the complex production processes pose demanding requirements for the provider. ENGIE Refrigeration meets these strict criteria and possesses extensive expertise in this specific area: Among its long-term customers are Nordmark Arzneimittel GmbH and Company KG from Uetersen, and Boehringer Ingelheim Ελλάς S.A. from



Koropi, near Athens. As of now, a renowned pharmaceutical and chemical company from France will be relying on the refrigeration specialist from Lindau on Lake Constance. In the first quarter of 2019, three water-cooled QUANTUM chillers with a refrigeration capacity of 2.4 megawatts each will be installed in its production hall; these are the largest water-cooled QUANTUM models – with a total of eight oil-free turbo compressors and the eco-friendly refrigerant R-1234ze – that ENGIE Refrigeration has ever implemented. Like all chillers, the models were made in traditional manner at the site in Lindau on Lake Constance and tested comprehensively on the test bed there before delivery. ■

Chemours collaborates with Carrier Transicold for low GWP refrigerant

The Chemours announced that Carrier Transicold Europe located in Rueil-Malmaison, France is collaborating with Chemours to specify and adopt an Opteon XL low global warming potential (GWP) hydrofluoroolefin (HFO) refrigerant to replace R-452A in transport refrigeration in 2021.

Opteon XL HFO refrigerants are the lowest GWP and long-term options under F-Gas Regulation for transport refrigeration reducing CO₂ emissions by up to 85 per cent when compared to R-452A. By collaborating with Chemours to select an Opteon XL refrigerant, Carrier Transicold Europe demonstrates its commitment to provide customers with the optimal

combination of low environmental impact, energy use, performance, safety, and longevity refrigerants.

“As the European F-Gas regulation continues to move the HVACR industry towards more environmentally sustainable solutions, it is critical to provide lower GWP options to equipment manufacturers around the world,” said Diego Boeri, Vice President of Chemours Fluorochemicals.

“Carrier is committed to providing efficient, sustainable solutions for its customers,” said Bertrand Gueguen, President, International Truck Trailer, Carrier Transicold. “The selection of a low-GWP refrigerant is the next logical step in the evolution of our industry.” ■



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Ingersoll Rand certified as a 'Great Place to Work' in India

Ingersoll Rand, a company in creating comfortable, sustainable and efficient environments, has been certified as a 'Great Place to Work' by the Great Place to Work Institute, an authority on recognising high-trust, high-performing workplace cultures. Ingersoll Rand has been awarded this certification for successfully building and sustaining a progressive, diverse and inclusive culture promoting growth and innovation amongst its employees.

'Great Place to Work' certification acknowledges organisations that are characterised by great leadership, consistent employee experience and sustainable financial performance. The assessment involves a rigorous culture audit and an anonymous employee survey based on proprietary 'Trust Index' model developed by the Great Place to Work Institute. Anil Gopinathan, Vice President and General Manager, Ingersoll Rand – Engineering and Technology Centers in India, said, "We stay invested in growing our business by growing our people first who are our pillars behind this achievement. The engaging and enriching culture at Ingersoll Rand constantly empowers our people to challenge the status quo and innovate to find better solutions for our customers, society and the environment."

Shirin Salis, Vice-President, Human Resources at Ingersoll Rand in India, said, "At the heart of our business is a rich progressive, diverse and inclusive culture. We believe that our ongoing investments in people, development, engagement and culture set us apart. This includes our relentless focus on building an inclusive and globally diverse workforce, fostering an inclusive culture and being transparent about our goals, progress and commitments."

The factors measured during the assessment include the respect and trust with which employees are treated and the recognition that makes an intangible and real difference. ■

Unique concept showroom from Mitsubishi Electric in Chennai

Mitsubishi Electric inaugurated an exclusive and unique 'concept showroom' for residential use, air-conditioners in Chennai in association with their channel partner Sakthi Cool Point. This exclusive showroom is referred to as MEQ Hiroba, which offers the range of Mitsubishi Electric products with highly advanced technology, quality and durability at a sustainable cost. Mitsubishi Electric Quality (MEQ), measures the quality to give the best experience in products, services, partnership and people. Hiroba in Japanese means a public space for people to gather and MEQ Hiroba will be the platform where new technologies are announced.

According to Yozo Ito, Director and Business Unit Head of Air Conditioners, Mitsubishi Electric India (MEI), said, "These are exclusive showrooms for display and sales of Mitsubishi Electric Air-Conditioning products to encourage the customers to have a touch and feel of

Mitsubishi Electric products. This will help enhance the visibility of Mitsubishi Electric as a premium Air-Conditioning brand. These exclusive showrooms will display the entire range of Mitsubishi Electric products."

According to Neeraj Gupta, Senior General Manager- Living Environment,



Mitsubishi Electric India (MEI), "Many shoppers in India, still prefer to try out products before buying them. There is a whole set of customers that prefer someone to walk them through the purchase process. MEQ Cooling Planets is a unique idea because it encourages customers to visit the store, take a proper look and then make a decision. On the other hand, MEQ Hiroba provides customers complete knowledge in the field of air conditioning." ■

Daikin Applied and CYVSA form alliance

Daikin Applied Americas has reached a definitive agreement to form an alliance with Grupo CYVSA, SA de CV, an HVAC solutions provider in Mexico. The group includes DYPRO, consulting engineering group, all CYVSA subsidiaries, and Clima-Flex manufacturing company, located in San Luis Potosí, Mexico.

This alliance has been established to aggressively respond to the increasing market expectations for integrated solutions. The alliance will focus on enhancing and growing the Clima-Flex product portfolio throughout the Americas, developing comprehensive new services, and expanding the ability of CYVSA to

maximise value to customers throughout the region. Combining the strengths of Daikin Applied and CYVSA positions, this alliance to deliver an exceptional customer experience through every stage of a building system's lifecycle in this changing landscape. The CYVSA group will continue to operate independently and will have the full autonomy to serve customers with the multiple suppliers and solutions that has led them to the leadership position they enjoy today.

Daikin Air-conditioning Mexico will independently continue to serve all existing channels and customers that contribute to the company's continued success. ■

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Solar Impulse Foundation selects efficient Danfoss Turbocor Compressors

The Danfoss Turbocor Oil Free Compressor has received the endorsement of the Solar Impulse Foundation as one of the top 1,000 solutions for protecting the environment. Already recognised as the world leader in oil free, magnetic bearing compressor technology for the HVAC industry, this prestigious award further validates the Danfoss Turbocor Oil Free Compressor as being a viable solution for reducing harmful greenhouse gas emissions while also providing economic benefits to end users through an ROI in less than eight years and reduced energy consumption.

With this new endorsement, Danfoss is the second company in the world today with Soprema that has three products selected by the Solar Impulse Foundation.

“The market for highly efficient solutions is growing rapidly, partly because of the increased focus on energy savings and partly because of urbanization which creates a need for more commercial buildings. Turbocor demonstrates that bold technology strategies are instrumental in securing long-term growth and profitability in our core businesses,” says Danfoss President and CEO, Kim Fausing.

Danfoss Turbocor compressor range has achieved the high score of 4.0 assessed on the criteria of technological feasibility, environmental and socio-economic benefits and profitability. Danfoss Turbocor compressors feature oil free, magnetic bearing technology that reduces energy consumption upto 40 per cent compared to traditional fixed-speed compressor technology. ■

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Cooling India

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Carrier Transicold aids food banks in cool deliveries

Supporting Utah Food Bank’s initiatives to fight hunger and food insecurity, Carrier Transicold recently provided the organisation with a new generation Supra truck refrigeration unit to keep perishable food at the right temperature as it is delivered to food pantries around the state. The grant is funded in part by Carrier and its parent company, United Technologies Corporation to aid food banks in the Feeding America network.

“With this gift, Carrier Transicold is helping Utah Food Bank to collect food from local drives, food manufacturers and grocery rescue programs and transport that food –free of cost – to our partner agencies, so it’s available for seniors, adults and children at moments in their lives when they simply don’t have enough money for food,” said Ginette Bott,

President and Chief Executive Officer, Utah Food Bank. “The value of the Supra unit is equal to the cost of about 48,100 meals provided by our organisation.”

For more than 110 years, Utah Food Bank has stayed true to its objective of serving those in need throughout the state. In 2018, it distributed more than 36 million meals through its network of 150 partner agencies located in all 29 counties. Utah Food Bank is the state’s only member of Feeding America, the nation’s leading domestic hunger-relief organisation.

“Utah Food Bank does great work for people in need locally and in communities throughout the state,” said Royal Richards, Territory Manager, Carrier Transicold of Utah, the dealership that installed the Supra unit onto a 24-foot box truck for the food bank. “Our employees were especially proud to be a part of this initiative.” ■

Maharaja Whiteline launches Hybridcool Series air coolers

Maharaja Whiteline has launched a new range of air coolers, Hybridcool Series. Equipped with unique and innovative concept of having both wood wool and honeycomb pads, makes the air coolers highly efficient and durable, and ideal for every home in summers. The new air coolers will be available in variety of sizes with trendy looks and color

combinations along with manual and remotely controlled options at all 750 distributors and 40,000 dealers of Groupe SEB India across India and various e-commerce platforms between the price ranges of Rs 15,199 to Rs 17,199.

The Hybridcool Series has been manufactured keeping in mind Indian consumers who want efficient and high cooling air coolers clubbed with durable and high air throw. Maharaja Whiteline’s new range provides all these comforts since the cooler is fitted with both, wood wool and honeycomb pads. Over last two decades, usage of cooling method (which



facilitates cooling of the outside air) has evolved from wood wool to honeycomb pads – with each having own set of positive aspects. By launching a product range with both the pads, Maharaja Whiteline has considered the needs of the both the consumers, who earlier opted either for wood wool or honey comb pad-based air cooler.

The high air suction coolers come with easy to remove panels for regular maintenance and pad replacements. The air coolers come in two variants, one is manually controlled and second one is equipped with remote control. Remote ensures convenience and comfort to the user to control the device at ease from the couch. Both the variants are available with two tank capacities of 55 and 65 depending upon the model. The air cooler range is armed with a 3-speed motor to run the new Aerodynamic Plastic 5 Blade fan (16”) and ensure consistent performance. The range provides an air throw of 52 ft and air delivery of 5000 CMH. ■

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Nidec to sell Secop Compressor Business

Nidec will sell its Secop compressor business to private equity funds ESSVP IV (Structured) LP and Silenos GmbH & Co KG. The announcement by the Japanese company follows the European Commission's approval of Nidec's acquisition of Embraco from Whirlpool Corporation on condition of the sale its existing domestic and light commercial refrigeration compressor business.

Nidec's announcement of its intent to purchase Embraco prompted an in-depth investigation into the acquisition by the European Commission in November, amid concerned that the takeover might reduce competition in the supply of refrigeration compressors. To address the Commission's competition concerns, Nidec proposed a set of commitments, including the sale of its refrigeration compressor business. This included the plants in Austria, Slovakia and China that would remove the entire overlap between Nidec and Embraco in the markets where the Commission had identified competition concerns.

Nidec acquired the hermetic compressor manufacturer Secop for ₹185m in 2017. The former Danfoss Compressors GmbH business was renamed Secop when it was acquired by German industrial holdings company Aurelius in 2010. Secop subsequently acquired ACC Austria GmbH in 2014.

A company statement confirms that the current transaction is subject to regulatory approvals in Germany, Austria and Spain, as well as the approval of the European Commission. ■

Alfa Laval completes divestment of Greenhouse Division

Alfa Laval – a company in heat transfer, centrifugal separation and fluid handling – has completed the divestment of its air heat exchanger business, related to commercial or industrial air heat exchangers. The business, previously placed in the Greenhouse division, is from May 1 part of the LU-VE Group.

The product group commercial or industrial air heat exchangers represented the major part of the Greenhouse division. It was moved there in 2016 along with a few other product groups, to provide it with the best possible conditions to improve its performance. The strategy was successful, and the air heat exchanger business reported revenues 2018 of about SEK 1.1 billion, with an EBIT margin of 8.6 per cent.

"I am pleased to announce the closing of this transaction, I am confident that the air business will have even better opportunities to continue developing under the ownership of the LU-VE Group," says Tom Erixon, President and CEO of the Alfa

Laval Group.

The divestment of the commercial or industrial air heat exchanger business to LU-VE Group affects about 400 employees, mainly based at the production sites in Italy, Finland and India, who have now joined the LU-VE Group.



The payment at closing will be EUR 43.6 million, reflecting a majority of the final purchase price. The second part will be paid within twelve months and based on performance. Alfa Laval will continue to supply air heat exchangers (such as Alfa Laval ACE, Alfa Laval Niagara and Alfa Laval OLM) for heavy process industry applications and other types of heat exchangers (such as brazed heat exchangers) for the HVAC and refrigeration industry. ■

Panasonic terminates distribution deal with TF

Panasonic UK has announced an end to its air conditioning distribution agreement with TF Solutions. No reason has been given for the termination of the agreement, which has been in place since 2007. In a brief statement from Panasonic, UK Country Manager Alfredo Armaos, said, "We would like to thank TF Solutions for their support and efforts over the last few years and wish them all the best in the future. Customers can rest

assured that Panasonic will honour any ongoing agreements and warranties regarding Panasonic products which will be dealt with in the usual way."

TF Solutions has been making a number of investments since its acquisition by Travis Perkins in 2017.

Already this year it has added Mitsubishi Electric and Samsung to its air conditioning product portfolio, which also includes Fujitsu. ■

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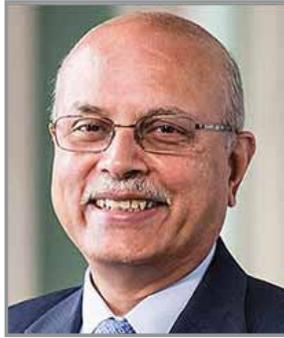
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Shailesh Haribhakti Appointed as Chairman of Blue Star

Air conditioning and commercial refrigeration maker Blue Star announced the appointment of Shailesh Haribhakti as its Chairman. The Board has unanimously approved the appointment of Haribhakti as the Chairman of Blue Star with effect from April 1, 2019. He succeeded Suneel M Advani, who retired from the Board on March 31, 2019 in accordance with the retirement policy for Non-Executive Directors. In its 75 years of existence, Blue Star maintained the tradition of being ahead of the curve in terms of corporate governance, much before the very terminology came into vogue. Shailesh Haribhakti joined the Board of Blue Star in 2005 as an Independent



Shailesh Haribhakti

Director and is the first professional, Independent Chairman in the history of the company.

He is a renowned Chartered Accountant, and among India's leading authorities on audit and tax related matters. He is actively involved with several prominent financial institutions and industry bodies, including the NSE, CII, IMC and ASSOCHAM. He is a certified public accountant, certified internal auditor, financial planner, cost accountant and fraud examiner. He is an independent Board member or chairman of a number of leading Indian companies including L&T Finance Holdings Limited, Mahindra Lifespaces, Future Lifestyle and ACC Limited. ■

Kuntz is CEO of Mitsubishi Electric Trane

Mitsubishi Electric Trane HVAC US (METUS), a provider of Zoned Comfort Solutions and a supplier of Variable Refrigerant Flow (VRF) heating and cooling systems, announces the promotion of Mark Kuntz to Chief Executive Officer (CEO). Kuntz leads the development, promotion and execution of METUS' business growth strategy and manages all departments. Kuntz reports to the METUS Board of Directors.



Mark Kuntz

"Mark brings incredible leadership, management and HVAC industry expertise to this position. In his previous role as Senior Vice President and Deputy General Manager of the Mitsubishi Electric US Cooling & Heating Division, Mark was critical in the formation of the METUS joint venture and we look forward to continued success under his vision and direction," says Masafumi Ando, Chairman of the METUS Board of Directors.

"Mark has played an instrumental leadership role in the

formation and success of the METUS joint venture," said Dave Regnery, Executive Vice President of Ingersoll Rand. "His strong HVAC industry knowledge paired with his vision and track record of operating performance make him the ideal CEO for the joint venture."

Kuntz joined Mitsubishi Electric US Cooling & Heating Division in 2010 and previously held positions in sales, marketing, product development, engineering and administration. Prior to the joint venture formation, he held the position of Senior Vice President and Deputy General Manager of the Cooling & Heating Division. He was promoted to Chief Operating Officer for METUS in August 2018 after the joint venture's formation.

Kuntz is a professional engineer licensed in California and a LEED accredited professional. He holds a bachelor's degree from California Polytechnic State University and a master's degree from Southern Methodist University. ■

Lynne Jack becomes First Female President of CIBSE

Professor Lynne Jack became the First Female President in the 122-year history of the Chartered Institute of Building Services Engineers (CIBSE) at the group's AGM recently.

Lynne Jack is the Director of Heriot-Watt University's Royal Academy of Engineering Centre of Excellence in Sustainable Building Design and is also Deputy Head of the School of Energy, Geosciences, Infrastructure and Society. She is a Chartered Engineer, a Fellow of the Chartered Institution of Buildings Services



Lynne Jack

Engineers and a Fellow of the Society of Public Health Engineers. Lynne is also the UK representative on the Scientific Committee of the CIB (Conseil International du Batiment) W62 Working Group and has recently been appointed to the World Plumbing Council Education and Training Committee.

Lynne is Chair of CIBSE's Accreditation panel and is also a member of the CIBSE Education, Training and Membership Committee, the CIBSE Scotland Committee, and the Ken Dale Bursary Panel. ■

IIR Awards to recognise contributions in field of refrigeration

Every four years during the IIR International Congress of Refrigeration (ICR), the International Institute of Refrigeration (IIR) offers a series of prestigious academic and scientific awards that recognise those who have made outstanding contributions in the field of refrigeration or who have completed noteworthy research.

This time round, the IIR received a record number of applications and submissions to its various awards and is delighted to announce the winners.

IIR Gustav Lorentzen Medal

This medal is awarded to a person for outstanding and original achievements in either academic or industrial research, on innovation or development, in all fields of refrigeration. As such, the research thus promotes creativity and modernises the fields of expertise of the IIR. For the 25th IIR Congress, the Gustav Lorentzen Medal goes to Ruzhu Wang (China), Vice-President of Commission B2 – Refrigerating Equipment for his contributions in technologies including adsorption heat pumps, absorption heat pumps, heat transfer to superfluid helium and green building energy systems.



Ruzhu Wang



Bart Nicolai

IIR Science and Technology Medal

This medal is awarded to a person for outstanding achievements over an extended period of time in science and technology in one of the fields of expertise of the IIR. For the 25th IIR Congress, the Science and Technology Medal goes to Bart Nicolai (Belgium), Honorary Member of

Commission C2 – Food Sciences and Engineering for his research in the area of post-harvest biology and technology with a focus on refrigerated storage and controlled atmosphere storage of in particular fresh fruit and vegetables.

IIR Young Researchers Awards are awarded for outstanding research carried out by young researchers on subjects in the domains of competence of the IIR. For ICR 2019 the winners are:

- Clarence Birdseye Award – Steven Duret (France)
- Sadi Carnot Award – Zhiwei Ma (China) & Kai Wang (China)
- Willis H. Carrier Award – Wei Wu (China)
- James Harrison Award – Claudia Capo (Italy)
- James Joule Award – Pascal Clain (France) & Zhenyuan Xu (China)
- Peter Kapitza Award – Shiran Bao (China)
- Carl von Linde Award – Jingyuan Xu (China). ■

Bitzer HS95 Compressor gets Innovation Product of 2019 award

Outstanding performance with high system energy efficiency – the new screw compressor series from BITZER convinced the specialist jury of the China Refrigeration trade fair. The HS95 compressors received the Innovation Product of the year 2019 award in the HVACR Parts category.

Bitzer has successfully developed its compressors further. The new and bigger models of the tried-and-tested HS screw compressor series offer significant efficiency improvements of motors and mechanics, enabling a better system efficiency in full and part load operations than ever before. The semi-hermetic HS95 screw compressors are designed for a wide application range like refrigeration, air-conditioning, heat pump and marine systems and offer displacements of up to 1,015 m³/h (50 Hz). HS95 screw compressors can be used both in single and parallel compressor systems, meaning up to four compressors can be connected. In parallel compounding, they reach displacements of up to 4,060 m³/h.

The HS95 capacity regulation can be performed both with the stepless mechanical capacity control or with the external



frequency inverters. The series is designed for a large number of refrigerants like R22, R507A/R404A, R134a as well as for new refrigerants like R1234yf, R1234ze(E) and low-GWP blends. Users benefit from the integrated BITZER IQ module, which ensures an extended protection concept and an accurately fitting slider control. Further advantages are the robust design, the low sound and vibration levels as well as the simple handling and serviceability. ■



Air Quality

What India can learn from the US

In India, maintaining air quality has become a concern as the air quality seems to be getting worse in some places. Monitoring and showing PM levels are getting higher. But it really comes down to figuring out your own path to improve air quality and the US could help.

Jack Broadbent,
Executive Officer, Bay Area Air Quality
Management District



Jack Broadbent serves as the Executive Officer/Air Pollution Control Officer for the Bay Area Air Quality Management District, US. In this position, he is responsible for directing the Air District's programs to achieve a healthy breathing environment for every Bay Area resident while protecting and improving public health, air quality, and the global climate for the nine-county San Francisco Bay Area. During his recent visit to India, he had an interaction with **Subhajit Roy** and explains how the US can help India in the area of air quality. Edited excerpts:

Air quality is a global concern today. How do you see the air quality awareness level in developing countries especially in India?

I think, there is a lot of interest in air quality in India and it is a concern of course in different metropolitan regions. The country understands the importance of air quality and monitors the air quite well. It is global phenomenon that when the economy improves, people become more interested in air quality and life.

How different is the scenario from the US?

In India, we see there is a considerable amount of interest in monitoring the air quality to understand what is in the air we breathe. In the US, we of course have moved towards cleaner vehicles and cleaner standards for the industry whereas India is still trying to figure out what is the

best path to move forward.

We are certainly not the one that doesn't make mistakes – we have made plenty in our march towards providing cleaner air. India has to figure out for itself how to move forward given all the other interests that it has. We can certainly serve in terms of our capacity of technical exchanges back and forth and share ideas on what has worked and what hasn't in the US.

Why improving and maintaining indoor air quality is so important?

On an average, a person spends 80 per cent of his or her time indoors. So, improving and maintaining indoor air quality is extremely important. But the philosophy we take in the US is what is outside to come in. Therefore, we want to make sure that air quality of outdoor environment is also maintained apart from having good HVAC systems with filtering systems to prohibit indoor air contamination.

Could you let us know more about your clean air shelters?

Wildfire smoke is the major source of air pollution in the Bay Area. We are in the process of setting up adequate clean air shelters that reduce the amount of particulates generated by wildfire smoke. These clean area shelters are going to be designed with a high-efficiency air filter to provide the cleanest air. Bay Area District Organisation has proposed a bill at California State Legislature to fund about US\$ 50 million over the next two years where we will fund clean air shelters throughout the Bay Area. Further, this program which we will launch in Bay Areas will be a model and is likely to be duplicated elsewhere in California.

How the US can help India in the area of air quality?

In India, maintaining air quality has become a concern as the air quality seems to be getting worse in some places. Monitoring and showing PM levels are getting higher. But it really comes down to figuring out your own path to improve air quality and the US could help. ■

COLD CHAIN HOT OPPORTUNITIES



An in-depth analysis on why cold chain is becoming a hot investment area in India.

Subhajit Roy,
Group Editor

India, the world's second largest producer of fruits and vegetables, throws away fresh produce worth Rs. 13,300 crore every year because of the country's lack of adequate cold storage facilities and refrigerated transport. Though India is agriculture-based country, according to Rupesh Khiste, Head - Quality and R&D, Sahyadri Farmers Producer Co Ltd, we have devastated agriculture economy due to following reasons:

- Small land holding, 80 per cent area non-irrigated.

- Low productivity, negligence towards quality.
- Disturbed agriculture finance system.
- Unpreparedness to natural calamities and losses.
- Poor post-harvest management, lack of basic infrastructure.

The overall perishable food production in India is over 400 million metric tonnes (MMT). However, 15-50 per cent of this perishable food is lost due to lack of proper cold chain. Hence development of healthy,



Of the existing cold stores, almost 80 per cent of cold stores run on old and outdated technology. The upgradation of these units is another area for new business and industry growth.

ADITI SURANGE,
HEAD - CONSULTANCY
DEVELOPMENT, ACR
PROJECT CONSULTANTS

energy efficient cold chain is essential for all food perishables.

Currently, India has 6,300 cold storage facilities unevenly spread across the country, with an installed capacity of 30.11 million metric tonnes. Studies have shown this is half the amount of cold storage facilities that India actually needs. Cold storage capacity for all food products in the country should be more than 61 million metric tonnes. In order to reach that target, the report says an investment of more than Rs 55,000 crore is needed just to keep up with growing fruit and vegetable production levels.

The study estimated that cold chain market in India valued at \$167.24 bn in 2016 is projected to reach \$234.49 bn by 2020. The cold chain market has grown steadily in the last few years and this trend is projected to continue until 2020.

Aditi Surange, Head - Consultancy Development, ACR Project Consultants Pvt Ltd, said, "The overall trend and future of the market of Indian cold chain industry is very positive. Food cold chain has been the major driving force in the entire sector. This is due to the fact that India is a major producer of perishable foods. India ranks No. 1 in milk production, No. 2 in fruits and vegetables production and is again one of top-ranking countries for meat, poultry and fisheries products."

Cold chain refers to storage and transportation of temperature sensitive products. The product range is quite wide and covers vegetables, fruits, milk products and other biological products including human organs, pharmaceutical and diagnostic products (healthcare) which are temperature sensitive. Their preservation and effectiveness on use, is dependent on proper storage at right temperature at all stages of supply chain, right from the point of origin to the end consumer. The required storage conditions vary from (-) 180 to (+) 25-degree C or so, as per product requirement with different low- and high-temperature limits.

For healthcare products, it is critical that storage temperatures are within the required preset limits as per their stability studies, lest, they become ineffective or



CAPEX plans are expected to increase in near future throwing the doors open for HVAC&R technology players.

NIPUN GOYAL
DIRECTOR - BUSINESS
DEVELOPMENT, GEETEE
CARRIERS

pose health risks on usage as in the case of vaccines and other protein-based products.

Explaining the overall market status for cold chain, Nipun Goyal, Director - Business Development, Geetee Carriers Pvt Ltd, said, "In India the business of cold chain is growing. Customers are now more educated and health conscious and thus demanding best quality at lowest cost. Therefore, in addition to the compliance requirements, companies or agencies are focusing on providing better quality products at minimum cost, to the consumers. This has become a necessity in competitive business environment."

However, he observed: "Only 5 per cent of India's Rs. 35,000 crore cold storage industry is organised. So many top logistics players and transporters are attempting to become integrated cold chain service providers. Hence CAPEX plans are expected to increase in near future throwing the doors open for HVAC&R technology players."

Growth Drivers

Indian cold chain market was worth about Rs 1,12,000 crore in 2018. It is projected

to reach about Rs. 2,61,800 crore by 2024 growing at a CAGR of 15 per cent during 2019-24. According to Goyal, "The main growth drivers are increasing demand for organised food retail, processed food sector, greater shift towards consumption of fruits and vegetables and increasing demand from healthcare sector. Demand is also driven by the increased thrust for compliance to label storage condition by industries as well as regulatory agencies."

As per recent draft guidelines, released by Central Drugs Standard Control Organization (CDSCO), on distribution practices for pharmaceutical products, transportation of pharmaceutical products need be in accordance with the storage conditions indicated on the label, among other stringent requirements. This will result in increased requirement for cold chain logistics from pharmaceutical companies. All these suggest surge in demand for multi-purpose cold storage,



Investment in the cold chain sector really looks attractive in the absence of major logistics players and professional logistics companies can tap this empty spot and can get early bird advantage in the longer term.

Rajesh Patil,
SENIOR MANAGER - BD,
COLD CHAIN DIVISION,
SICAL LOGISTICS

third-party temperature-controlled distribution and regional growth and expansion, observes Goyal.

Highlighting the growth drivers for Indian cold chain industry, Ms Surange said, "The drivers for growth of the industry include changing demographics, lifestyle and food consumption patterns, increasing buying power, increasing demand for ready-to-eats, and increasing government initiatives and financial support. There is increasing interest in Indian food market and investments from international players like food chains and logistic players."

Rajesh Patil, Senior Manager - Business Development, Cold Chain Division, Sical Logistics Ltd illustrates the growth drivers as:

- Indians are slowly but steadily adopting frozen and processed food. Consumption pattern has changed and more and more people are eating at the restaurants or QSRs (Quick Service Restaurants).
- New start-ups in foods are focusing on healthy premium food sectors like fresh meat and fish products, dairy products, processed food products and frozen food products and relied heavily on temperature-controlled logistics.
- Stringent FDA norms and consolidation of the pharmaceuticals cargo post GST also generating demand of cold chain logistics.

Along with this growth, the growth of support industries, more so, for HVAC&R too is imminent with more emphasis on cost competitiveness, compliance, reliability and agility. Other technologies for remote sensing, monitoring, controlling and recording for global positioning, temperature and humidity are also expected to be in increased demand along with review procedures, as assurance concept along with appropriate risk evaluation, prioritisation, mitigation and control plan. Goyal summarises by saying: HVAC&R and other associated technologies are in take-off stage along with cold chain supply chain expansion in India.



Our success in growing the business in the India market relies on meeting the customer interests which include product robustness and reliability and the differentiation of a portfolio that can work with severe voltage fluctuation.

Esequias Pereira,
SALES SR MANAGER
ASIA-PACIFIC REGION,
EMBRACO

Aligned with the company's mission to promote innovative solutions for a better quality of life, Embraco's solutions maintain the food preserved through the whole chain and has a complete portfolio to supply cold room in farms; mobile cold rooms for food transportation; to refrigerate the products in the supermarkets and to keep the food fresh at home. The portfolio includes condensing units and compressors such as NJX, NT, and FMX (variable speed technology).

"Our success in growing the business in the India market relies on meeting the customer interests which include product robustness and reliability and the differentiation of a portfolio that can work with severe voltage fluctuation. All those aspects reach a high level of efficiency while delivering power consumption reduction," informs Esequias Pereira, Sales Sr Manager for Asia-Pacific region,

Embraco.

Investment opportunities

According to Aditi Surange of ACR Project Consultants, there is a huge potential for new cold chain facilities to be setup in India viz. need for almost 70,000 more pack houses in the country, more than 50,000 reefer vans to fill the gap in cold transport and around 500 to 700 more cold stores. Frozen food stores and fruit ripening units are also in demand.

The current demand estimates show that the potential for growth in the cold storage capacity is about 10 per cent. Of the existing cold stores, almost 80 per cent of cold stores run on old and outdated technology. The upgradation of these units is another area for new business and industry growth, Ms Surange adds.

Rupesh Khiste from Sahyadri Farmers Producer Co Ltd. outlines the hot investment scopes for the cold chain as:

- To establish farmer facility centres across cluster to facilitate technical support, inputs and services to farmers associated. This will increase



While there are many positive changes in Indian cold chain market, high operating cost is a major roadblock for sector's overall growth.

RUPESH KHISTE,
HEAD - QUALITY AND
R&D, SAHYADRI FARMERS
PRODUCER

the knowledge and awareness at producer level and will help to increase the cold supply chain from root level.

- To establish primary collection and packing centres across clusters for primary collection, grading, sorting, cold chain distribution mechanism with precooling and cold storage facility. This will reduce the actual field heat from the produce and will minimise the initial losses in the perishable fruits and vegetable and will increase the shelf life of the produce. For example, pre-cooling of fruits and vegetables at primary collection centre.
- To create central processing unit for each value chain to handle farm produce in bulk quantities equipped with post harvesting infrastructure as per the need of value chain like freezing etc. It will help in handling the product in bulk as well as processing the surplus quantity to avoid the losses. For example: freezing of fruits and vegetables in different forms.
- To create a controlled temperature frontend retail network with cold supply chain once the product is precooled, cold chain has to maintain throughout the supply chain. It will help to reduce the losses and to maintain the freshness of the product up to the end user.

"Investment in the cold chain sector really looks attractive in the absence of major logistics players and professional logistics companies can tap this empty spot and can get early bird advantage in the longer term," Patil of Sical Logistics said.

According to Rajat Gupta, CEO, Tessol, "Cold chain is a hot investment area due to growth in allied sectors including agriculture especially horticulture, food processing and retail. With these sectors growing and the customers becoming more quality conscious, brands becoming more compliant and quality becoming a major point of differentiation, the growth of cold chain is inevitable. Due to the large gap between the requirement and current capacity, the growth is even faster than the growth in these individual sectors."



Cold chain is a hot investment area due to growth in allied sectors including agriculture especially horticulture, food processing and retail.

Rajat Gupta,
CEO, TESSOL

Challenges

While there are many positive changes in Indian cold chain market, high operating cost is a major roadblock for sector's overall growth, opines Khiste. While retail cold chain as a sector is currently struggling to be more efficient, there is a lot of headroom for improvement with the help of operational and technology level changes which can be brought into the overall system.

Government initiative

In order to promote technically sound, energy efficient and sustainable cold chain, the Indian government has established National Centre for Cold chain Development (NCCD) under Ministry of Agriculture. There are various subsidy schemes made available by the government through MoFPI, NHB, NHM, APEDA and other bodies. The government provides good financial incentives through these arms for various types of cold chain projects, informs Ms Aditi Surange. She adds, "Efforts are also being made to promote green and sustainable technology with application of renewable energy in the cold chain sector."



Cold Chain in F&B Industry

Food and grocery retail needs passive temperature-controlled packaging.

The Food and Grocery (F&G) segment in India is a very critical market to focus our attention on when looking at cold chain. The Indian market for F&G is expected to reach USD 810 billion by 2020. This segment consists of a diverse portfolio of consumers, channels and unique distribution models. For instance, today the various channels in this segment are the traditional mom and pop stores, large supermarkets, online grocery retailers with the largest channel still comprising of small stores popularly known as *Kiranas*. The *Kiranas* account more 90 per cent of the total F&G segment and the newest channel in the segment - online grocery retail or e-grocery accounts for 2 per cent already within the last five years. The



Macrovector/Freepik, n.d.

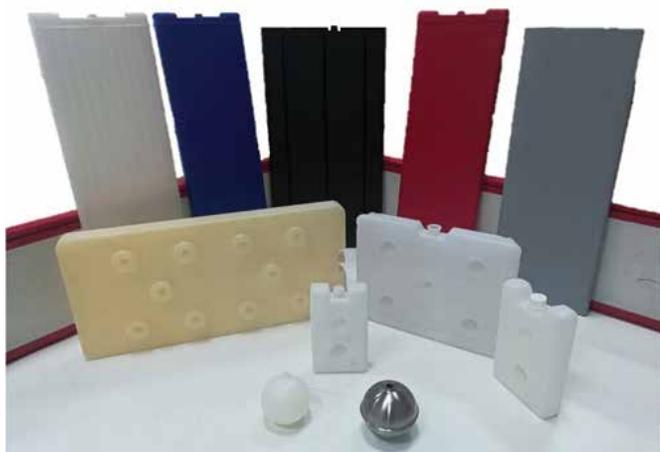


Figure 1: PCM thermal batteries

e-grocery phenomenon cannot be ignored and its adoption will only keep increasing with the increase in internet connectivity and access to smart-phones.

The shift from *Kiranas* to alternate channels such as the large supermarkets and e-grocery essentially aims at getting wide range of food products to consumers conveniently, faster and in the right condition. The most challenging aspect in the supply chain is the preserving the quality and value of perishables.

Challenges

Small part load shipments

The complexity of offering a wide portfolio of food products requiring different temperature conditions of storage further increases as one goes downstream to the last mile. In a supermarket, the last mile is taken care by the consumer, while in case of an e-grocery retail it has to plan its process until the consumer doorstep. Whether the order is for a single-family pack ice cream or a mix order of cereals, yogurts, frozen meat and fresh vegetables the amount of effort in planning and cost of resource is the same.

Pre-packaging of orders

The increasing competition for market share and high expectations of the consumer has resulted in unique business models. Large super markets have begun offering home deliveries while e-grocery companies are moving from pre-defined delivery schedules to just in time deliveries. For instance, a popular e-grocery retailer based in Gurgaon offers a unique value proposition aligned to the young millennials and one which I personally use. The offering is to ensure that any order placed latest by 11pm is delivered sharp at 7am at your doorstep. For such services the challenge is in preparing the packages of perishables and temperature sensitive products in advance which on an average is seven hours. Within the temperature-controlled food products, the chilled category (2C to 8C) of products such as fruits, vegetables, milk, yogurt, constitutes 80 per cent and the frozen category (-)15C to (-)25C constitutes 20 per cent of the order. From winters to summers the cost of rejection and complaints vary from as low as 1 per cent to 7 per cent a month.

Multi-temperature transport

Each state would have a central warehouse where the products are consolidated and further moved to the spokes which in case of e-grocery retail is known as a dark store and in case of large supermarket chain it is the outlet itself. The movement from hub to spoke is relatively simple as consolidation can be based purely on temperature category. However, the challenge is that a full truck load is not viable as refrigerated trucks have single temperature in which case moving multi-temperature commodity becomes a challenge and a high cost.

Passive cold chain Ecosystem

Difference between Active and Passive cold chain

A cold chain that uses conventional air-conditioning which is dependent on instantaneous power whether the fuel is electricity or diesel is termed as an active cold chain ecosystem. An active system such as compressor-based packaging system would be high on capital cost and maintenance cost. It does not offer flexibility in payload. While a passive cold-chain system is based on thermal energy storage (TES) technology that enables decoupling the cooling operation from the source of energy. TES technology based on Phase Change Materials (PCMs) enable storage of energy at different temperatures. These materials can be packed in plastic cartridges or pouches as shown in the figure 1. Popularly known as 'PCM packs' or 'thermal batteries' it could be customised in any shape, colour and size.

Bespoke Solutions

The temperature and number of hours of retention forms a parameter to design the insulated box and the thermal batteries. Also, understanding the customers requirement to arrive at an optimal universal packaging volume for the last mile delivery becomes critical. In many cases the customer would have already made the investment in an insulated box. In such cases the box specification should be considered to arrive at the right type and quantity of thermal battery.

The standard packaging from a solution provider is validated to perform at under various ambient conditions. The combination of the three components - PCM, the insulation quality and the volume of the packaging play an important role, hence, it is important to get the performance re-validated incase the customer wishes to take only the thermal battery.

Charging of thermal batteries

The charging of thermal batteries essentially means freezing



Figure 2: plo save® PCM charging unit

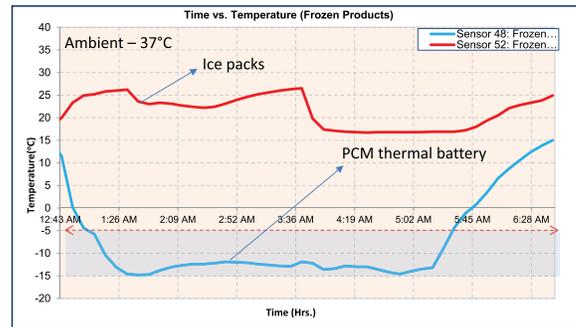
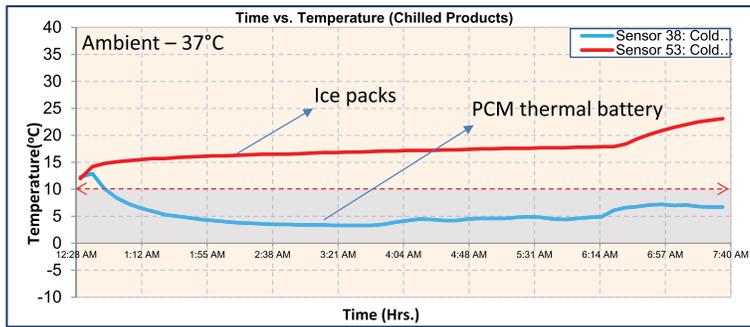


Figure 3: Thermally insulated boxes lined with PCM thermal battery of the PCM material completely. A PCM material's core utility is derived from its ability to store latent heat at the designed temperature. Latent heat is the energy absorbed or released during phase transition, for instance, if the PCM thermal battery contains a (-)26C Cell material then it needs enough cooling energy at a temperature lower than (-)26C Cell to ensure freezing. A PCM thermal battery provider hence would provide the right charging unit as shown in figure 2.

Precise, predictable and lean

PCM thermal batteries not only offer precise temperature control in virtue of its property as explained above but also eliminates any uncertainty linked to active cooling systems. In an active cooling system, a machine failure or switching of the equipment would result in temperature excursion. However, in case of passive systems one can control it but not switch it off. In retail supply chain for intercity the routes are predictable hence, with the thermal battery one can essentially quantify the amount of cooling requirement, which is stored in advance. The most critical product is ice cream in which thawing and freezing cannot be tolerated at all. PCMs are the only solution to provide for an accurate (-)18C transport for as long as 16 hours (Most requirement is below 16 hours).

The layout and arrangement of the thermal batteries as shown in figure 3 also changes depending on the temperature and retention time required.

Performance

Ice packs, glycol packs and dry ice were the commonly used passive materials which today become redundant owing to its disadvantages in terms of precise temperature control, repeatability and reusability. PCMs ensure all these key performance metrics required to ensure product integrity and lower operating cost of supply chain. The above graph indicate the performance of the product packaged with PCM battery pack vs ice packs. In absence of PCM thermal batteries, the product is exposed to a much higher temperature beyond the threshold zone (The highlighted zone).

The Indian cold chain sector provides for immense opportunity for making an impact on the social, economic and environmental conditions. With rapidly growing demand, the adoption of new technology to handle this demand is becoming mandatory. Passive cold chain packaging is just one of the many applications of PCMs and it is time companies proactively identify supply chain efficiency gaps which can be filled with simple and smart technology interventions.

Vishnu Sasidharan
 Vice President
 Pluss Advanced Technologies Pvt. Ltd.



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India HVAC Market to Reach \$5.9 bn by 2024

The growth in the market can be attributed to increasing number of high-rise buildings, shopping complexes & malls, and hypermarkets in Tier-II cities.

India HVAC market is expected to reach USD 5.9 billion by 2024, registering a CAGR of 7 per cent during the forecast period, according to P&S Intelligence.

The growth in the market can be attributed to increasing number of high-rise buildings, shopping complexes & malls, and hypermarkets in tier-II cities. Apart from this, the market is expected to propel on account of on-going smart city projects in the country.

Insights into the market segments

Based on ventilation type, India HVAC market is segmented into ventilation fans, humidifiers or dehumidifiers, air cleaners, and air handling units and fan coil units. Of these, ventilation fans category is estimated to hold the largest revenue share in the market, in 2018. This is due to growing demand for ventilation fans from commercial buildings owing to the

guidelines provided for natural ventilation in national building code of India, 2005.

In 2018, air handling unit category is estimated to hold higher revenue share. This is owing to rising usage of air handling units across various applications such as commercial offices and buildings, industries, hospitals, data centers, server rooms, and universities. With further rising penetration of air conditioning systems across the country, the demand for air handling units is expected to increase throughout the forecast period.

Variable Refrigerant Flow (VRF) system is categorised into heat pump systems and heat recovery systems. Out of these, heat recovery sub-category is projected to register faster growth during the forecast period. This can be attributed to the fact that these systems provide significant advantages over heat pump systems, such as efficient heat management as well as lower energy requirements. The rising awareness among people regarding the

advantages of heat recovery systems is providing a major boost to the growth of heat recovery sub-category.

Surging infrastructure spending in India buoyed the market growth

Surging infrastructure spending in India is driving the growth of Indian HVAC market. There are several infrastructural projects such as ongoing and upcoming airports, and metro railway expansion projects across the country. For instance, the government of India has granted around USD 57 million in the interim budget of 2019, for construction of Noida and Ghaziabad sections of the metro network.

Thus, increasing number of airports and metro stations in the country would increase the demand for HVAC systems. Hence, surging infrastructure spending especially on metro railway, and airports, is expected to fuel HVAC market growth in the country. ■



Cooling Technology for Data Centers

Cooling costs are one of the major contributors to the total electricity bill of large data centers. Particularly, two major factors affecting data center cooling energy consumption, namely air flow management and data center location selection.

Two cooling systems, computer room air conditioning (CRAC) cooling system and airside economiser (ASE), have been used for cooling purpose of large data centers.

In data centers, about 40 per cent of the total electrical energy is consumed for cooling the IT equipment. Cooling costs are, thus, one of the major contributors to the total electricity bill of large data centers. Particularly, two major factors affecting data center cooling energy consumption, namely air flow management and data center location selection. Two cooling systems, computer room air conditioning (CRAC) cooling system and airside economiser (ASE), have been used for cooling purpose of large data centers. It is found that the cooling efficiency and operating costs vary significantly with different climate conditions, energy prices and cooling technologies. As climate condition is the major factor which affects the airside economiser, employing the airside economiser in the cold climate yields much lower energy

consumption and operation costs.

The worldwide energy consumption of data centers has increased dramatically, now accounting for about 1.3 per cent of the world's electricity usage. The data centers have evolved significantly during the past decades by adopting more efficient technologies and practices in data center infrastructure management (DCIM). It is estimated that the market will grow by about 5 per cent yearly to reach USD 152 billion in 2016. Meanwhile, there is a trend to build mega data centers with capacities over 40 MW. Energy efficiency is an important issue in the data centers for minimising environmental impact, lowering costs of energy consumption and optimising data center operation performance.

A modern data center has a large room with many rows of racks filled with a huge number of servers and other IT equipment used for processing as shown in Figure 1, storing and transmitting digital information. An amount of heat is generated by these thousands of servers and another IT equipment. To maintain reliability of the servers and other IT equipment in the data center, it is of importance to maintain proper temperature and humidity conditions. Figure 2 reports the results of an investigation of 10 random data centers. It reveals the representative power consumption distribution and the variation, showing a spread between 30 per cent and 55 per cent of the total energy consumed by cooling data center IT equipment. Cooling and ventilation systems consume on average about 40 per cent of the total energy used. Therefore, how to reduce power consumption, power costs and increase cooling efficiency and maximise availability must be taken into account before building up a data center.

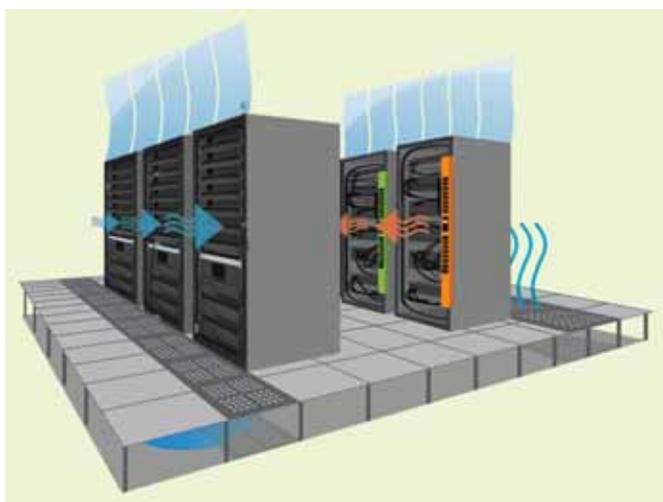


Figure 1. Cooling of modern data centre

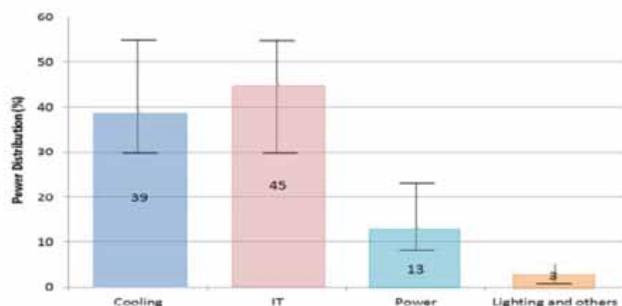


Figure 2. Data center power consumption distribution and variation.

IT devices always show high necessities in working conditions (Table 1), especially, the indoor temperature ($22 \pm 2\text{C}$) and humidity ($50 \pm 5\%$) control. Therefore, the air conditioning system is of great significance in space cooling for such data centers, considering the huge and consecutive heat emissions Figure 3 shows the typical refrigeration system for data centers. The electrical chiller is used to produce low temperature water in its evaporator and then the chilled water is delivered to the terminal air handling units to take away the emission heat from racks. On the other hand, the condensation heat of the chiller is exhausted to the ambient through the cooling tower.

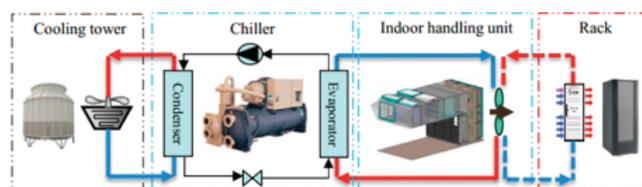


Figure 3. Typical refrigeration system in data centers.

Table – 1. Summary of data center usual thermal loads and temperature limits.

Power loads	
Component	Values
Processors	60–75 W each (2 per server)
DIMM	6 W each
Auxiliary power per server	150–250 W
Total power per server	300–400 W
Rack capacity	1 U servers, up to 42 per rack Blade servers at 10 U, up to 64 per rack
Total rack power	13–26 kW
Racks per data center	250
Total power per data center	3.2–6.5 MW
Temperature limits	
Component	Values (°C)
Processor	85
DIMM	85
Disk drive	45

Data Center Cooling Systems

Air cooled systems

The terminal cooling equipment should provide air with the right cooling capacity and a properly distribution. There are several parameters that could influence the cooling efficiency, such as ceiling height, where hot air stratification may occur, raised floor or dropped ceiling height (Figure 4), which is important for achieving a correct air distribution between the IT equipment, and airflow direction in the room as shown in Figure 5.

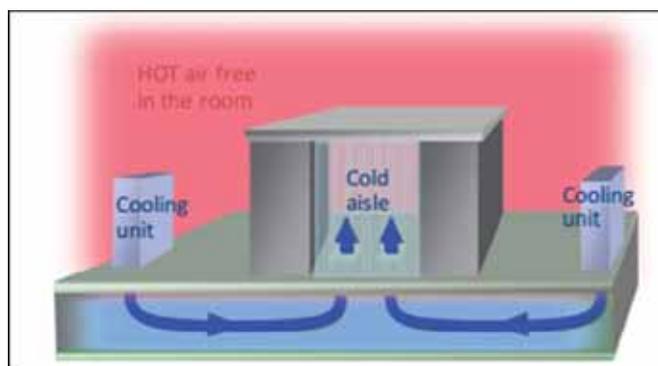


Figure 4. Cold-aisle containment system (CACs) deployed with a room-based cooling approach

Two major air distribution problems have been identified in data center, by-pass air and recirculation air. Re-circulation air occurs when airflow to the equipment is not sufficient and part of the hot air is re-circulated, which results in a considerable difference between inlet temperature at the bottom and the top of

the rack can occur. By-pass of the cold air occurs due to a high flow rate or leaks through the cold air path. In this case, part of the cold air stream skips directly from the cold air supply to the exhaust air without contributing to the cooling process. This poor air management results in a low cooling efficiency and generates a vicious cycle of rising local temperature. In fact, about one rack in ten works with a temperature above the standard recommendations and the majority of hot spots occur in data centers with light load, indicating that the main cause of hot spots is a poor air management. In order to prevent hot spots, usually the temperature of the cooling system is set below the IT requirements.

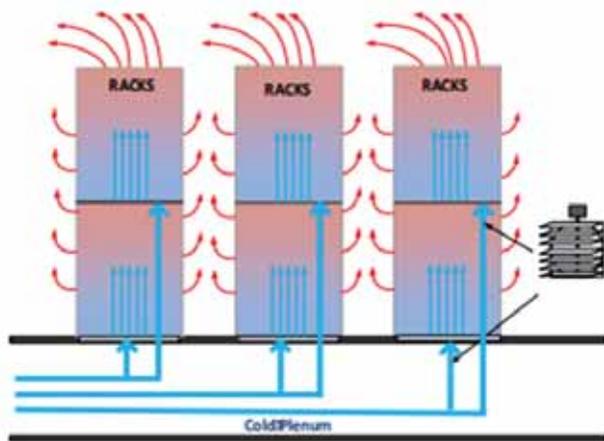


Figure 5. Air flow illustration in data center vertical server rack layout.

Liquid cooled systems

When DCs have a high-power density equipment, air-cooled systems might not be the best solution in terms of efficiency and reliability. Therefore, different cooling technologies should be employed in such cases, like liquid-cooled systems as shown in Figure 6 that are capable of supporting high density power and offer a wide range of advantages. The main advantage is the higher heat transfer capacity per unit, which allows working with lower temperature difference between the CPU and the coolant. Moreover, this solution eliminates two low efficiency steps of air-cooled systems, heat-sink-to-air and air-to-coolant heat transfer. Hence, a decrease in the system thermal resistance and an increase in energy efficiency can be obtained. Higher inlet temperatures can potentially eliminate the need of active equipment for the heat rejection, and also open up the possibility of heat reuse. Liquid-cooled systems can be constructed using micro-channels flow and cold-plate heat exchangers in direct contact with some components such as CPUs and DIMMs.

Liquid cooling technology is the fully immersed direct liquid-cooled system, as proposed in. The server enclosure is sealed and contains a fluoro-organic dielectric coolant in direct contact with electronics, which is used to transfer heat to a water jacket by natural convection. The heat can be then directly transferred from the cabinet to an external loop and eventually released or reused.

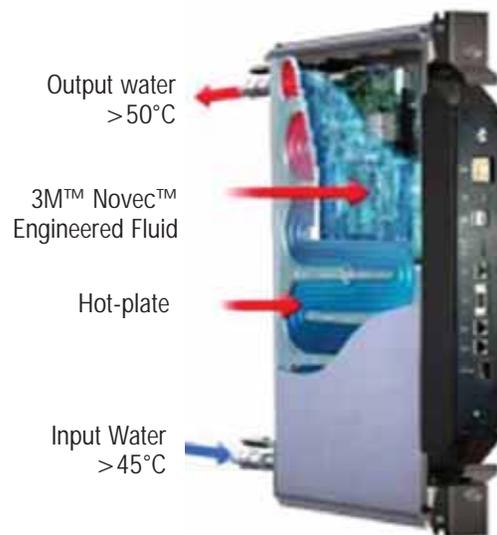


Fig. 6. Liquid cooling of data centers.

Future Cooling Strategies

Future DC applications will have higher number of transistors for chip and clock rates, which in turn would lead to a further increase in heat dissipation density. To balance this high heat density several others advanced cooling technologies are being developed, such as fully immersed direct liquid-cooled, micro-channel single-phase flow or micro-channel two-phase flow. The cooling technology with the higher heat removal capacity is by far micro-channel two-phase flow system, which takes advantage of the latent heat of the fluid. The use of the latent heat leads to a greatly increased convection heat transfer coefficient due to nucleate boiling compared to the sensible heat of a single-phase fluid. The two-phase cooling could remove higher heat fluxes while working with smaller mass flow-rates and lower pumping power than a single-phase cooling solution. Moreover, if properly designed, two-phase cooling could provide a more uniform equipment temperature. Coolant temperature can reach 80C increasing the quality of the heat, allowing an easy reuse in several applications. With a CFD simulation, it is found that a flow rate of 0.54 g/s with an entering temperature of 76.5C can be sufficient to cool an 85W CPU. The newly proposed and simulated a two-phase cooling cycle having the relative energy performance as well as energy recovery opportunities. Results showed that the liquid single-phase cycle had a pumping power consumption 5.5 times higher than the HFC134a two-phase cooling cycle.

A further step for improving energy efficiency and reducing energy consumption in data center is the capture and reuse of the waste heat produced by the IT equipment. The implementation of waste heat recovery measures can have a great effect on reducing CO2 emissions. Nevertheless, the main impediment to introduce a WHRU (Waste Heat Recovery Unit) in a data center is the low quality of the heat produced, despite the large quantity.

Another step toward the reduction of CO2 emissions in data

center industry is the implementation of renewable energy sources (RES) to cover part of data centers overall energy consumption. The main obstacle is the intermittent nature of RES, whereas data center require energy 24 hours per day every day, which needs to be provided even when green power is not available.

Strategies for Slowing Rate of Heating

Despite the challenges provided by recent data center trends, it is possible to design the cooling system for any facility to allow for long runtimes on emergency power. Depending on the mission of the facility, it may be more practical to maximise runtimes within the limits of the current architecture and, at the same time, plan to ultimately power down IT equipment during an extended outage. There are four strategies to slow the rate of heating.

- Maintain adequate reserve cooling capacity

- Connect cooling equipment to backup power
- Use equipment with shorter restart times
- Use thermal storage to ride out chiller-restart time

Conclusion

With data centers enabling nearly all aspects of modern societies and their ever-increasing demand for energy, we need them to be not only cost efficient but also smart, sustainable and ideally part of fighting climate change. ■



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Process Chillers Market to grow at 5.1% CAGR through 2027

According to a recent report, the process chillers market is poised to register a steady growth during the 2018-2027 period with global sales surpassing 130,000 units in 2019. The report tracks the process chillers market for the period 2018-2027. According to the report, the process chillers market is projected to grow at 5.1 per cent CAGR through 2027.

A combination of multi-pronged factors such as the burgeoning demand for food, energy, medicine and health products, construction material, and chemicals are contributing significantly to the process chillers market growth.

According to the study, end-users continue to show preference for air-cooled chiller systems over water-cooled systems. Easy installation, lower maintenance costs, and enhancements in technology supporting the efficiency of the system are fueling air cooling chiller system sales.

According to the study, manufacturers are continuously working on improving the efficiency of their product offerings. Introduction of variable frequency drives and novel, eco-friendly refrigerants are few of the latest trends in air-cooled chillers category, according to the study. The study opines that the factors will propel air-cooled chiller systems to over 102,000 units in 2019. The study opines that water-cooled chillers sales are also likely to remain steady, on the back of widespread application in a range of industries.

Development of Advanced Compressor Systems to Bolster Market Growth

Highlighting the innovations in the process chillers market, the report opines that production of advanced compressors is aiding in enhancing the efficiency of process chillers. Compressors play a key role in enabling end-users to alter the pressure of the refrigerant to obtain the desired temperature in a room and hence plays a vital role in the determination of the efficiency of process chillers. For instance, Danfoss launched a new compressor

named Tubocor which leverages magnetic bearing and variable speed technology to offer efficient cooling while significantly reducing CO2 emissions. Additionally, the company claims the product offers high efficiency, produces lower noise, and reduces the overall operating costs.

The development of technology supporting performance enhancements in process chiller systems is another pervasive trend expected to bolster market growth. Production of advanced valves, pressure sensors, and heat controllers are some of the key factors influencing market growth. The launch of smart systems to optimize process chiller operations is another key factor driving demand for the cooling systems in industries. For instance, Thermal Care launched a novel central chiller controller technology named Dynamic Lift. The technique at the core of Dynamic Lift adjusts the pressure in the condenser automatically after sensing different parameters such as outside temperature, heat load, and performance metrics of different process chiller components. The company claims the system substantially reduces the energy consumed by process chillers and optimizes its efficiency.

Absorption Chillers to Find Widespread Adoption as Energy Crisis Deepens

Intensifying demand for energy-efficient cooling systems across different industries is prompting process chiller manufacturers to consider boosting the production of absorption chillers. Absorption chillers operate on thermodynamic and chemical principle and utilise water as the refrigerant. Additionally, the heat required for absorption chiller systems to function is derived from various low-cost sources making the chiller systems efficient. The development of 2-step evaporator/absorber cycle and parallel flow design is offering a solution for manufacturers to overcome the conventional drawbacks of absorption chillers. ■



Carrier Transicold:

Focus on Innovative & Reliable Solutions

Carrier Transicold provides customers with the most advanced, energy-efficient, direct-drive units, diesel-truck units for road transport applications as well as multi-modal and trailer refrigeration systems for sea and rail logistics. **Pankaj Mehta, Managing Director, Carrier Transicold, India & South Asia** reveals gaps in cold chain ecosystem, technologically innovative solutions suitable for Indian conditions etc. in an interaction with **Cooling India**.

What are the evolutions that you have witnessed in cold chain logistics sector over the past few years? What opportunities and challenges are envisaged for the coming years in the cold chain supply sector?

The cold chain ecosystem is constantly evolving and has steadily grown over the past few years as a result of enhanced focus from the Indian Government and industry. Over the next few years, increases in the organised retail sector, online grocery stores, quick service restaurant chains, as well as the government initiatives are trends that will drive cold chain growth. The provisions and guidelines concerning cold chain logistics infrastructure in the draft of National Logistics Policy by Ministry of Commerce (MoC) and the draft on Good Distribution Practices for Pharmaceutical products by Central Drugs Standard Control Organisation (CDSCO) are testaments to the paradigm shift in the evolution of the cold chain logistics industry. The major challenges to the development of the cold chain are limited infrastructure at the farm gate, a fragmented agriculture base and lack of awareness of the benefits of the cold chain on access to expanded segments.

Carrier Transicold India has been an industry leader for more than two decades and provides customers with the most advanced, energy efficient and environmentally sustainable, direct drive units, diesel-truck units for road transport applications as well as multi-modal and trailer refrigeration systems for sea and rail logistics. Contrary to the other large geographies, India has been greatly dependent on road transportation for cold chain activities. The Golden Quadrilateral Freight Corridor, as well as the Sagarmala project, have provided an excellent platform to exponentially boost the cold chain supply in India, thus, enabling faster deliveries and leading to greater value realisation for the goods producer.

What are the major infrastructure components that need to be developed for effective integration of the cold chain sector?

A cold chain is only as strong as its weakest link. Cold storages, pack houses, pre-coolers and reefer vans are important links in the cold chain. The National Center for Cold Chain Development estimates that the largest gap is at the farm gate of approximately 70,000 pack houses, which also include pre-cooling facilities and around 53,000 reefer vans or trucks for agri-cold chain logistics.

Carrier Transicold India is a part of the CII Task Force on cold chain development as well as a life member of the National Center for Cold Chain Development, and has continuously over the years undertaken initiatives to establish a robust cold chain in India.

What are the gaps in the cold chain system that need to be bridged? What steps is Carrier taking to overcome challenges, such as lack of cold chain logistics infrastructure, low awareness of labour in handling temperature sensitive products etc.?

Agriculture is one of the main drivers of the country's economic growth. It ranks high in production and is moving from a supply driven to a market-driven segment.

An efficient post-harvest management and agri-logistics system including aggregation, pre-conditioning, pre-cooling and refrigerated transportation not only helps to reduce food loss but also aids in expanding the reach to distant markets. The extension in holding life using controlled atmosphere cold storage also overcomes price fluctuations based on seasonality. A well-established cold chain can play a crucial role in enhancing the economic returns to farmers, and thus, has been a focus area in the recommendations for the government initiative on doubling farmers' income.

The majority of Indian farms are small and are not in a position to invest directly in infrastructure or transact at wholesale markets. The recent announcement by the government for upgradation of

existing 22,000 rural haats to Gramin Agricultural Markets (GrAMs) will advance development of physical infrastructure. These GrAMs will be electronically linked and will allow farmers to make direct sales to consumers and bulk purchasers.

The government has also approved a Scheme for Agro-Marine Processing and Development of Agro-Processing Clusters (SAMPADA) with a focus to create modern infrastructure with an efficient supply chain management from farm gate to retail outlet. Such initiatives would help to create employment opportunities and reduce agri wastage.

Carrier Transicold India believes there is huge opportunity to reduce food loss and improve food distribution by implementing existing cold chain technology. With a focus on the agri-logistics sector, we are working closely with several stakeholders to help plug the identified gaps by offering Carrier cold chain solutions, such as availability of reefer trucks in remote areas where cultivation or harvesting takes place. These infrastructure interventions have helped our customers achieve better returns over their investments and have benefitted farmers, traders and transporters. Carrier participates in various sessions and panel



The key to success in the cold chain business in India is the creation of technology-based, tailor-made solutions that address the unique challenges that exist across the cold chain.

discussions at forums pertaining to cold chain logistics as well as also provides education and training on optimum unit utilisation, good distribution practices and material handling to corporate staff, material handlers or pickers and truck drivers as part of ongoing efforts to educate and train cold chain stakeholders.

To change the perception that the cold chain is complicated and too expensive for small-holder farms, we recently conducted a demonstration on the impact of the cold chain on kinnow fruit from Punjab. The study measured the effects of cold storage and refrigerated transport from Abohar to Bangalore, a roughly 2,500 km (1,600 mi) overland journey that is a four to five-day drive by truck.

The study demonstrated that investment in refrigeration pre-cooling equipment and refrigerated trucks can reduce food loss by 76 per cent while increasing profit margins up to 23 per cent. As a result, the kinnow selling season was extended by one month, the selling region was expanded 2,500 km from Punjab to Bangalore, and carbon dioxide (CO₂) equivalent emissions from wasted food were reduced by 16 per cent. Further, impact of the pilot has been in the second year, with more than 80 refrigerated ocean containers of the fruit shipped during the selling season

including exports to Dubai, Russia and Bangladesh, and around 350 refrigerated truck trips were made – up from zero, just two years ago. The cost per tonnage of refrigerated goods could also be reduced by using multi modal or rail reefers.

Indian road and transport conditions need creative solutions. How do you handle those?

Carrier Transicold over the past few years has launched several India specific products or solutions in the Indian segment. For last mile distribution using refrigerated small vans, Carrier Transicold introduced several models of the Citimax series for chilled and frozen applications, which operate using the van engine, much like a car air-conditioning system. The Citifresh system designed to carry fresh produce was also introduced recently to meet the growing demand in India for transportation of fruits, vegetables, dairy and confectionary products using longer refrigerated trucks. To cater to the demand of higher capacity and airflow on larger container sizes, Carrier Transicold launched the high capacity Supra diesel drive range.

Carrier Transicold India has introduced advance telematics solutions for diesel drive truck and trailer units. These systems

devices and automation. The various cooling, heating and defrost cycles are controlled through an advanced microprocessor-based controller with other features such as sleek design, self-diagnosis, error alarms, high customisation. Carrier Transicold is committed to providing efficient cold chain solutions around the world by offering sophisticated equipment, engineered applications, sharing vast experience and offering access to global best practices. In line with our initiatives for introducing environmentally sustainable products, Carrier Transicold introduced the Pulsor refrigeration unit for Light Commercial Vehicles, featuring E-Drive all electric technology.

The Supra and Oasis offerings for large trucks comes with their own engines and can run independently of a truck engine. This product range is specially designed for hot desert and tropical conditions. All of these products are designed to provide strong, reliable performance in hot, dusty ambient conditions and offer superior pull down and cooling efficiency.

Carrier Transicold's innovations also include the NaturaLINE container refrigeration unit for marine transport, the first in the industry to use R-744 natural refrigerant carbon dioxide (CO2). In Europe, Carrier Transicold is conducting demonstrations of a trailer refrigeration unit using CO2 refrigerant, the first of its kind for road transport, with several supermarket chains.

Carrier Transicold also recently introduced a new generation of engineless transport refrigeration technology, harnessing the hydro-electric power generated by a truck's engine to reduce emissions and maintenance costs, and help to improve fuel efficiency. These units add a new dimension to Carrier's range of products and help

fleet operators meet their efficiency and sustainability goals, and achieve a sustainable cold chain.

When mounted to a commercial vehicle, the ECO-DRIVE GenSet is driven by a hydro- pump connected to the truck's power take-off (PTO) motor. The hydraulic system drives a generator that delivers electrical power to the host Carrier Transicold unit, without any requirement for the refrigeration unit to use its own diesel engine. Integrated into the hydraulic system is a control unit that ensures the generator consistently runs the same number of revolutions. This maintains constant power, even when the truck is idling in heavy traffic, eliminating any need for the driver to rev the truck's engine to provide sufficient cooling power.

The key to success in the cold chain business in India is the creation of technology-based, tailor-made solutions that address the unique challenges that exist across the cold chain. The concept of 'one size fits all' does not work for the Indian landscape, which means innovation and reliability are essential for meeting the diverse demands of the cold chain in this environment. ■



Cargo safety, efficiency and reliable temperature control are key to effective cold chain transportation. Carrier equipment offers superior technology, advance control, remote monitoring, safety devices and automation.

empower customers to remotely monitor and control refrigeration units, and help them track their consignments with a strict watch over temperature integrity. This has helped them track and reduce theft, secure and control the number of door openings, and optimise time for loading or unloading. The smart features such as alerts and alarms, geo-fencing and geo-tracking have helped our customers greatly improve their delivery timelines.

Carrier Transicold continuously works with its stakeholders to understand the evolving market requirements and introduces solutions to meet the same. Our strength lies in adapting products to suit Indian conditions, engineering them as per requirement and supporting them with our after sales team.

What technological innovations do you want to incorporate for achieving a more optimised, cost-effective temperature-controlled supply chain?

Cargo safety, efficiency and reliable temperature control are key to effective cold chain transportation. Carrier equipment offers superior technology, advance control, remote monitoring, safety

Gandhi Automations` Prime Freeze High Speed Doors for Cold Storage

Consultative selling has always been the basics of high-end technical products. Gandhi Automations, a 22-year old company and dominating 70 per cent of the automated door market in India still believes in basics. Probably the reason may be it is a company which doesn't get solutions from other parts of the world and just use Ctrl C-Ctrl V for the Indian market.

When one talks about cold chain, the geographical dynamics and operational conditions are very different in India as compared to other countries. And only one who has built solutions from scratch can address the Indian market. That is where Gandhi Automations fares sky above others. The 23 branches of Gandhi Automations across India are the data engines that generate humungous data on day-to-day challenges of a cold storage but the good news is customers always walk out of these branch offices with a solution that was specially designed and customised for them, surely "Early Doors to Success" for cold storage owners.

'Envelop', a concept for cold chain Distribution Centre (DC), means a DC has to be perfect at walls to floors to entry-exit doors so that energy loss is low. DCs cannot afford to have solid panel doors and simultaneously the cooling wastage needs to be curtailed. Even Door and Access System Manufacturers Association (DASMA) confirms roll up design has lesser energy losses. Prime Freeze Duo is the solution from Gandhi Automations with a high-speed dual curtain technology with blower aid, roll up door. This product is suitable from (+)5C to (-)35C. In case of a forklift impact, the Prime Freeze Duo resets itself back into position. Hence, it is a self-repairing product, innovative indeed. It has high level of insulation and is extremely safe and ideal solution to avoid any cooling loss. Again, products like high speed doors are apt for food storing cold storage with lesser cooling loss and ensuring reduced bacterial activity, thus, promising higher standards.

The high-speed door by Gandhi Automations is a flexible, low-temperature insulated industrial door system that allows easy transition between areas with large temperature differences. The rapid opening and closing of the door system prevent a dramatic drop or increase in temperature.

The creation of a physical barrier that prevents the penetration of cold through a particularly strong fabric that has been coated with a special material is a system solution that has been specially designed for cooling areas.

Designed for cold storage applications, the Prime Freezer high-speed door allows fast traffic in and out freezer room, minimising temperature variations. Its excellent seal limits the loss of cooled air and saves energy. An optional insulation curtain mounted on the high-speed freezer door reduces condensation and frost. It forms an extra barrier between warm outside temperatures and cold inside temperatures.

Low consumption electric heating cables in the side posts of this high-speed freezer door reduce frost and avoid down-time. Combined with the self-reinserting door curtain, this guarantees a long lifetime of the roll up door. A Prime Freezer high speed door is safe for people, products and vehicles. The flexible door curtain is free of rigid parts. It avoids injuries and damage.

These high-speed doors incorporate the speed of the passages and the functionality of opening so that the low temperature and humidity remain within the separated area. Gandhi Automations offers a great and extremely safe product.

Gandhi Automations solutions cater to wide variety of customers ranging from large beverage manufacturing corporates to cold storages operating in retail markets, and every requirement is unique. But the company offers tailored solution to every client who decides to opt for 'Early Doors' to success. Insulated high-performance doors preserve the cold chain in high-traffic cooler and freezer applications. Able to open and close rapidly, they prevent drafts and resist moisture as well as reduce energy costs.

Gandhi Automations believes in detailed research of its customers so that it can offer an unique solution for better ROI that creates impact in the business and plans future scalability. This process of owning customers and working as business partner ensures Gandhi Automations a sublime customer satisfaction, a must for a leader in Industry 4.0. ■



While the potential of India's cold chain sector is apparent to anyone who has knowledge of the industry, there are constraints that prevent this potential from being fully realised. Cold chain is emerging as a vital sector with an expected CAGR of 19 per cent till 2022. Yet, agricultural produce worth Rs 133 billion is discarded annually due to the country's lack of proper refrigerated storage and transportation. This is due in part to India's issues of food shortage and food security, but many of the bottlenecks can be eased through the adoption of new technologies, and the government's push to promote the industry.

Cold chain is one of the toughest aspects of logistics to get right, and the demand for it is on the rise in many industries. Food and pharmaceuticals are key segments that will drive the growth of the cold chain business for logistics providers in the foreseeable future. Pharma and healthcare companies often ship products like vaccines, blood products and various medicines, which need to be maintained at certain temperatures to preserve their potency or validity. Similarly, industries like dairy and confectionary, processed foods and quick-service restaurants require their products to be maintained at cold or frozen



UPTO 50% REDUCTION
IN TRANSIT TIMES



NEED FOR AUTOMATION IN REFRIGERATION

The article analyses why logistics providers should employ automation in refrigeration.

temperatures. The nature of these products is such that they cannot be stored in warehouses for long periods.

Businesses in such industries seek to ensure that their shipments reach their destinations without being tampered with; they seek a logistics partner that they can trust. Unfortunately, the problem with India's cold chain industry, by and large, is that around 90 per cent of the market is unorganised with more than 3,500 players, and there is a lack of transparency with no assurance of temperature control or shipment integrity. Moreover, the cold

chain facilities in India are mostly unsuitable for the conditions here, resulting in less-than-satisfactory performance of many refrigerated systems.

Further, with only 10,000 reefer vehicles and no reefer rail containers, the refrigerated transport set-up in India is insufficient to cope with the country's demand for cold chain transportation. As road transport constitutes a major percentage of the total freight traffic, customers prefer working with logistics partners that demonstrate competency in at least three fundamental areas: transit



time; temperature control; and the placement time of the vehicles (or the time elapsed between the request for a vehicle and its fulfillment). Of these, temperature control is the one aspect that can benefit the most from automation.

An automated temperature-controlled trucking service could help to ensure that temperature-sensitive goods are handled in compliance with all relevant regulations. It can employ wireless devices and technologies to continuously monitor the temperature of the storage area during the journey, and transmit this information to

the logistics provider and, if required, to the consigner.

With a 24x7 monitoring facility, a logistics provider can monitor the storage temperature within the vehicle as well as the consignment temperature throughout the journey from a central control tower. By using digital sensors to remotely monitor and manage these temperatures in real-time, one can ensure that the freshness and quality of goods is preserved. Moreover, the trucks should be equipped to enable reliable temperature-controlled transport over different ranges such as $+2^{\circ}\text{C}$

to $(+8^{\circ}\text{C}$ and $(+15^{\circ}\text{C}$ to $+25^{\circ}\text{C}$.

This kind of efficiency, flexibility and monitoring can be achieved with the aid of IoT sensors and applications that can tag the containers and monitor parameters such as humidity and temperature in the storage area, or the shocks and vibrations experienced during transit. The system must be designed to include ways of mitigating risks and losses, and to have strong capabilities for dealing with contingencies. Moreover, it should incorporate proactive problem-solving processes.

It is also possible to prevent tampering – whether accidental or deliberate – with the help of indicators or door sensors that alert the control tower if it is opened at an unscheduled time during the journey. This information can be relayed in a timely manner to the concerned employee or truck drivers, who can immediately take the necessary corrective action. In addition, On-Board Diagnostics (OBD) can help monitor driver behaviour and alert the control tower if the driving is rash and the shipment is at risk of being damaged.

Every employee involved in the shipping process must be aware of the temperature requirements of different types of products and the policies, procedures, and protocols involved in using these automated systems. To improve driving behaviour and safety, training can be provided to the drivers to help hone their skills and increase efficiency.

Technology and automation are becoming increasingly ingrained in not just refrigeration, but all the different aspects of logistics. The cold chain systems of the future will be powered by the new and emerging technologies of the day, and the logistics providers who adopt them will be most likely to succeed, while those who don't could be left in the cold. ■

Charles D'Costa,
Chief Sales Officer
– Cold Chain,
DHL SmarTrucking India



LEGIONELLA CONTROL

Important Aspect of
IAQ Management



The article focuses on one important and fatal hospital acquired infection caused by water contamination and consequently Indoor Air Quality disruption by aerosolisation called Legionnaires disease.

Legionella is a ubiquitous organism, a rod-shaped bacterium found in natural water resources, viz: rivers, lakes, streams, soil samples, including drinking water sources like wells, etc.

Following the 1976 American Legion Convention in Bellevue Stratford Hotel in Philadelphia, 34 attendees died and 221 people became ill from pneumonia. The infection was eventually researched and attributed to organisms residing in the water stored in the cooling towers being spread by air-conditioning system itself, in aerosolised water droplets.

Being associated with the American Legion, the Bacterium was named Legionella Pneumophila and the associated disease called Legionnaire disease.

Legionella occurs in very low concentrations and typically thrive and proliferate in a warm and damp environment in manmade water systems, at temperatures ranging from 20C to 45C e.g. Cooling Tower drifts, lagoons, spas and domestic water systems and even swimming pools, if not treated adequately.

Legionnaire Disease is a respiratory infection that usually strikes individuals with weak immune systems. Heavy smokers, especially, male above 50 years of age are more susceptible. Infection results from inhaling airborne water droplets or mist containing viable count of Legionella which are small enough to pass deep into the lungs and get deposited in the alveoli. The incubation period can vary from 2 – 10 days. Symptoms vary from high fever, chills, headache, muscle pain and at times dry cough may develop leading to breathing difficulty and a feeling of disorientation.

Legionnaires Disease Causation in Healthcare Facilities

A typical healthcare unit consists of various equipment and water systems which pose a risk for growth of Legionella bacteria and triggering the onset of Legionnaires Disease. The equipment includes dental water lines, respiratory therapy gadgets and water therapy tubs systems to basic facilities like faucet aerators, shower heads and decorative fountains, all being aerosol generating systems.

The Crux of ASHRAE standard 188-2015

Legionellosis is 'Recognised as Hazard'

Healthcare facilities either housing patients for more than 24 hours or treating patients for burns, chemotherapy ,organ or bone marrow transplantation, liable to comply.

Code Recommendations for Healthcare Facilities

Develop a Legionella management plan to include:

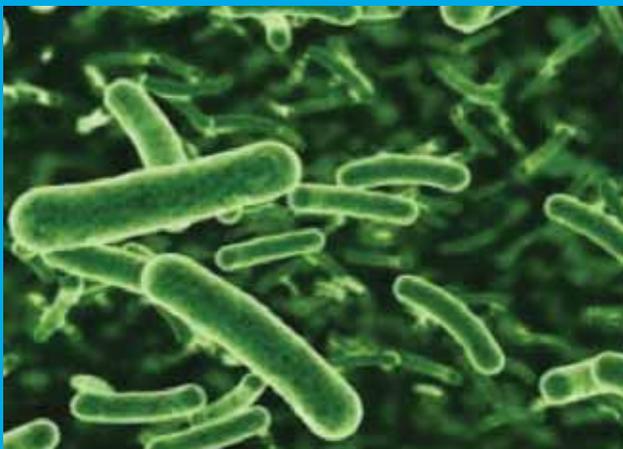
- o Environment assessment which includes description and documentation of the building water system and conducting a detailed risk assessment and hazard analysis.
- o Preventive maintenance which includes development and implementation of Water management plans and adoption of engineering controls.
- o Sampling and Validation, identifying water sampling points based on risk systems, conducting Legionella Specific Water Analysis from a NABL certified lab and validation of engineering controls based on lab reports.

Water Safety Organisational Group for Hospitals

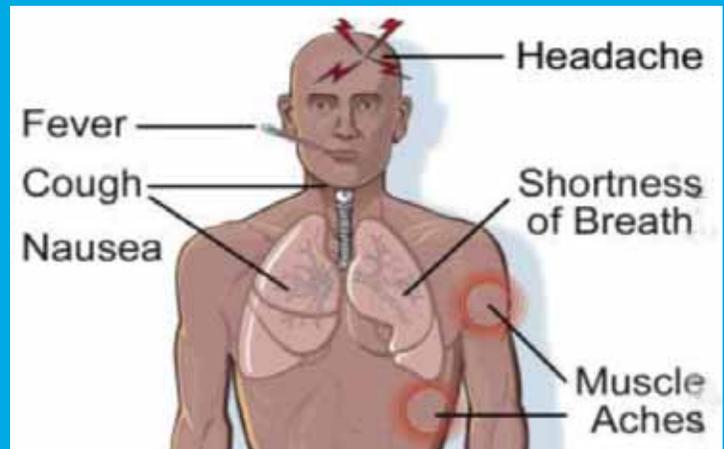
There is code requirement for a team of experts referred to as the Water Safety Group or WSG. In healthcare environments, the WSG describes a team of specialists that collectively has the responsibility for creating, implementing, and maintaining a Water Safety Plan (WSP). This plan is designed to ensure that the water used in hospitals and similar healthcare settings is safe to use by patients, staff and visitors, and poses minimal risk of infection from waterborne pathogens i.e. through the presence of legionella bacteria, pseudomonas and other unwanted contaminants.

Primary Role of the Water Safety Group

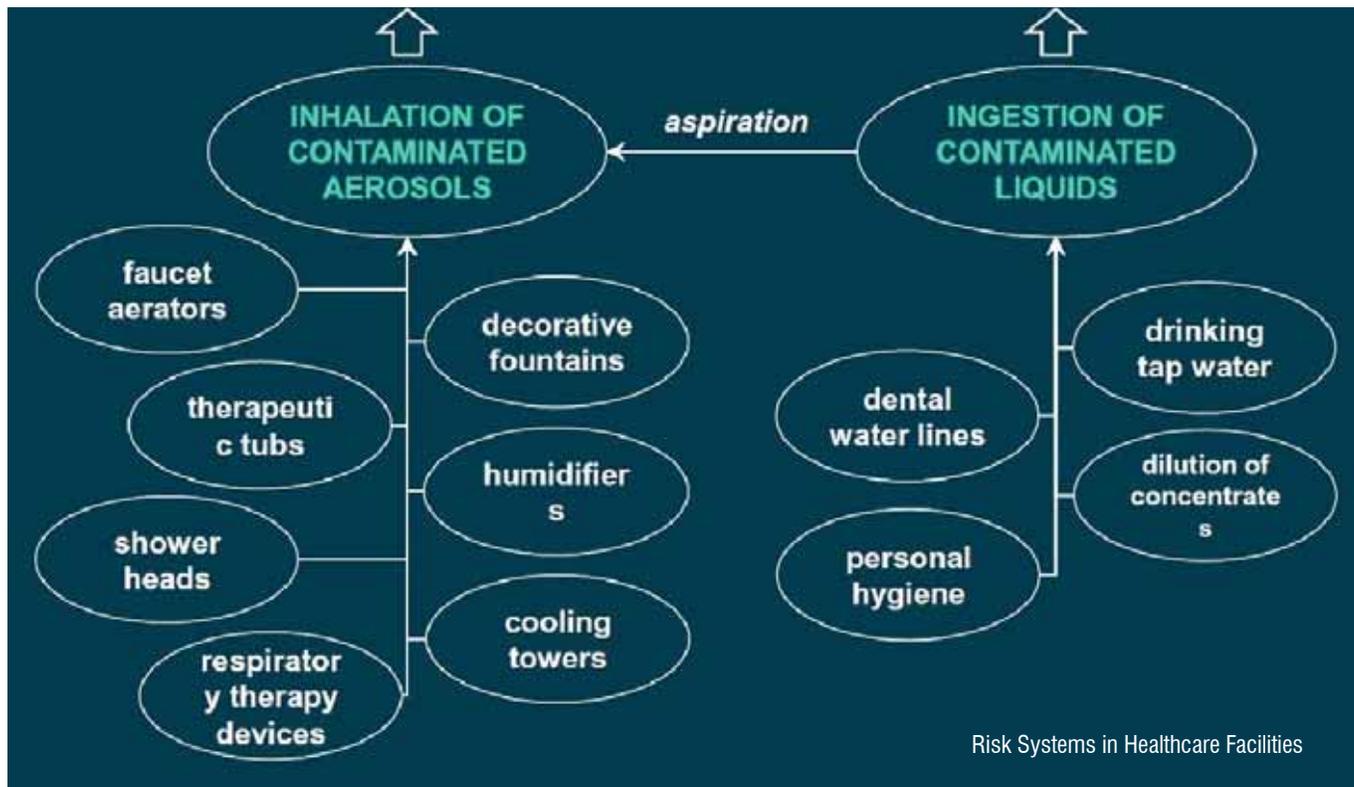
The Water Safety Group through its team of experts should take responsibility for the identification and assessment of water-related hazards, the development of suitable monitoring and control measures to minimise the risks, and the creation of suitable incident protocols.



Legionella Pneumophila under a microscope



Symptoms of Legionnaires Disease



Who should be part of the WSG?

Ideally, the Water Safety Group should have several team members, each of whom brings a particular skill set to the table. For example, one might have extensive engineering knowledge relating to water systems. Another might have experience of working with water in a healthcare setting, thereby, understanding the potential risks that a system poses. This approach ensures that the group has the required extensive knowledge and experience that would be impossible to glean from just one person.

Typically, the WSG would include people from some or all of the following specialist areas:

- Property and estates management including operations and projects
- Infection control
- Medical microbiology
- Nursing
- Augmented care
- Housekeeping/support services
- Authorising Engineer (Water)
- Medical technical officers
- Specialist users of water (such as renal units and departments offering aquatic therapy)
- Sterile services departments (SSDs)

Accountability and Group Structure

Ultimately, the duty holder is responsible for the maintenance and safety of the water systems in use throughout a hospital or healthcare facility. The duty holder may be a business owner, a board of directors, an NHS Trust, its Chief Executive, a director or senior manager, but should be clearly identified at the outset. Whoever this is will depend on the organisation and the circumstances. However, the entire WSG should be responsible to the duty holder and be organised with clear accountability in mind. Each person should be aware of their role within the group, and of the responsibilities they have. A typical structure for a Water Safety Group can be seen on the next page.

Water Disinfection Strategies to inhibit growth of Legionella Bacteria

Heat : Constant Temp control and Thermal Shock

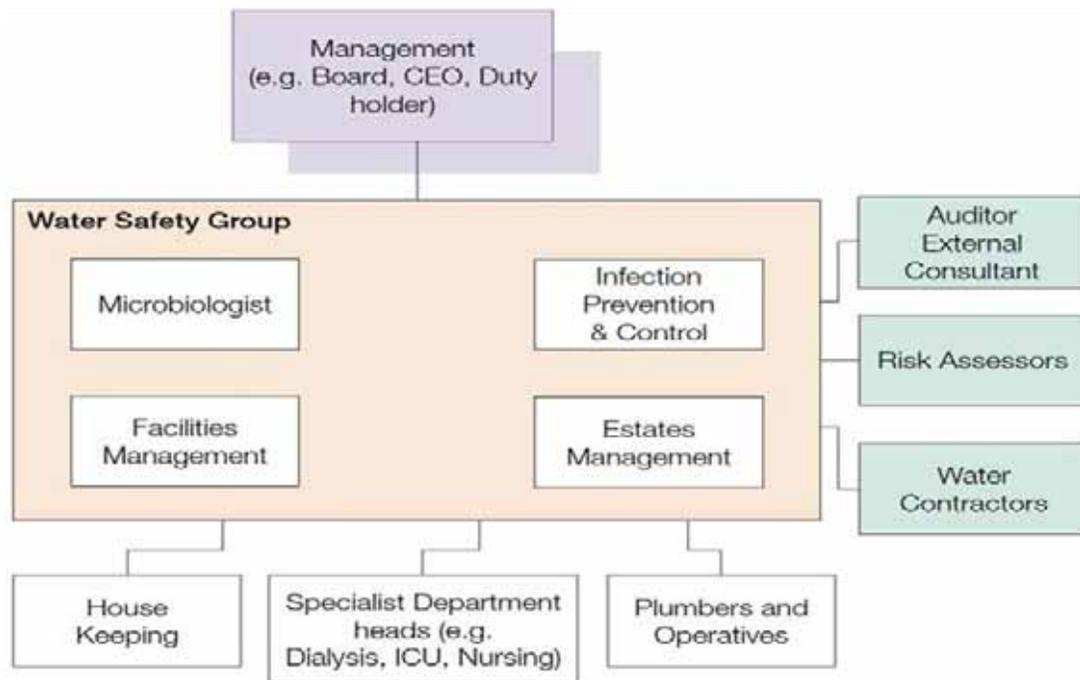
Constant maintenance of the temperature between 55-60°C

At 60C, it takes approximately two minutes to inactivate 90 per cent of a population of Legionella pneumophila. The effectiveness of maintaining the circulating temperature at 60C has been demonstrated both in

hospitals and in hotels. Hot water installations maintained at temperatures above 50C are less frequently colonised by Legionella. Circulating water at 60C such that the temperature at each outlet reaches at least 50C and preferably 55C within one minute of opening the outlet, is the method most commonly used to control legionella in hot water distribution systems. Although raising the temperature to a constant 60C has consistently been shown to control outbreaks it does not necessarily eliminate Legionella from the system but controls them at a level that prevents further cases. Provided, there is sufficient heating capacity it is relatively easy to implement and is easy to monitor continuously. It has the possible disadvantage of increasing energy consumption and there is an increased risk of scalding. Where thermostatic mixer valves are installed to reduce scalding risk, they must be subjected to a program of planned monitoring and maintenance

Thermal shock

Thermal shock treatment at 70-80C for relatively short periods has been used both for emergency disinfection, and also for periodic disinfection of systems, as part of long-term control programs.



A Typical Water Safety Organisational Group in a Healthcare Facility

Thermal disinfection is carried out by raising the temperature of the whole of the contents of the hot water storage heater to 70-80C then circulating this water throughout the system for up to three days. To be effective, the temperature at the hot water storage heater should be high enough to ensure that the temperatures at the taps and appliances do not fall below 65C. Each tap and appliance should be run sequentially for at least five minutes at the full temperature, and this should be measured. For effective thermal disinfection, the water system needs to be well insulated. Some recommend emptying the hot water tanks in advance, cleaning them and decontaminating them with chlorine (50 mg/l for one hour or an equivalent) but this may cause corrosion.

It is essential to check that during the procedure, the temperature of the water in distal points reaches or exceeds 65C.

At the end of the procedure, samples of water and sediment should be collected at distal points of the installation and examined for Legionella. If the result is unsatisfactory, the procedure must be repeated until documented decontamination is achieved. Following decontamination, microbiological checks must be repeated periodically.

Thermal treatment has the advantages that no particular equipment is required so

that the procedure can be carried out immediately, provided there is sufficient heat capacity in the system. However, the procedure requires considerable energy and manpower and is not normally practical for large buildings but may be suitable for small systems. It will not disinfect downstream of thermostatic mixer valves and so is of limited value where such valves are installed. There is a severe risk of scalding at these temperatures. Although the numbers of Legionella may be reduced, recolonisation of the water system can occur from as little as a few weeks after treatment, particularly, if it has not been accompanied by other remedial measures.

Chlorination

Chlorine has also been used for the treatment of hot water systems. As the bactericidal action of the chlorine is pH sensitive and decreases rapidly at values above 7 the pH of the water will have to be monitored and may need adjustment.

Shock hyperchlorination

This must be carried out in water at a temperature below 30C with a single addition of chlorine to the water to obtain concentrations of free residual chlorine of 20-50 mg/l throughout the installation, including distal points. After a contact period of at least two hours with 20 mg/l

of chlorine or at least one hour with 50 mg/l of chlorine, the water is drained. Fresh water is then let into the installation until the level of chlorine returns to the concentration of 0.5-1 mg/l.

Continuous chlorination

This is achieved by the continuous addition of chlorine, usually in the form of calcium hypochlorite or sodium hypochlorite. Residual levels of chlorine can vary depending on the quality of the water, the flow, and the amount of the biofilm in the system. However, the residual disinfectant must be between one and two mg/l. Where there are stagnant areas or circulation problems in the water distribution system, the chlorine will not inactivate Legionella in these areas. Although continuous chlorination has been used as a means of control in hot water systems, it is difficult to maintain the required levels of chlorine as it volatilises off from hot water. In addition, chlorine is corrosive and this effect is increased with raised temperatures.

Chlorine dioxide

Chlorine dioxide has been successfully used to control Legionella in some hot water systems and can be used in the same manner as chlorine. It has the advantage that it is not as volatile at high temperatures as chlorine and is said to be more active on biofilms.

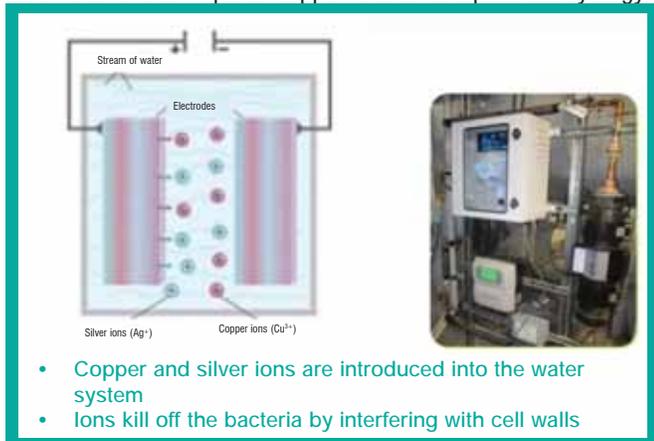
Monochloramine

There is some evidence that hospitals receiving water that has been treated with monochloramine rather than chlorine are less likely to have outbreaks of legionnaires' disease and are less colonised with Legionella. It is possible that treating hot water systems with monochloramine may prove more effective than chlorine but appropriate dosing systems are not yet available for buildings. Monochloramine is slower acting than chlorine but persists longer and is therefore, said to be more effective against biofilms.

Cu/Ag Ionisation

"Ionisation" is the term given to the electrolytic generation of copper and silver ions for use as a water treatment. Metals such as copper and silver are well known bactericidal agents. They act on the cell wall of the micro-organism that alters the cells permeability which, together with protein denaturation, lead to cell lysis and death.

Copper and silver ions are generated electrolytically and their concentration in the water depends on the power applied to the electrodes. Copper and silver ion concentrations maintained at 400 µg/l and 40 µg/l respectively can, if properly managed be effective against Legionella in the planktonic and biofilm phase in hot water systems. If, however, the water is softened then silver ion concentrations between 30 to 20 µg/l can also be effective, provided a minimum concentration of 20 µg/l is maintained. This level of silver still requires copper ions to complete the synergy.



The application of ionisation will need to be properly assessed, designed and maintained as part of an overall water treatment program. It should be noted that in hard water systems, silver ion concentrations can be difficult to maintain due to build up of scale on the electrodes, unless anti-scaling electrode cells are employed. High concentrations of dissolved solids may precipitate the silver ions out of solution. For both hard and soft water, the ionisation process is pH sensitive and it is difficult to maintain silver ion concentrations above pH 7.6. The build-up of scale and concentration of dissolved solids therefore needs to be carefully controlled so that suitable ion levels are consistently maintained throughout the system. This may require additional water treatments.

The method is easy to apply and is not affected by the temperature of the water. However, because the system is subject to fluctuations in concentration unless automatic controls are employed,

- UV light can be used at the point of delivery
- High energy short wavelength UV light disrupts bacterial DNA, preventing cellular reproduction and killing the cells.



it is necessary to check the concentration of the two metals regularly, as well as the pH of the water at 6-8. This technique is not suitable for systems that employ zinc cathodic protection for water systems because the metal deactivates silver ions. Furthermore, if the treatment is used continuously it is necessary to check that the maximum permissible concentration (CMA) laid down by current legislation for drinking water is not exceeded.

Hydrogen peroxide and silver

Treatment is carried out using a stable concentrated solution of hydrogen peroxide (oxygenated water) and silver, exploiting the bactericidal action of each of the two components and the synergy between them. The technique is relatively recent and requires further experimental confirmation.

Ultraviolet (UV) radiation

Irradiation with ultraviolet light is an alternative method for the disinfection of drinking water. Ultraviolet light (254 nm) inactivates bacteria by producing thymine dimers in their DNA that inhibit replication. The application of ultra-violet light is a method of disinfection that has proven effective close to the point of use. The thermal shock and chlorination methods can be used prior to application of ultraviolet light to control Legionella present in the system. UV equipment is relatively easy to install and has no adverse effects on the taste or potability of the water and does not damage piping. The technique is not suitable as the only method for an entire building or water system because there is no residual effect, and Legionella remains in the biofilms, dead ends and stagnant areas of the system.

Conclusion

It can be inferred from the above, that controlling Legionella Bacteria is not an expensive affair. It involves proper design and thereafter pursuit of an appropriate operation and maintenance schedule which needs to be followed diligently. With these simple but critical measures, Legionella Bacteria can be controlled effectively and maintained below limits that may cause detrimental health effects.

In conclusion, Legionella Compliance is definitely the way forward for the healthcare facilities to protect their brand image and ensure continuity of business. ■

Mahesh Prabhu

Member of the ISHRAE National Technical Committee
& a charter member of IAQA India Chapter



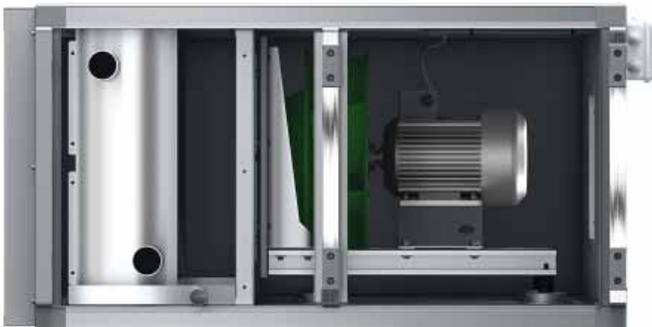
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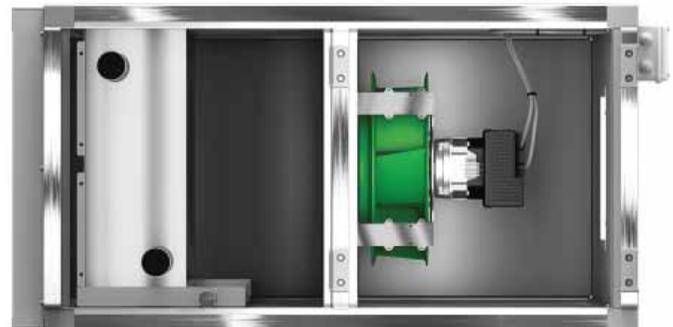
VTS launches new generation of ducted AHUs



Units are available with two types of motors



AC motor



EC motor

VTS has launched a new generation of ducted air handling units – VENTUS S-type (SVS).

The most important advantages of the new VENTUS S-type units are:

- Optimisation of the unit size to the installation parameters - series of 5 sizes with efficiency from 900 CFM to 5600 CFM.
- Competitive height – one of the lowest on the market
- Excellent work parameters – energy-saving and performance flexibility
- Wide range of work and parameter adjustments
- Trouble-free and practically maintenance-free operation of fans
- High durability and tightness of the structure
- 40mm, double skin casing
- Excellent anti-corrosion protection.

The new SVS units are characterised by such technical solutions as:

- 1) **Fan sets of PLUG type:** VENTUS S-type has equipped in PLUG type fans with direct drive are used. The fan sets in the new SVS units are available with AC and EC motors. AC motors are manufactured as standard with class F winding insulation, which ensures its trouble-free operation when supplied from VFDs. EC motors are PM (Permanent Magnet) motors, differ from classic asynchronous AC ones mainly by their higher energy performance, especially, when running at wide range of revolutions. The EC motor requires a 0-10V or ModBus control signal.
- 2) **Air coolers and air filter:** In VENTUS S-type, units are available water heat exchangers, as well as DX heat exchangers designed to work with refrigerants commonly met on the

market. In the range of available air cooler options, 4 and 6 rows coil are available for chilled water and DX coils. The whole device is protected by the section air filter of EU4 class, removable from the outside.

- 3) **The casing:** The casing is made of a 40 mm thick PUF panel coated on both sides with galvanised sheet metal. What distinguishes it is excellent tightness and rigidity with very high corrosion resistance and perfect thermal insulation.
- 4) **Inspection panels:** The AHU has functional inspection panels. Their biggest advantage is that they are normally mounted on both sides of the unit. Each panel is equipped with handles and hinges ensuring their safe and easy use. ■

For more info, please contact at sales-india@vtsgroup.com.

Proper cold chain infra will reduce food waste



Sub Zero is a Khira Group company that manufactures advanced technology insulated truck bodies used for transportation of perishable items. **Deep Khira, CEO, Sub Zero Insulation Tech Pvt Ltd** sheds light on its journey, transitions in cold chain industry, solutions offered by the company, challenges and many more in an interaction with **Cooling India**.

How has been the journey of Sub Zero Mobile Refrigeration Solution so far?

Jayanand Khira & Co has been manufacturing all types of commercial vehicle bodies since 1949, including reefers since 1984. I joined the Khira about five years back and saw real potential in this sector. I also realised that our technology of manually injecting PU chemical and making heavy steel containers was not the way forward. So, we started researching companies and practices globally. I visited several companies globally to understand various technologies available. We finally decided to invest and set up a future ready factory to develop this business in India. We wanted to create a new company, which only focused on reefers. Hence, Sub Zero Insulation Technologies was formed. From the start of production in 2015, till today has been a fantastic growth story for us and we have been able to establish our brand as a trusted source for high quality reefer trucks.

What are the evolutions that you have witnessed in the cold chain logistics over the past few years?

Over the past few years, we have seen logistics companies primarily focusing on large sized trucks for bulk movement of perishable goods. The SCV and LCV segment has also seen strong growth and this segment demands light weight reefer boxes to maximise the payload.

We are also in recent times witnessing specialised application requirements like multi temperature vehicles to carry goods requiring different temperatures within the same truck, double deck vehicles, tail lifts, etc. Customers are looking at bringing and investing in new technology in cold chain logistics.

What are the solutions offered by the company for the cold chain logistics industry?

Sub Zero primarily focuses on refrigerated trucks. We offer good



quality mobile transport solutions well suited to customer requirements. We have solved several customers challenges by providing them with the right solution including multi temperature vehicles in recent times. There is a growing demand for people wanting to deliver products which require 2 or 3 different temperature settings in the same truck.

We use vacuum press technology to ensure that the insulation in our sandwich panels is 100 per cent efficient. Our truck bodies are made with the best in class raw materials imported from Germany ensuring a long life. We use GRP and composite technology to make our bodies light weight thus maximising fuel efficiency and payloads.

What are the challenges the industry is facing?

The biggest challenge is lack of proper end to end infrastructure right from collection points, packhouses, processing units, warehouses to retails. When we will have proper infrastructure, we can truly cut down on food waste in the country and be able to reduce food prices and improve profitability across the entire chain.



We use vacuum press technology to ensure that the insulation in our sandwich panels is 100 per cent efficient.

Why cold chain is becoming a hot investment area in India?

There are a lot of companies entering this space and it is growing rapidly. the government is also supporting via subsidy to companies that are interested in investing in reefer trucks for horticulture and dairy produce. Despite having enough business potential, the competition amongst all cold chain industry players must be healthy and service oriented instead of being simply price driven.

What are the growth drivers for the industry?

Regulations and directives by the government for movement of any perishable cargo would be the biggest growth driver. These are already applicable for pharmaceutical products. But it should be applicable for all perishable goods.

What impact does Good and Services Tax (GST) have on the cold chain industry?

The introduction of GST has been very good for the cold chain logistics industry. Customers who buy a fully built refrigerated truck (i.e. chassis, insulated body, reefer unit) end up paying 18 per cent GST while 28 per cent needs to be paid only for chassis. This number multiplies significantly for large fleet owners.

What are the future prospects of the cold chain industry in India?

The future looks promising for the cold chain industry. We still have a huge gap to fill up in terms of building requisite infrastructure. We are still working on very small volumes of reefer trucks and cold stores when you think about the scale of our food output and the population of our country. ■

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Highly-efficient cold rooms for reliable food storage



Picture Courtesy: www.ice-ltd.co.uk

The article summarises the current scenario and the trends for cold rooms that will help to face the new challenges.



CAREL UltraCella

The refrigeration sector is facing a historical moment. On one hand, governments are particularly active in the creation of regulations to promote environmentally-friendly solutions. On the other, the evolution of technology is speeding up exponentially. All of this has made the refrigeration market, especially, competitive and constantly innovating. The objective is to provide highly efficient, safe, reliable products, with a low environmental impact, and at a reasonable price. In the case of cold rooms (also called walk-in coolers and freezers), reliability and efficiency are of particular importance, as the target is to ensure the

quality of the products stored in rooms that typically operate 24 hours a day, 365 days a year.

Current Scenario

It can be said that regulations, in particular, refrigerant and energy efficiency rules, and technological advances are the two drivers of refrigeration market today. Refrigerant regulations are currently focused on the phase down of hydrofluorocarbons (HFCs) with the aim of respecting the limits established by the Kigali Agreement signed in the fall 2016 of while continuing to reduce the use of refrigerants with ozone depletion potential.



CAREL boss mini

In Europe the global warming potential (GWP) limit established by F-gas regulation for stationary equipment, including cold rooms, is 2,500 starting from 2020. This means that R-404A will have to be replaced by lower GWP refrigerants. There are different alternatives worth analysing in detail, considering that the choice of the refrigerant will determine the design of the unit, especially, if the selection is R-744 (CO₂). When focusing on A5 (developing) countries, such as India, the Kigali agreement defined the phase down of HFCs starting from 2029 with its first major — 30 per cent step starting from 2035.

Moreover, energy efficiency regulations aim to optimise the use of the systems and consequently reduce electricity consumption. One example involves the energy conservation standards imposed by the Department of Energy (DOE) in the United States for walk-in coolers and freezers entered into force on September 8, 2017. It should be noted that the limits have the same values as the Max-Tech ones, which means that the best technology available should be used to comply with the rules. In Europe, the energy efficiency regulation (Ecodesign) for condensing units is included in ENTR Lot 1, with the introduction of the Energy Labelling based on the seasonal energy

performance ratio (SEPR). According to this, since July 2018 condensing units with low SEPR can not be placed in the market anymore. SEPR takes into account variations in temperature during the year, which makes it especially important to manage the variations of load precisely. SEPR is used for condensing units with more than 5kW cooling capacity and minimum limit increases with capacity.

In this context, technological advances

have been mainly focused on increasing the efficiency of devices. Recently, a new concept has emerged: Internet of Things (IoT). In the field of refrigeration, interconnection will allow systems to be optimised by improving control through knowledge of historical data. The objective is to increase the efficiency of equipment to the highest level. The first steps have already been taken, whereas implementation and dissemination are expected to begin soon.

Trends

Selection of the most appropriate technology for cold rooms not only allows the limits set by the regulations to be met, but also guarantees that the stored products will retain their quality, as well as ensuring the reliability, safety and flexibility of the system.

First of all, it is important to provide an efficient control system with optimised and advanced control algorithms. This ensures a constant temperature and humidity in the cold room, parameters that are essential for maintaining the quality of stored food products. An optimised control system also has benefits in terms of energy efficiency, with a consequent reduction in environmental impact, two



CAREL humiDisk



CAREL hecu

important challenges these days. Obviously, the reliability and safety of the cold room are also increased by precise control of the unit. Furthermore, configurability is highly desired, as this allows higher flexibility by giving users the possibility to select the operating conditions. An additional value comes from usability: a clear and simple control interface, a configuration wizard with multi-language guided questions, the possibility to automatically select a range of pre-set parameters values according to the user desired application improves system accessibility also to new user, saving commissioning and configuration time.

Closely related to control are alarms and supervision systems, essential in optimising energy performance and maximising savings, thus, maintaining the quality of the stored products as well as ensuring operator safety. In this regard, development of the IoT is definitively bringing additional benefits: the cold room becomes now connected, its status can be monitored anytime and anywhere from a simple mobile phone, with the major value of receiving periodical feedback about its functioning, including real-time alarms reports.

Another important component in the refrigeration circuit is the expansion valve. In particular, the use of electronic expansion valves (EEV) allows adaptive adjustment of the control characteristics during operation, as well as operation with a lower pressure difference, meaning a more radical decrease in condensing temperature. This increases both system energy efficiency and reliability. To improve usability even more, and saving installation time, now on the market are available evaporators with factory fitted EEV and electronic driver. This solution allows reducing welding and cabling time, providing an electronic-embedded evaporator that can be managed directly from the main cold room controller.

Efficiency can be further improved by adopting inverter DC technology, allowing compressor speed and consequently unit cooling capacity to be modulated with precise load management and constant control of the compressor envelope. This makes significant increase in unit COP possible during operation at part load, giving a higher SEPR. End-user comfort is enhanced by the noise reduction and the absence of vibration across the whole refrigeration circuit. Clearly, it also helps to maintain the quality of the stored products

by keeping a constant temperature.

Installation of a humidifier in a medium temperature cold room with a corresponding advanced control system, is highly recommended, as this ensures the minimum level of humidity (85 per cent to 90 per cent) required to optimise fresh food preservation while preserving appearance, quality and value of the products.

Evaporative pre-cooling of the condenser units or dry and gas coolers can be applied to cut power consumption during periods of peak temperatures. Evaporative cooling exploits the natural evaporation of water, which occurs both in the intake air flow and on the coils using the renewable heat of the outside air; this additional, sustainable cooling enhances equipment heat rejection and thus, dramatically reduces power consumption. It should be noted that evaporative cooling does not add any direct global warming potential because it uses water as the coolant. Regarding its indirect effect, this is very low due to the low power consumption of the evaporative cooler; in some cases, this can be fully offset or even exceeded by the associated decrease in energy consumption of the dry or gas cooler condenser.

Last but not least, the choice of a low GWP refrigerant with high performance meets the challenge to reduce environmental impact while increasing the energy efficiency.

Conclusion

Available technology allows the development of highly efficient refrigeration systems for cold rooms, while ensuring the quality of the stored products and at the same time reliable, safe and flexible operation. Essential features that meet market requirements and at the same time are friendly to the environment. ■

Stefano Soggia
CAREL Application Manager -
Refrigeration



According to Fact.MR market report, HVAC relay market is estimated to continue its bullish run during the 2018-2026 period with the market generating revenue of almost USD 3 billion in 2017. The steady growth of the HVAC relay market can be attributed to the continuous addition of new features,

in facilities is increasingly being linked to the growing number of HVAC system failure incidences. Coupled with the high costs associated with HVAC system installation, the factor is a key deterrent to HVAC relay market growth. However, the development of the Industrial Internet of Things (IIoT) is allowing facility managers and administrators

other HVAC systems leveraging renewable sources of energy for operation. In order to capitalize on the surge in the demand for HVAC systems utilising renewable sources of energy to function, manufacturers operating in the HVAC relay market are launching products specifically for the particular segment.

Asia Pacific to Remain Vital Revenue Pocket for HVAC Relay Market

The steady growth of the HVAC relay market can be attributed to the continuous addition of new features, burgeoning demand for HVAC systems across industries, and growing awareness about the cost-effective benefits of the products.

burgeoning demand for HVAC systems across industries, and growing awareness about the cost-effective benefits of the products.

Study opines that Asia Pacific will continue to retain the bulk of the HVAC relay market share during the forecast period. Burgeoning consumption of plastic in South Asia in addition to the increasing demand for processed food and chemical production are estimated to be the vital causes propelling the growth of the market in the region. Emerging economies in the region are constantly focusing on renovating and modernising the existing infrastructure such as metros, trains, buses, hospitals, and corporate spaces. The rigorous developmental activities in the region are likely to fuel demand for HVAC systems in the region which is eventually estimated to augment to the HVAC relay market growth.

Bolstering Technological Development to Uphold HVAC Relay Market Growth

Maintenance of HVAC systems is complicated and lack of technical expertise

to leverage data analytics and internet of things to predict the requirement of maintenance. The widespread adoption of the technology can boost HVAC relay market growth substantially.

Extensive Adoption of Geothermal HVAC Systems to Pave Way for Lucrative Opportunities

With sustainability, energy efficiency, and environmental protection gaining prominence in industrial production, demand for products operating using renewable sources of energy is on the rise. Consequently, geothermal HVAC systems are gradually gaining traction in residential as well as industrial applications. Geothermal systems use the heat from the earth to provide the desired temperature in systems while substantially reducing the carbon footprint relative to other HVAC systems. Growing consumer awareness about environmental concerns coupled with the imposition of stringent governmental regulations on energy efficiency and greenhouse gas production is estimated to bolster demand for geothermal HVAC systems along with

Proliferating EVs Market to Generate Demand for HVAC Relays

According to the report, the burgeoning production and demand for electric vehicles are estimated to contribute significantly to the HVAC relay market growth. With the performance of electric vehicles depending significantly on battery life, the HVAC systems used in electric vehicles are expected to showcase high energy efficiency. OEMs in the automotive industry are constantly working towards the development of energy-efficient HVAC systems for electric vehicles. For instance, Hanson Systems in collaboration with Kia Motors launched a novel cabin heating system specifically for electric vehicles. According to the company, the innovative HVAC system leverages two heat exchangers and coolant circuits to store heat when the vehicle is charging. When the vehicle is in operation the HVAC system is turned off and it uses the stored heat in addition to the waste heat generated during the motor operation to produce the desired effect. Such developments in the segment are estimated to create demand for specialized HVAC relays which support the efficient performance of these systems.

In addition, demand for HVAC systems in conventional automobiles particularly passenger vehicles are expected to remain robust. The increasing demand for HVAC systems in automobiles can be attributed to the intensifying swings in temperature owing to global warming.

The report tracks the HVAC relay market for the period 2018-2026. According to the report, the HVAC relay market is projected to grow at 7.3 per cent CAGR through 2026. ■

Low Energy Sustainable Buildings Design Solutions



Picture courtesy: <https://santacruzarchitect.wordpress.com>

In this article integral concepts for buildings with both excellent indoor environment control and sustainable environmental impact are presented.

In many countries, global warming considerations have led to efforts to reduce fossil energy use and to promote renewable energies in the building sector. Energy use reductions can be achieved by minimising the energy demand, by rational energy use, by recovering heat and cold and by using energy from the ambient air and from the ground. To keep the environmental impact of a building at sustainable levels (e.g., by greenhouse gas neutral emissions), the residual energy demand must be covered with renewable energy. In this article integral concepts for buildings with both excellent indoor environment control and sustainable environmental impact are presented.

Special emphasis is put on ventilation concepts utilising ambient energy from the air, the ground and other renewable

energy sources, and on the interaction with heating and cooling. It is essential to avoid the need for mechanical cooling, e.g., by peak load cutting, load shifting and the use of ambient heat or cold from the air or the ground.

Techniques considered are hybrid (controlled natural and mechanical) ventilation including night ventilation, thermo-active building mass systems with free cooling in a cooling tower, and air intake via ground heat exchangers. For both residential and office buildings, the electricity demand remains one of the crucial elements to meet sustainability requirements. The electricity demand of ventilation systems is related to the overall demand of the building and the potential of photovoltaic systems and advanced co-generation units.

Environment pollutions

The multifaceted role of present-day environmental engineers demands a greater understanding of the functioning of living systems and their interaction with the environment on which the work of the engineer is based. As shown in Figure 1 the physical and chemical (abiotic) components are one part of the natural environment, while the biotic components are living organisms that provide well-being for the human species and the earth as a whole.

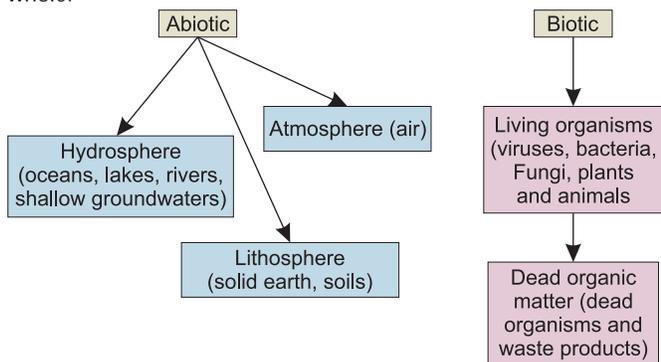


Figure 1: The major components and subcomponents of the natural environment

Table 1 lists the significant directives. The list is meant to give an idea of the range of directives and is not meant to be comprehensive. The significant ‘environments’ are water, air and land (soil). The criteria air pollutants (ambient air standards) and some limits and associated directives are listed in Table 2. It is noted from Table 2 that not all criteria pollutants have EU ambient limit values. The direct and indirect effect is to be described on:

- Material and cultural heritage.
- Human beings, fauna and flora.
- Soil, water, air, climates and landscape.

Methods of expressing concentration

The methods of expressing the concentration of a constituent of a liquid or gas are:

1. Mass/volume: The mass of solute per unit volume of solution (in water chemistry). This is analogous to weight per unit volume, typically, mg/L = ppm (parts per million).
2. Mass/mass or weight/weight: The mass of a solute in a given mass of solution, typically, mg/kg or ppm (parts per million).

If the density of a solution = ρ = mass of solution / volume of solution (kg/L)

And, Concentration of a constituent in mg/L = C_{A1} = mass of constituent/volume of solution (mg/L)

And, Concentration of a constituent in ppm = C_{A2} = mass of constituent/mass of solution (mg/kg)

Then rearranging,

$$\rho = C_{A1}/C_{A2}$$

$$\text{If } \rho = 1 \text{ kg/L, then } C_{A1} = C_{A2} \tag{1}$$

i.e., the concentration of a constituent in ppm mg/kg =

concentration of a constituent in mg/L.

For most applications in water and wastewater environments, $\rho = 1$ kg/L. For applications in the air environment, Eq. (1) does

not hold. The use of mg/L is the most common in water applications as the volume of the solution is usually determined as well as the mass of the solute. The unit ppm is typically used in sludges or sediments. To prove the portable transmutation of pollutants, experimental investigations may be conducted to bombard C or CO₂ or CH₄ or other air pollutants by accelerated alpha particles in a low-pressure vacuum tube in a similar condition of ionosphere. Heating them with gamma radiation can accelerate the alpha particles. The results of such experimental investigation may prove the probable transmutation of pollutants and self-sustaining equilibrium of the global environment.

Table 1: Significant EU environmental directives in water, air and land environments

Environment	Directive name
Water	Surface water for drinking
	Sampling surface water for drinking
	Drinking water quantity
	Quality of freshwater supporting fish
	Shellfish waters
	Bathing waters
	Dangerous substances in water
	Groundwater
	Urban waste water
	Nitrates from agricultural sources
Air	Smokes in air
	Sulphur dioxide in air
	Lead in air
	Large combustion plants
	Existing municipal incineration plants
	New municipal incineration plants
	Asbestos in air
	Sulphur content of gas oil
	Lead in petrol
	Emissions from petrol engines
	Air quality standards for NO ₂
Emissions from diesel engines	
Land	Protection of soil when sludge is applied

Table 2: EU criteria pollutant standards in the ambient air environment

Pollutant	EU limit
CO	30 mg/m ³ ; 1h
NO ₂	200 µg/m ³ ; 1h
O ₃	235 µg/m ³ ; 1h
SO ₂	250-350 µg/m ³ ; 24h
	80-120 µg/m ³ ; annual
PM ₁₀	250 µg/m ³ ; 24h
	80 µg/m ³ ; annual
SO ₂ + PM ₁₀	100-150 µg/m ³ ; 24h
	40-60 µg/m ³ ; annual
Pb	2 µg/m ³ ; annual
Total suspended particulate (TSP)	260 µg/m ³ ; 24h
HC	160 µg/m ³ ; 3h

People, power and pollution

Populations of different species live together, many interacting with each other, forming a community, e.g., in a pond-a natural community of plants, animals and microbes forming a distinctive living system.

The 'greenhouse effect' is but one of the environmental problems that have resulted either directly or indirectly from the activities of man. The role of the human population on environmental change has been simply summarised by Erlich in the simplified equation:

$$I = PAT \tag{2}$$

Where the impact I of the population on the environment results from the size of the population (P), the per capita affluence or consumption (A) and the damage caused by technologies (T) employed to supply each unit of consumption. As P increases, so too does T because supplies to additional people must be mined from deeper ores, pumped from deeper deposits, transported further. It is also suggested that the per capita consumption of commercial energy in a nation can be used as a surrogate for the AT part of the equation- a considerable proportion of the environmental damage involves use of commercial energy, from cleaning tropical forests for agriculture to mining, manufacturing, road building and extraction of fossil fuels.

Energy-efficient comfort

In warm humid conditions, airflow can be an energy-efficient means to achieve indoor thermal comfort. Airflow does not create sensible cooling of air that can be measured on a thermometer; it conducts heat from our skin. This results in a cooling sensation ASHRAE. This cooling sensation becomes noticeable with uniform airflow above 0.2 m/s, while airflow greater than 1.0 m/s begin to disturb loose papers. This discourages utilisation of airflow greater than 1.0 m/s in office type spaces. Airflow up to 2.0 m/s is frequently provided in industrial and storage buildings as well as living areas and bedrooms in houses in hot humid climates. Many studies, (ASHRAE) have modelled the cooling sensation of uniform airflow on human thermal response. In steady airflow, the cooling sensation (CS), of airflow can be estimated in degrees Celsius using equation:

$$CS = 3.67(V-0.2)-(V-0.2)^2 \text{ } ^\circ\text{C} \tag{3}$$

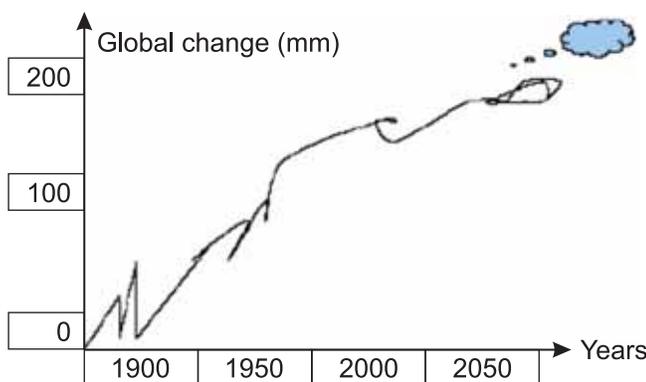


Figure 2: Change in global sea level

When average airflow, V, is in m/s.

Natural ventilation from breezes or difference in air temperature generated by solar chimneys can induce passive indoor airflow. The problem with a passive approach is that breezes are not always present when needed and solar chimneys rarely produce enough airflow for comfort. Fans, particularly ceiling fans, can provide a reliable source for airflow for indoor thermal comfort in warm humid environments. Unsteady airflow, with an appropriate gust frequency, can enhance the cooling sensation of airflow. Airflow provides a cooling sensation for occupants of buildings in warm humid climates. The enhanced benefits of turbulent airflow, with gust velocities within the range of 0.3 Hz to 0.5 Hz (with a peak preference at 0.47 Hz), present further opportunities to utilise large, high-volume, low-speed ceiling fans for energy efficient cooling. This effect appears to be due to a peak response of human cold cutaneous thermoreceptors just beneath the skin.

As an alternative and new design philosophy, hybrid ventilation and cooling technologies (HVAC) combine the advantages of mechanical HVAC systems and natural ventilation. It has the potential to reduce energy consumption in many buildings, improve the satisfaction level of the occupants' comfort and minimise sick building syndrome (SBS). Hybrid ventilation and cooling provides opportunities for innovative solutions to the problems of energy-consuming environment control in buildings. Because hybrid systems combine natural and mechanical ventilation, they present several complex challenges to design and analysis tools, requiring a global approach that takes into account the outdoor environment, the indoor environment, the control strategy and the mechanical system.

Wind towers

With the advent of mechanical or chemical cooling systems, the use of Baud-Geers in new buildings has been greatly reduced. The use of evaporative or desert coolers and mechanical air conditioners is now very common. The major advantage of wind towers or Baud-Geers is that they are passive systems, requiring no energy for their operation. Major disadvantages of the conventional wind towers may be summarised as follows:

- Dust and insects can enter the building.
- A portion of the air admitted in the tower is lost through other

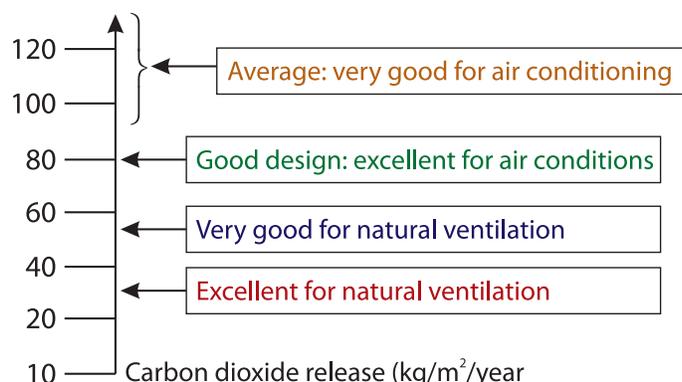


Figure 3: Designing for atmospheric pollution

tower openings and never enters the building. When the tower has only one opening facing the wind, all the air entering the tower enters the house.

- The amount of coolness which can be stored in the tower mass is generally limited (due to small mass and low specific heat of the energy-storing material), and may not be enough to meet the cooling needs of the building during hot summer days.
- The evaporative cooling potential of the air is not fully utilised.
- Baud-Geers do not find any application in areas with very low wind speeds.

Modern designs of wind towers are briefly discussed below:

- (1) Wind towers with evaporative cooling column: This design consists of three distinct improvements. The height and the total cross-sectional area of the column can be selected to produce a desired airflow rate and temperature to meet the level of thermal comfort needed in a building.
 - A tower head, which accepts wind blowing in any direction and prevents the air from leaving the other tower openings.
 - A column with a substantial increase in the heat and mass transfer areas.
 - Full utilisation of the potential of evaporative cooling of air by wetting the wall areas of the column.
- (2) Wind towers with evaporative cooling pads placed at the tower entrance: In areas with little or no winds, the entire opening area of the wind tower head can be covered with evaporative cooling pads. The air circulation through the tower and the building is accomplished through buoyancy effects. This design finds applications in areas with low winter heating needs.

Bioclimatic design

Bioclimatic design cannot continue to be a side issue of a technical nature to the main architectural design. In recent years, bioclimatic design started to alter course and to become much more holistic in its approach while trying to address itself to:

- The achievement of a sustainable development.
- The depletion of non-renewable sources and materials.
- The lifecycle analysis of buildings.
- The total polluting effects of buildings on the environment.
- The reduction of energy consumption, and Human health and comfort.

Hidden dimensions of architectural creation are vital to the notion of bioclimatic design. The most fundamental ones are:

Time, which has been called the fourth dimension of architectural space, is of importance because every object cannot exist but in time. Time relates to seasonal and diurnal patterns and thus to climate and the way that a building behaves or should be designed to couple with and not antagonise nature.

Air, is a second invisible but important element. Air due to air-movement, which is generated by either temperature or pressure differences, is very much there and alive. And related to the movement of air should be building shapes, sections, heights, orientations and the size and positioning of openings.

Table 3: The external environment

Damage	Manifestation	Design
NO _x , So _x	Irritant	Low No _x burners
	Acid rain land damage	Low sulphur fuel
	Acid rain fish damage	Sulphur fuel
CO ₂	Global Warming	Thermal insulation
	Rising sea level	Heat recovery
	Drought, storms	Heat pumps
O ₃ destruction	Increased ultra violet	No CFCs or HCFCs
	Skin cancer	Minimum air conditioning
Legionellosis	Crop damage	Refrigerant collection
	Pontiac fever	Careful maintenance
	Legionnaires	Dry Cooling towers

Light, and in particular daylight, is a third important element. Architecture cannot exist but with light and from the time we have been able to substitute natural light with artificial lighting, many a building and a lot of architecture has become poorer so.

Vernacular architecture is beautiful to look at as well as significant to contemplate on. It is particularly interesting to realise the nature of traditional architecture where various devices to attain thermal comfort without resorting to fossil fuels can be seen. Sun shading and cross ventilation are two major concerns in house design and a south-facing façade is mandatory to harness the sun in winter as much as possible. Natural ventilation required higher ceilings to bring a cooling effect to occupants in buildings built fifty years ago, whereas modern high technology buildings have lower ceiling heights, thus making air conditioning mandatory. Admitting the human right of enjoying modern lives with a certain level of comfort and convenience, it is necessary to consider how people can live and work in an ideal environment with the least amount of energy consumption in the age of global environment problems. People in the modern age could not put up with the poor indoor environment that people in the old age used to live in. In fact, in those days people had to live with the least amount of fuels readily available and to devise various means of constructing their houses so that they would be compatible with the local climate. It is important; therefore, in designing passive and low energy architecture for the future to learn from their spirit to overcome difficulties by having their creative designs adapted to respective regional climatic conditions and to try to devise the ecotechniques in combination with a high grade of modern science.

Relationship between climate, building and occupants

In climate-sensitive architecture, strategies are adopted to meet occupants' needs, taking into account local solar radiation, temperature, wind and other climatic conditions. Different strategies are required for the various seasons. These strategies

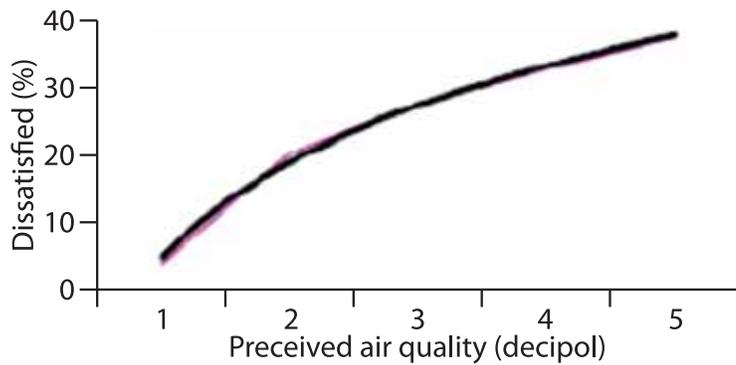


Figure 4: Designing to a satisfaction level

can themselves be subdivided into a certain number of concepts, which represent actions.

Innovative daylighting systems have four key aims: to increase daylight levels deep within rooms, to improve daylight uniformity, to control direct sunlight and to reduce glare. In non-domestic buildings, lighting can be a major energy consumer. The provision of daylight therefore, needs to be viewed as an important part of low energy, passive solar design. Crisp et al have identified substantial potential savings (typically around 20-40 per cent of lighting use) from exploiting daylight in such buildings. The four aims of such daylighting systems are therefore to:

1. Increase daylight levels towards the rear of deep rooms.
2. Improve daylight uniformity within a space, and hence its appearance.
3. Control direct sunlight so that it can be used as an effective working illuminant.
4. Reduce glare and discomfort for occupants.

Laminated glass with light-directing holograms allows a great variety of applications in architecture for utilisation of solar energy, improvement of room comfort as well as design of solar light and colour effects. The angle of diffraction of light depends on the wavelength described by the following equation:

$$\sin \alpha = \lambda/g \quad (4)$$

Where:

λ is the wavelength of light

g is the constant of grating

α is the angle of diffraction

The environmental advantages are obvious. Daylighting in buildings can be improved and reductions in electricity for room illumination will be more than 50 per cent. Shading of direct solar radiation in combination with photovoltaic power generation and diffuse daylighting opens a wide field of future developments and applications.

Health and the built environment

Two opposing trends threaten engineers. The first is concern for global pollution. Not only energy use but also energy sources will be defined in terms of atmospheric contamination. The second is demand for a performance specification for a more satisfactory indoor climate. The engineers of today are facing two

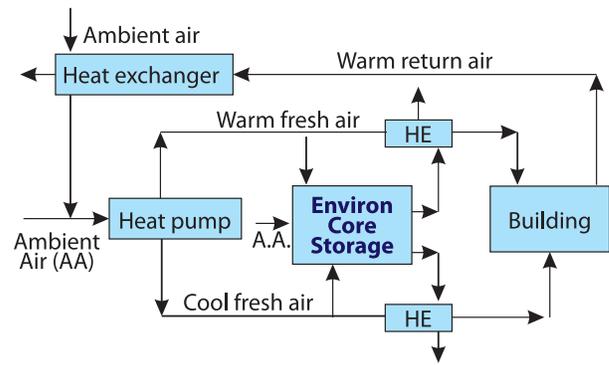


Figure 5: Flow sheet of combined heating and cooling with air-source heat pump and energy recovery from return air in combination with Environ-core thermal storage

kinds of environmental forces. The first is a respect for the global external environment, which knows no natural boundaries and is now near saturation with pollution and may be affecting our climate in a harmful way. The second is a rising expectation of better indoor conditions, which in the past has meant a more energy intensive building through air conditioning. Safety issues and avoidance of exposure to toxic materials are being reinforced by concern for long-term health and welfare. The second trend is the continued increase in energy use as our population rises and our productivity increases. Rising standards of living require more fuel to keep us cleaner and warmer and enable us to travel long distances for recreation. More effective use of energy is now essential.

The four more important types of harm from man's activities are global warming gases, ozone destroying gases, gaseous pollutants and microbiological hazards (Table 3). The earth is some 30C warmer due to the presence of gases but the global temperature is rising. This could lead to the sea level rising at the rate of 60 mm each decade with the growing risk of flooding in low-lying areas (Figure 2). At the United Nations Earth Summit at Rio in June 1992, some 153 countries agreed to pursue sustainable development. A main aim was to reduce emission of carbon dioxide and other greenhouse gases (GHGs). Reduction of energy use in buildings is a major role in achieving this. Carbon dioxide targets are proposed to encourage designers to look at low energy designs and energy sources (Figure 3).

Performance based design will specify how many shall be satisfied. Target figures suggest satisfaction for 90 per cent of the occupants is high quality, down to 70 per cent for poor quality designs. Such performance values are being applied to a whole range of indoor factors such as air quality (Figure 4), thermal comfort, and noise levels.

Comfort temperatures and climate

Nearly half the world's energy use is associated with providing environmental conditioning in buildings and about two thirds of this is for heating, cooling and mechanical ventilation. Whilst in cooler climates, the energy used for heating has been reduced by the application of conservation technologies; energy requirements for cooling are on the increase. The application of passive cooling

techniques to buildings in warm climates creates the need for appropriate comfort criteria. The perceived need for mechanical cooling is to achieve accepted standards of thermal comfort, usually defined (directly or indirectly) by temperature limits. There is, however, growing controversy as to what these standards are. For example, in a compilation of results from 47 field studies, predominantly in warm and hot climates, Humphrey's (1978) found that the preferred comfort temperature in buildings was a function of the average monthly outdoor temperature:

$$T_n = 0.534 T_o + 11.9 \quad (5)$$

Where:

T_n is the indoor comfort temperature, and T_o is the mean of the local daily maximum and daily minimum outdoor temperatures at the appropriate season of the year.

Fanger's theory relates the sensation of hot or cold (Predicted Mean Vote, PMV), and subsequently the discomfort or dissatisfaction (Predicted Percentage Dissatisfied, PPD), to the imbalance between the heats produced by the bodies' metabolism, and the heat loss to the environment. Obviously, this imbalance cannot exist indefinitely, and the sensation of discomfort is a signal to the person to take some action to restore heat balance

$$PMV = (0.303 \exp^{-0.36M} + 0.028) (M-H) \quad (6)$$

And

$$PPD = 100 - 95 \exp(-0.0335PMV^4 + 0.218 PMV^2) \quad (7)$$

Where

M is the metabolic rate and H is the heat loss to the environment.

The storage concept is based on a modular design that will facilitate active control and optimisation of thermal input or output, and it can be adapted for simultaneous heating and cooling often needed in large service and institutional buildings. The conceptual integration of various warm or cold energy sources combined with thermal energy storage system is illustrated as shown in Figure 5. A main core with several channels will be able to handle heating and cooling simultaneously, provided that the channels to some extent are thermally insulated and can be operated independently as single units, but at the same time function as integral parts of the entire core. The shapes and numbers of the internal channels and the optimum configuration will obviously depend on the operating characteristics of each installation some possible configurations.

Conclusions

One way to accomplish to reduce carbon footprint on the

environment is to resort to passive and low-energy systems to maintain thermal comfort in buildings. The conventional and modern designs of wind towers can successfully be used in hot arid regions to maintain thermal comfort (with or without the use of ceiling fans) during all hours of the cooling season, or a fraction of it. Climatic design is one of the best approaches to reduce the energy cost in buildings. Buildings should be designed according to the climate of the site, reducing the need for mechanical heating or cooling. Hence, maximum natural energy can be used for creating a pleasant environment inside the built envelope. Technology and industry progress in the last decade diffused electronic and informatics' devices in many human activities, and also in building construction. The utilisation and operating opportunities components, increase the reduction of heat losses by varying the thermal insulation, optimising the lighting distribution with louver screens and operating mechanical ventilation for coolness in indoor spaces. In addition to these parameters the intelligent envelope can act for security control and became an important part of the building revolution. Application of simple passive cooling measures is effective in reducing the cooling load of buildings in hot and humid climates. 43 per cent reductions can be achieved using a combination of well-established technologies such as glazing, shading, insulation, and natural ventilation. More advanced passive cooling techniques such as roof pond, dynamic insulation, and evaporative water jacket need to be considered more closely. The building sector is a major consumer of both energy and materials worldwide, and that consumption is increasing. Most industrialised countries are in addition becoming more and more dependent on external supplies of conventional energy carriers i.e., fossil fuels. Energy for heating and cooling can be replaced by new renewable energy sources. New renewable energy sources, however, are usually not economically feasible compared with the traditional carriers. In order to achieve the major changes needed to alleviate the environmental impacts of the building sector, it is necessary to change and develop both the processes in the industry itself, and to build a favourable framework to overcome the present economic, regulatory and institutional barriers. ■

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Cold Room and Industrial Refrigeration

An efficient cold chain infrastructure has the ability to transform the way in which a farmer stores his produce.

Understanding Indian food industry

The Indian sub-continent is one of the fastest growing economies in the world, which is currently striving to optimise the utilisation of its demographic dividend and its geographic expanse amidst the rising challenges of pollution and climate change.

Today, in terms of total farm output, India is the second largest in the world; it ranks first in the production of milk, jute, pulses. Over 58 per cent of the total workforce of India is either directly or

indirectly dependent on agriculture and its allied sectors (fisheries, forestry, livestock, dairy, etc.) to sustain their livelihood. Agricultural sector accounts for 17.9 per cent of the nation's GDP. There is immense opportunity here to improve sustain or capitalise from the returns of the sector, especially, if the demand and supply are matched with producers and consumers.

Over 40 per cent of India's total agricultural produce gets lost in India after harvest during transit or due to inefficient handling or due to lack of an understanding

of the demand cycles by the producers which to a large extent can be addressed through an efficient cold chain infrastructure. Presently, the country has a total installed capacity of 30.11 million metric tonnes (MT).

About 75 per cent of this capacity is utilised for the storage of potatoes while the remaining 25 per cent is being shared for the storage of other vegetables, fruits, processed food and pharmaceuticals. Of the existing cold storages, 36 per cent have a capacity below 1,000 MT. It is important



to understand how is the existing infrastructure connected to markets through an efficient chain and the markets which are underserved where infrastructure needs to be established for us to truly get value out of these investments past and future.

Cold chain industry and its growing relevance

An efficient cold chain infrastructure has the ability to transform the way in which a farmer stores his produce. They ensure that the produce can be stored at optimum temperatures suitable for preservation that will increase their overall longevity. They can be used for a variety of perishable products such as grains, fruits, vegetables, meat, dairy etc. Through this, freshness of the produce can be maintained from the time that it is harvested till the time that the consumer buys the product from the local supermarket for consumption. Investing in such a technology can ensure that healthy and nutritious food is served from farm to fork.

A functional cold storage can rewrite the profitability aspect for the food producers. Since the loss is reduced, they can be assured that their hard work does not turn futile and that they are able to gain the monetary profits that they deserve. The system will also create greater awareness in the society about the value of fresh, healthy and nutritious food that is protected through means that do not affect the quality of the produce in any manner unlike the usage of preservatives and pesticides which is detrimental to the consumers.

We have seen the effectiveness of this in many pockets in India such as grape farmers in Nashik, Fishery exports from Andhra Pradesh, Banana farmers in Tamil Nadu, Kinnow from Himachal to name a few.

Danfoss powering the growth of India's cold chain infrastructure

With innovation as the main focus at Danfoss, and backed by more than 80 years of experience in the global refrigeration business, Danfoss develops



and supplies the right products for advanced, environmentally friendly cooling installations.

Danfoss Industrial Refrigeration solutions offer highly efficient and reliable refrigeration systems optimised for ammonia and other natural refrigerants. Additionally, the components are designed to provide the lowest total cost of ownership, while at the same time ensure near-zero downtime in food-processing plants, warehouse and storage facilities.

The other decisive criteria for the sector is compliance with hygiene and food safety regulations, but also energy and refrigerant regulations, maintenance and operating costs. These factors have an impact on all market players from OEMs to wholesalers, installers to shop owners.

Understanding this, Danfoss' solutions fit the very diverse needs of the food service applications for restaurants, catering, canteens etc., specialty retail for butchers, bakeries, etc., process cooling in lab or medical, fruit ripening chambers, etc., convenience stores, petrol stations and pharmaceutical industry.

Refrigerant safety in industrial refrigeration

Environmental concerns and new regulations such as Kigali agreement and Montreal protocol are forcing scientists and refrigeration technicians to take a serious look at natural refrigerants like ammonia and carbon dioxide as a long-term alternative for refrigeration. Anyone

involved in food preservation and industrial process plants already know ammonia as the refrigerant of choice due to its unmatched thermodynamic properties and are increasingly understanding that if used with the right safety standards and protocols in place it is the safest refrigerant.

Having passed the test of time over more than a century as one of the best choices, ammonia is now receiving attention in areas of application where it was unthinkable earlier. Danfoss is a leader in ammonia refrigeration components, including manual, mechanic and electric valves. The company is constantly working on developing components that enable safe and energy-efficient application of ammonia refrigeration.

In focus: Danfoss' diverse product portfolio

The company's extensive range of products includes condensing units, compressors, VLT drives, heat exchangers, controls, sensors and valves and system protectors. Danfoss' condensing units provide high energy efficiency, reliability, food safety and assures low noise operation apart from using lower-GWP refrigerants that are environment friendly and help the country meet its targets under Montreal and Kigali protocols. The company's Micro Channel Heat Exchangers (MCHE) assure of a reduction of refrigerant charges and optimised heat transfer in condensers. Apart from this, Danfoss' compressors function is varying

ranges of fixed speed and variable speed scrolls designed with high efficiency motors from ½ to 20HP.

The multi-faceted benefits of Danfoss' solutions include reliable and sturdy solutions to preserve the cold chain and protect perishables in different climate types, technology and refrigerant options to maximise efficiencies, from applied to maintenance costs, unique application expertise and Application Development Center capabilities to reduce development time and compact and low sound level solutions for use even in residential areas.

Danfoss' products cater to a wide range of components for industrial refrigeration and can therefore deliver all valves for a project reducing complexity and optimizing project deliveries.

Catering to the market needs – the Danfoss Way

Climate change regulations, new demands for energy efficiency, higher comfort level expectations, cold chain

reliability, and pressure to reduce overall cost of ownership are driving the current developments and installations in a competitive marketplace. Through Danfoss, HVAC-R professionals including OEMs, installers, wholesalers, owners, and end users have access to the widest portfolio of user-friendly solutions available on the market.

For plant owners, choosing solutions from Danfoss is the safe and cost efficient choice for their refrigeration installation as it offers a number of advantages to improve competitiveness and target specific industries among others including excellent system performance, low risk of leakage and optimised components for a wide pressure range, low energy consumption, high product quality, catering to the strictest food safety requirements and reliable and safe operation in the daily work apart from providing a high ROI.

For contractors, Danfoss offers one of the widest selections of high-quality

components as a one-stop-shop for turnkey solutions delivered by a global market leader that have been well-tested and are at the forefront of industrial refrigeration. With its reliable solutions, the maintenance process has been made easy with an added assurance of reduced installation time. Additionally, all required certificates, documentation and calculation tools are easily made available for use.

For OEMs, Danfoss offers the best solutions to sustain a profitable and long-term partnership with a close cooperation to meet current and future needs of the customers. Apart from unique and flexible valve solutions, Danfoss is also known for its tailor-made solutions for all applications including heat pumps and CO2 packs. ■



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Time for Switch on to Next-Gen Refrigerants

Indian cold storage owners, supermarket groups need to be aware of the changes ahead, understand the replacement options.

Commercial businesses that supply India's population with fresh food and produce are facing significant mandatory requirements regarding food refrigeration. To meet these requirements, businesses need to start preparing now for these changes.

India's compliance with the Montreal Protocol's Kigali amendment means that high global warming hydrofluorocarbons (HFC) and hydrochlorofluorocarbon (HCFC)-based refrigerants like R-22 and R-404A – which are presently used in commercial refrigeration systems across the country – will be phased down in favour of next-generation refrigerants that have low-global-warming-potential (GWP) and are better for the environment.

With a baselining of HFCs planned before 2024, and a country-wide freeze on using HFCs in 2028, Indian cold storage owners, supermarket groups, small and medium sized food retailers and refrigeration consultants

need to be aware of the changes ahead, understand the replacement options available and begin to plan their migrations.

The pressure is on India's food suppliers and retailers to begin for switching on to next-generation refrigerants like Solstice N40 ahead of the ODS phase-out of R-22, avoid a disruption in supply and continue to meet the food integrity and safety expectations of consumers.

Fortunately, there are now new low and reduced-GWP refrigerant technologies that address Kigali requirements and allow a quick and easy path to compliance. One example is hydrofluoroolefin, or HFO, technology, on which Honeywell's Solstice N40 (R-448A) refrigerant is based.

Solstice N40 delivers an optimal blend of performance, environmental compliance and energy efficiency, offering GWP that is approximately 38 per cent lower than R-22 and R-404A. It is also more energy efficient: in the

US and European supermarket trials, Solstice N40 demonstrated between 3 to 5 per cent lower energy consumption in low-temperature applications and between 9-12 per cent lower energy consumption in medium-temperature applications compared to R-404A. In fact, it is estimated that replacing HFC and HCFC refrigeration systems with HFO solutions like Solstice N40 could save the carbon dioxide equivalent of removing more than 10 million cars from the road (based on Honeywell calculation of CO2 emissions or GWP value).

Around the world, commercial businesses are beginning to tackle Montreal Protocol requirements by implementing Honeywell HFO technology. To date, Solstice N40 has been deployed in more than 20,000 refrigeration systems and adopted by more than 30 supermarket brands. Tesco, for example, is upgrading 1,200 of its stores in the UK to HFO, and expects to reduce emissions in those stores by 40 per cent. ■



Rajarshi Datta
Country Head & General Manager - South Asia
Honeywell Advanced Materials



Stimuli of Indian HVACR Industry

The article talks about the growth drivers of HVACR industry.

The Indian HVACR industry is driven by multiple stimuli. The supply side of the industry is dominated by three major stakeholders mentioned below:

- Manufacturers of room air conditioners, packaged air conditioners, central air conditioning equipment, refrigeration equipment, multiple associated components and systems
- Channel partners of these manufacturers and their multiple affiliated contractors who install these equipment and systems and service them
- Unattached contractors and vendors who provide multiple and related engineering services.

The demand side is driven by factors mentioned below:

- The government who is the single largest buyer of all these products and systems
- Consumers who are a rapidly growing segment - sourcing room and packaged air conditioners and refrigerators

- Developers who provide air conditioned commercial and residential spaces
- Industrial buyers of air conditioning and refrigeration for processes
- Large commercial buyers who are in retail and entertainment.

The rise in demand and supply is in Tier 2, 3 and 4 cities and towns where rapid development is taking place due to the easy availability of power, solar power and rising disposable income as well as rapid urbanisation at these locations.

The penetration of air conditioning is less than 5 per cent of India's population – that is an indicator of the hidden potential for growth.

The carbon footprint of the HVACR industry as well as the global warming potential of HFC refrigerants severely impacts India's commitment to lower both substantially. Both the above pose challenges to manufacturers to regularly raise energy efficiency as well as change to zero ODP Refrigerants. Regulatory authorities like the Bureau of Energy Efficiency will strictly drive these compliances because India is committed

to abide by the Paris agreement.

In this regard, several catalysts shall play an influencing role to bring awareness to manufacturers and consumers to augur change:

- Standards and guides by institutions and the government for minimum energy performance of equipment; outdoor and indoor climate design data; indoor environment quality standards; efficient commissioning and HFC refrigerant phase down
- Education: Certified courses in HVAC design
- Exhibitions, seminars and conferences: These platforms run by multiple organisations across India give industry, the government, institutions and professionals an opportunity to display, discuss and develop good practices by consensus.

The Ministry of Environment recently released the India Cooling Action Plan – ICAP – a document that addresses several factors and key result areas. Skill development of technicians is one of them, just as energy efficiency program,



refrigerant phase down, installation guidelines and several other parameters that will develop a holistic and beneficial development of the Industry. The India Cooling Action Plan is a unique and significant document released by the Indian Government that has received worldwide attention and applause.

Licensing or certification and acceptance of HVAC technicians just like electricians and plumbers shall raise their quality, their acceptance in society as well as their self-esteem. These factors shall see the profession of HVACR technicians grow in value and demand.

Similarly, another focus area of the India Cooling Action Plan is to lower our carbon emissions. If there is anything to do to meet carbon reduction goals, it is to bring down demand for energy guzzling cooling systems. Relentless driving of energy efficient design as well as finding solutions that use alternate methods of cooling shall

lead us to be in harmony with environment.

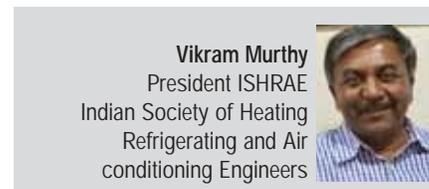
Refrigeration and cold chain logistics in India are at an abysmally low level of penetration. It can guarantee food security, good health and safety for entire population. This is a significant potential for growth and investment.

National Cold Chain Development (NCCD), a Government of India Department closely monitors the development of the cold chain as well as provides guidance, training and incentives to the rapidly growing sector. However, the penetration of cold stores and consequently the cold chain is abysmal as compared to developed countries – including China. The private sector must realise the large business opportunities of backward integration of cold stores and thereby, rapidly raise the deployment of the Indian cold chain. Logistics suffers badly due to poor roads across India. Railway Wagon Cold Chain movement is also a driver.

However, that is under utilised. It is evident that the cold chain has a long path of growth towards developing food security as well as farmer economic benefit. For a healthy economy, this must become the prerogative of the private sector simply because it needs investment, management and the ability to reinvest profits. The beginning of such intent is visible in several existing and potential investors

An altered future of cooling in a decade from now can be envisaged. Thermal comfort is the right of each and every one that lives in India, not just the elite. The future of HVACR is, adaptive cooling, natural cooling, thermal storage, radiant cooling and passive cooling. The need to stop global warming has become critical for the planet. That driving force alone shall alter the HVACR industry completely. The human being's demand for over cooling his indoor environment will reduce as he begins to adapt to the environment rather than trying to change it drastically – I refer to over cooling and overheating during summer and winter respectively.

The products of the HVACR industry as we now know them today will not exist 10 years from now. They have all become dinosaurs whose time of extinction has nearly come. The inventions that will lead to HVACR products of the future are being tested in Labs around the world. The industry has no option but to work towards a cooler planet within a decade. HVACR professionals and consumers must all play a significant role in that fulfillment. ■



Vikram Murthy
President ISHRAE
Indian Society of Heating
Refrigerating and Air
conditioning Engineers

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FCAOI to host biggest cold storage seminar in Agra



Organised by the Federation of Cold Storage Associations of India (FCAOI), All India Cold Chain Seminar will take place from 12-13-14 July 2019 at Kunjmal N Convention Centre, Fatehabad Road in Agra, Uttar Pradesh. The cold storage owners from all over India are invited to attend the annual national seminar on cold chain and storage industry taking place in Agra.

The national seminar will be attended by the entire cold storage and cold chain industry and will offer ample of business and networking opportunities to all participants. Alongside the seminar, an exhibition will also take place where leading companies offering cold chain technologies will showcase the best of products and services.

14th All India Cold Chain Seminar (AICCS 2019) – an initiative taken by FCAOI, where cold storage owners from all across India meet solution providers of cold storage industry, while showcasing their technologies and solutions for the industry. The platform also acts as a networking platform to discuss the latest trends and development in the cold storage industry. The seminar will the presence of the policy makers along over 2000 delegates and more than 100 witness technological solution providers showcasing their innovations, products and services.

The show every year promises to tap the very pulse of the industry and brings together latest cold chain solutions, new and innovative technology solutions, live demonstrations and new product launches.

AICCS 2019 demonstrates a vivid range of companies from various sectors of the industry. The show boasts being one of the largest players in the cold chain industry with a wide range of visitors and exhibitors from all walks of the cold chain industry.

FCAOI is a nodal body for the cold storage industry with 18 state cold storage associations and 6000 Cold Storage owners from across India as its members. The association has been actively serving its members with various initiatives that has led to the tremendous growth and development of this industry sector over years. ■

Facebook Data Centre uses Nortek Air Solutions Cooling System

Nortek Air Solutions, a provider of custom air handlers, has announced the use of its patented StatePoint Technology in two buildings at the Facebook data center in Clonee, Ireland. Facebook announced "the Clonee Data Center will continue to be one of the most advanced, energy efficient data centers in the world and will be supported by 100 per cent renewable energy."

The StatePoint system uses a liquid-to-air membrane exchanger in which water evaporates through a membrane separation layer to cool the data center. "This new exchanger technology addresses some of the fundamental disadvantages of open spray and wetted media evaporative cooling systems and opens up new possibilities for high performance liquid cooling in data centers and other applications," explains Philip LePoudre, Fellow Engineer of Nortek. The liquid-to-air membrane exchanger prevents cross contamination between the water and air streams, greatly reducing the risk of water side fouling and aerosol carryover in the exhaust air stream. In addition, the StatePoint Liquid Cooling system achieves exceptional levels of water usage efficiency while maintaining industry leading energy efficiency.

"We are excited to be part of the innovations by Facebook to support their world class levels of efficiency," said Bruno Biasiotta, CEO of Nortek. Since 2015, Nortek Air Solutions has worked closely with the Facebook engineering team to develop StatePoint Technology. ■

Hygro-Thermometer Clock

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Features

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- Complete with built-in tilt stand, wall mounting bracket and AAA battery

Specifications: 445702

Humidity range: 10 to 85%

Basic RH accuracy: ± 6%

Temperature range: 14 to 140°F (-10 to 60°C)

Basic Temperature Accuracy: 1.8°F/1°C

Dimensions: 4.3 x 2.8 x 0.8" (109 x 71 x 20mm)

For more information, contact at flirindia@flir.com.hk ■



Company Name	Page No.
AICCS 2019	15
FLIR Systems India Pvt. Ltd.	5
Food Pro 2019	17
Gandhi Automations Pvt. Ltd.	9
Harind Chemicals & Pharmaceuticals Pvt. Ltd.	11
Mist Resonance Engineering Pvt. Ltd.	IBC
TATA Motors Limited	FCGF
Testo India Pvt. Ltd.	13
VTS TF Air Systems Pvt. Ltd.	BC
Werner Finley Pvt. Ltd.	IFC

Forthcoming Events At A Glance

AICCS 2019

Venue: Kunjamal N Convention Centre (KNCC), Agra

Date: 12th to 14th July 2019

Website: www.aiccs.in

Foodpro 2019

Venue: Chennai Trade Centre, Chennai

Date: 23rd to 25th August 2019

Website: www.ciifoodpro.in

Dairy Tech India 2019

Venue: Bangalore International Exhibition Centre, Bangalore

Date: 30th August to 1st September 2019

Website: www.dairytech.in

ISK-SODEX Istanbul

Venue: TÜYAP Fair Convention and Congress Centre

Date: 2nd to 5th October 2019

Website: www.sodex.com.tr/en

Ashok Leyland, the first office in India to get LEED v4.1 Platinum

Ashok Leyland, flagship of the Hinduja Group, and one of the largest commercial vehicle manufacturers in India, has been awarded LEED v4.1 Buildings Operations and Maintenance certification at the Platinum level, for its corporate office building in Chennai. LEED v4.1 is the newest version of the LEED (or Leadership in Energy and Environmental Design) rating system, developed by the US Green Building Council (USGBC). With this honor, Ashok Leyland becomes the first office in India and fourth in the world to receive LEED v4.1 Platinum certification.

Ashok Leyland's office is located in the heart of Chennai city,



with easy access to bus, metro and rail networks. The ease of access created due to the location of the Chennai office leads to a high share of public transport usage. The project achieved 91 points, and continues to monitor, analyse and optimise their performance by using the Arc platform. Sustainability features at the project include a rainwater collection tank

that captures 100 per cent of rainwater runoff and low flow water fixtures to reduce water consumption. 100 per cent of the waste generated at the building is segregated on-site, pre-processed and recycled or diverted from landfills. To ensure occupants health and well-being, the site has enough outdoor air intake as per ASHRAE standards, ensuring low CO2 and TVOC levels. ■

Carrier's tech integration for efficiency

Carrier's world headquarters, the UTC Center for Intelligent Buildings, first-of-its-kind building is designed as a living showcase of what's possible through technology integration to increase efficiency, protect people and property, and enhance the occupant experience. Carrier's innovative product integrations also provide a scalable and repeatable model for total green building design.

Carrier is the first commercial building in Florida to earn LEED Platinum v4 certification. The Platinum rating – the highest designation – was awarded under the stringent version 4 LEED green building program for building design and construction from the US Green Building Council. "Earning LEED Platinum certification is a significant achievement, as sustainability is a core value of our organisation and our portfolio of products," said



Bob McDonough, President, Carrier. "We designed the UTC Center for Intelligent Buildings to push the boundaries of sustainable building design and provide our employees and customers with a model of what's possible when Carrier's best technologies are deployed in green buildings. " ■

Largest Kraftliner industry in Europe

Smurfit Kappa manufactures kraftliner, which is a type of paper used to produce high-grade corrugated cardboard. Kraftliner means that the paper is entirely or mostly made of wood raw material, which produces a paper of excellent strength, moisture resistance and printability, and it is chemically and biologically clean. This means that is possible to use in contact with food. The factory produces 700,000 tonnes of kraftliner each year, making Smurfit Kappa the largest kraftliner factory in Europe. Mitsubishi Electric Hydronics & IT Cooling Systems, through its brand Climaveneta, has supplied the cooling system for Smurfit Kappa Piteå production facilities in Sweden.



With over 55 years of experience, Smurfit Kappa strives for sustainability in each fiber and has high environmental awareness in their production process, in fact kraftliner is made up of 80 per cent wood and 20 per cent recycled fiber from corrugated cardboard boxes. At the Piteå factory, there is a very big focus on environment and emissions. In normal

operation, the factory uses no fossil fuels. A biotech boiler is used as the energy source, where residual products from production, such as bark, sludge, and plastics are burnt. The company has also considered the cooling system in their goal to be free of fossil fuels, which is why for their process cooling, Smurfit Kappa installed one Climaveneta high efficiency water cooled chiller. ■

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Typical case study data of a 1200 TR Chiller

Sr. No.	Parameter	Cooling Tower (Induced Draft)	LTMCS
1	Wet Bulb Temperature	29°C	29°C
2	Chilled Water Temp in °C (Assumed)	5°C	5°C
3	Supply Temp. from CT / LTMCS	33°C	30°C
4	Approach to WBT	4°C	1°C
5	ΔT for Chiller	28°C	25°C
6	Chilled Water Compressor Motor Kw for 1200 TR	720	643
7	Energy Saved in %	-	10.7%
8	Energy Saved in Kw	-	77 Kw/Hr
9	Total Running Hours per Annum	8640	8640
10	TOTAL POWER SAVED PER ANNUM	-	6,65,280 Kw



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