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Out of the Cold Storage

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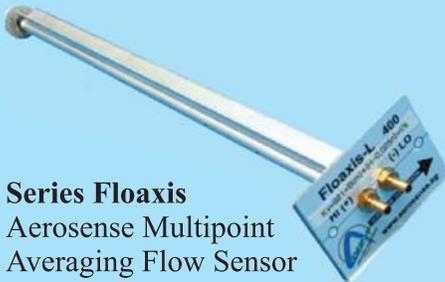
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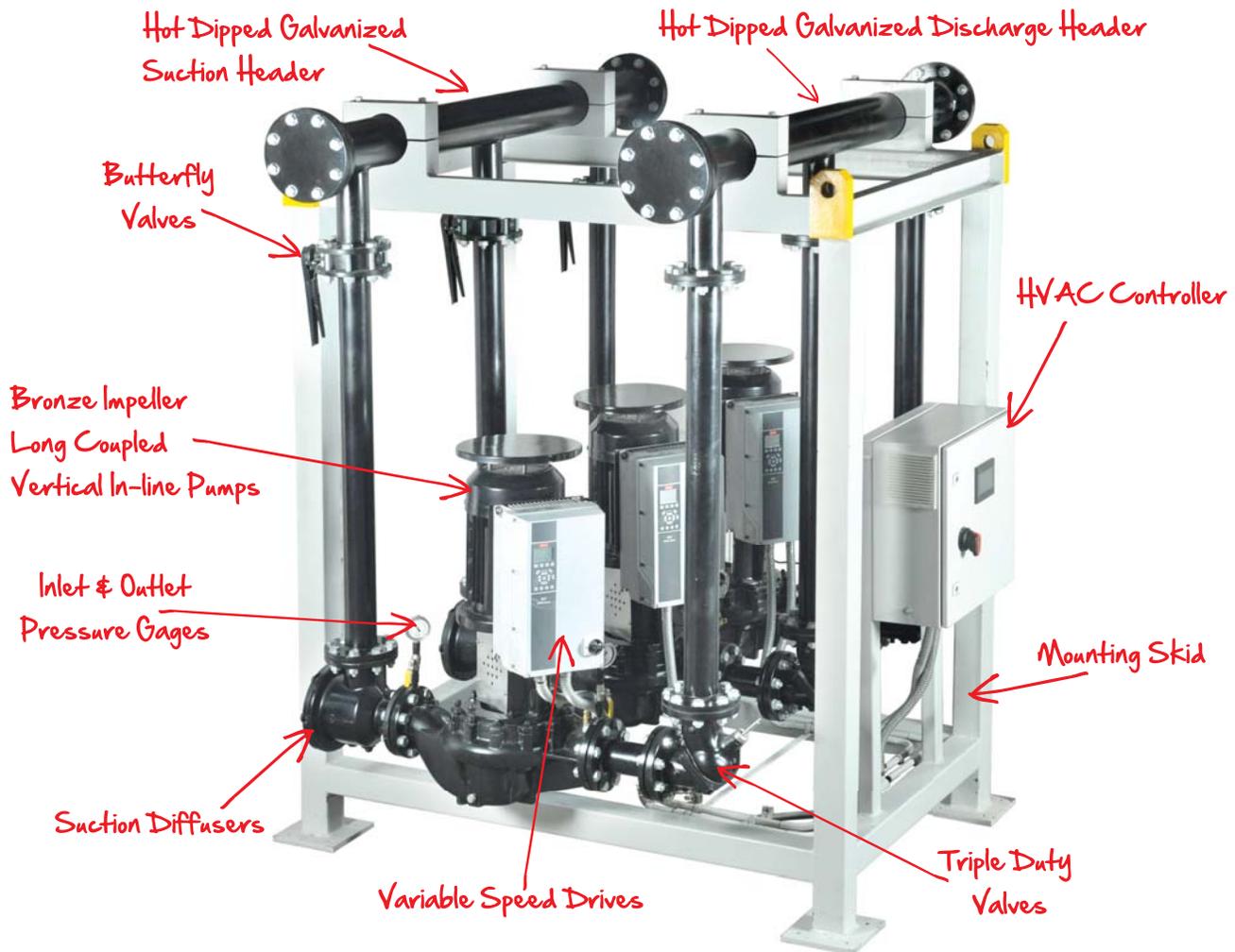
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Publisher's Letter

Hello and welcome once again to *Cooling India*.

Access to cooling has emerged as a fundamental issue of equity, and as temperatures hit record levels, this could also mean the difference between life or death for some. According to a recent report by Sustainable Energy for All (SEforALL), there are over 1.1 billion people globally face immediate risks from lack of access to cooling. The report reveals that 9 countries including India have the biggest populations facing significant cooling access risks. It is therefore essential to close the cooling access gaps for economic growth and overall development. This issue of *Cooling India* features extensive ideas of keeping different areas cool!

Cold chain, a temperature-controlled supply chain, plays an important role in our daily life, especially in food and pharmaceuticals industries. However, India is short by 10 million tonnes of cold storage capacity and over 50,000 refrigerated trucks due to which over 30 per cent of agricultural produce goes waste every year apart from the fact that more than 20 per cent of produce from fields that gets lost due to poor post harvesting facilities and lack of cold chain infrastructure. Today, less than 3 per cent of farm and horticultural produce goes on cold chain whereas in the case of pharmaceuticals sector, around 25 per cent of vaccines go waste due to lack of cold chain.

With increasing awareness and advent of advanced technologies, cold chain industry is transforming from traditional quantity stores for standalone commodities to quality cold chain – integrating various missing links. A CRISIL Research report published early this year anticipates that the cold chain industry to register a CAGR of 13-15 per cent in the five fiscals through 2022, compared with 11-13 per cent in the previous five. This will swell the industry to Rs 47,200 crore in fiscal 2022 from Rs 24,800 crore in fiscal 2017.

This special issue on cold chain logistics industry highlights the potential opportunities, key market trends, technological innovations, product update etc. The issue also highlights the key trends impacting the cold chain logistics industry. Hope you enjoy reading this issue as always. Do send in your comments to me at pravita@charypublications.in.




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Contents

Vol. 14 No. 1 | August 2018

Articles

- Out of the Cold Storage** 20
– Subhajit Roy
- Cold Chains, Hot Prospects** 28
– Hetal Gandhi
- V-Belts Handle with Care** 32
– C Maheshwar
- IAQ Monitoring: The Basics You Need to Know** 40
– Louie Cheng
- Cold Storage for Horticulture Produce** 50
– Dr Mahesh Kumar, J B Sangha
- Warehouse Cooling Technology** 56
– Dr. (Prof.) D. B. Jani, Prof. Kiran Bhabhor, Prof. Mohsin Dadi
- Energy Conservation in Refrigeration & HVAC System** 60
– Paresh R Modha
- How Can We Breathe Better?** 68
– Ashish K Jain



Departments

- 4** Publisher's Letter
- 8** News
- 16** Appointments
- 18** Awards
- 19** Market Watch
- 71** Statistics
- 72** Product Profile
- 73** Event Calender
- 73** Index to Advertisers
- 74** Cooling Museum

Interviews



“Need to set up multi-commodity EX-IM and distribution storages”

Steve Felder
Managing Director, Maersk Line

26



“India at the forefront of green growth”

Prem C Jain
Chairman,
Indian Green Building Council (IGBC)

30



REFCOLD to promote Indian refrigeration industry to the World

Pankaj Dharkar
Chairman, REFCOLD India

38



Features

- 29** USGBC Releases Resilience Study on the City of Boston
- 47** Ensaviour: Addressing Energy Efficiency & IAQ
- 48** 1.1 bn people at risk from lack of cooling: Study
- 55** Siemens software solution helping cities improve air quality
- 59** Honeywell delivers voice-directed system for U.S. Defense Logistics Agency warehouses
- 67** Mitsubishi Electric Trane HVAC US Announces Updates to Residential Business Leadership Team

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Voltas Beko Lays Ground to Start Building its First Manufacturing Facility in India

Voltas and Arçelik B V (a subsidiary of Arçelik A S; part of the Koç Group – Turkey’s largest industrial and services group), had earlier announced a Joint Venture for Consumer Durable Products in May 2017. Accordingly, a Joint Venture Company (JVC) - Voltbek Home Appliances Private Limited (Voltbek) was established in India to engage in the business of White Goods. Voltbek has during the past few months taken various actions including identification of land for its manufacturing activities. Voltbek has recently laid ground to start construction of their first manufacturing facility, spread over 60 acres, in Sanand, an upcoming industrial hub in Gujarat. This facility will be manufacturing Home Appliances that include refrigerators and washing machines.



Voltbek will leverage Arçelik’s global expertise in setting up large, modern, state-of-the-art manufacturing unit, quality and R&D labs and international benchmarking processes and Voltas’ strong brand presence, and country wide sales and distribution network. This manufacturing facility will be one of the first white goods appliances unit in the state of Gujarat, creating an OEM base for home appliances in the region along with local employment opportunities. The choice of Gujarat as the destination for the manufacturing unit was due to State’s ‘ease of doing business’, and ‘good governance’. Speaking on this occasion, Pradeep Bakshi, Managing Director & CEO, Voltas Limited, said, “This JV will play a significant role in catering to the consumer aspirations in the home appliances sector. I am sure that this JVC will continue to delight all our stake holders.” ■

Blue Star Wins EFM Orders from Airport and Metro

Air conditioning and commercial refrigeration major, Blue Star, has won Engineering Facility Management (EFM) orders for operation and maintenance services including facility management services for efficient functioning of electro-mechanical utilities from the airport and metro segments in India. Blue Star recently forayed into EFM, which covers a wide repertoire of operation and maintenance services for efficient functioning of electro-mechanical utilities. The EFM services offered by Blue Star principally address the mechanical maintenance of heating, ventilation and air conditioning, chillers and cooling towers, boilers, pumps, air compressors and other equipment; electrical aspects of high tension or low tension distribution, transformers, generators, UPS system, lifts and related electrical equipment; utilities such as water, air, fuel and gas systems; and other facilities such as plumbing systems, fire-fighting equipment, building management system, CCTV and access control, besides others.

The company has secured orders from, Airports Authority of India for



operation and maintenance of electrical and mechanical installations for 33 kV new substation and terminal building of Lal Bahadur Shastri International Airport, Varanasi; Airports Authority of India for operation and maintenance of electrical and mechanical installations of Coimbatore International Airport, Coimbatore; Chennai Metro Rail Limited for providing facility management services for Mechanical Electrical and Plumbing (MEP) systems of Chennai Metro; and Airports Authority of India for operation and maintenance of electrical and mechanical installations of Chaudhary Charan Singh International Airport (CCSI) Airport, Lucknow. B Thiagarajan, Joint Managing Director, Blue Star Limited adds, “We forayed into the EFM arena in order to leverage our capabilities and credentials in the execution of large Electro-Mechanical projects.” ■

LG Brings Architects Creative New Design Solutions

Air conditioning technologies innovator LG Electronics has brought architects, engineers and contractors the utmost in design flexibility and installation versatility for modern building projects with its next-generation air conditioning and control systems showcased at the American Institute of Architects (AIA) 2018 Conference on Architecture Expo recently in New York.

Spotlighting how advances in HVAC technologies give architects new creative design solutions, AIA Expo marks the premiere of the latest video case study in LG’s Project Profile Series, featuring the upscale boutique Marlton Hotel in Lower Manhattan.

The unique project features LG’s award-winning LG Multi V VRF system, known for its incredible energy efficiency, high performance and flexibility in design and installation options. It was selected for

the architecturally-significant Marlton Hotel, based on design versatility and overall efficiency as well as the ability to provide occupants the freedom to control their precise comfort level.

LG’s VRF system helped preserve the architectural integrity and charm of the original, intricate design details of the nine-story structure such as herringbone-wood floors, crown molding, marble bathrooms and brass fixtures. The system also maximised space utilisation, a key criterion from the building owners, allowing the Marlton to create an open, airy rooftop space for guests to enjoy in the heart of Greenwich Village.

LG is dedicated to advancing the HVAC industry with limitless vision, innovative technology and flexible connectivity solutions for today’s modern residential and commercial building projects, all of which are featured at this year’s AIA Expo. ■



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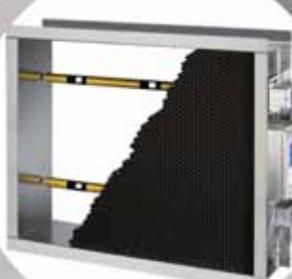
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Burke Porter Announces Acquisition of Galileo TP Process Equipment

Burke Porter Group, a leading global supplier of intelligent testing, instrumentation and assembly systems and solutions announced its acquisition of Galileo TP Process Equipment S.r.l. (Galileo), which is headquartered in Florence, Italy. Full terms of the deal were not disclosed.

Founded in 1997, through the merger of Galileo Vacuum Tec operations dedicated to the refrigeration industry and Tecnoplant S.r.l., Galileo specialises in vacuum, leak detection, and refrigerant charging technology. The company designs and engineers sophisticated on-production machines, test machines and off-production machines for the refrigeration and air-conditioning industry.

"We continue to see advances in intelligent manufacturing solutions across the industry. Galileo's expertise and technologies align with our own and allow us to continue enhancing and expanding our technology platform," said David DeBoer, CEO of BPG. "The synergies within our group make this addition a great fit to broaden our product portfolio with Galileo's assembly and testing solutions."

The acquisition agreement provides for management continuity over the company's business activities with no change in day-to-day business or contacts. Galileo's CEO and President Giovanni Gonfiantini and Sales Director, Piero Poggiali, will remain with the company.

"Galileo has continued to grow and develop worldwide since the 1940s and the opportunity to join the Burke Porter Group will support our growth in the US and Asia," said Gonfiantini. "We are eager to work closely with the BPG team to continue advancing our technologies and expanding our customer base globally." ■

NEDO and Daikin Develop Automated Demand Response System

NEDO and Daikin Industries Ltd. have completed an Automated Demand Response (ADR) demonstration system for air conditioning in the city of Lisbon, Portugal. The system, under development since November 2016, will start operation from July 2018.

The demonstration project is being conducted in collaboration with a Portuguese electric power retailer and a Virtual Power Plant (VPP) operator, who aggregates multiple small-to-medium power generation facilities of renewable energy. For this project, multi-split air conditioning systems for office buildings were equipped with cold storage units and a demand response function and installed in four public facilities in Lisbon, including City Hall. The upper limit of electricity consumption for the air conditioning systems is automatically controlled in response to the needs of the grid in balancing electric power supply and demand. The project aims to establish business models for electric power retailers to maximize renewable energy usage during peak demand hours



throughout the summer season using ADR technology. Consequently, the effectiveness of the system to ensure a stable supply of renewable energy will be evaluated. Based on the project results, Daikin hopes to utilize ADR technology in conjunction with air conditioning systems in Portugal and other EU countries.

NEDO and the National Laboratory for Energy and Geology (LNEG) of Portugal signed an MoU to launch a project to demonstrate Automated Demand Response (ADR)*1 technology that could automatically adjust demand upwards or downwards in response to the power demand-supply balance. At the same time, NEDO concluded an Implementation Agreement (IA) with the city of Lisbon, designating facilities in Lisbon. ■

BITZER Australia to Distribute Guntner Heat Exchangers in Australia & NZ

The long-standing German companies Guntner, producer of refrigeration and air-conditioning heat exchangers, and BITZER have decided to bring their strengths in the Pacific region together. Both companies have signed an exclusive long-term distribution contract.

The compressor specialist BITZER will exclusively market all commercial and industrial Guntner heat exchanger products in Australia and New Zealand. Products from the commercial refrigeration segment will continue to be marketed under BITZER's Buffalo Trident brand; those from the industrial refrigeration segment under the Guntner brand. The agreement specifies that Guntner manufactures the goods and BITZER distributes them. However, this does not change anything for customers. In order to supply the Australian market, BITZER will be opening a warehouse in Sydney.

Simon Wood, Managing Director of

BITZER Australia Pty Ltd., emphasises: "Both companies and their customers will benefit from the close cooperation between Guntner and BITZER."

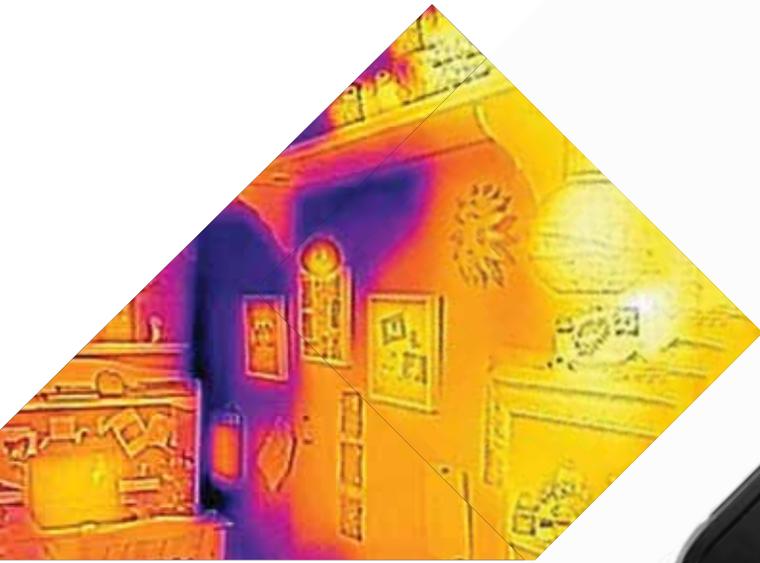
The fact that an expanded product range is now available means we can offer the right solution for every heat exchanger, refrigeration and air-conditioning application." And Guntner Group Asia Director Glen Wiles adds, "The cooperation of Guntner and BITZER will combine the advantages of high-quality global manufacturers and offer customers the latest technologies for refrigeration and air-conditioning equipment." The name and service of Buffalo Trident will continue through the technology synergies between Guntner and BITZER. Buffalo Trident's manufacturing operations at Sunshine Victoria will be shut down by the end of 2018. Guntner and BITZER are convinced that this cooperation will serve the market in a competitive and responsive way. ■

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CoolSys Acquires Energy Squared

CoolSys, the parent of market-leading refrigeration and HVAC companies nationwide, announced the acquisition of Energy Squared, LLC, which will join as the newest member of the CoolSys family of companies. Energy Squared is a consulting engineering firm providing mechanical, electrical, plumbing and refrigeration (MEPR) engineering analysis and design for all types of buildings worldwide, including commercial, industrial, retail, hospitality, entertainment, leisure, mixed use and multifamily residential facilities.

"The addition of Energy Squared to the CoolSys family of operating companies is very exciting. Adding 100 engineers to our team not only significantly expands our engineering resources, expertise, and technological sophistication, but gets us involved at the inception point of projects in existing and new verticals," comments Adam Coffey, President and CEO of CoolSys. "We are confident that the Energy Squared team will make vital contributions to our organisation as we expand our spectrum of services and broaden our customer set."

Led by Allan Samuels, Principal, and Clive Samuels, Principal and Professional Engineer (PE), Energy Squared's team of professional engineers, designers, licensed inspectors, and sustainable design and energy professionals has designed MEPR systems for more than 30 years. "Allan and Clive Samuels are well-known and very accomplished engineering consultants and we are honoured to welcome them and their team to the CoolSys family," adds Coffey.

"This is a tremendous opportunity for Energy Squared," says Allan Samuels, Principal at Energy Squared. "By combining our team of MEPR engineering professionals with an extensive list of long-term customers, we bring a significant amount of synergy and growth potential to the CoolSys business." ■

Danfoss Supports Launch of New Cooling Report

Cooling is an essential need in everyone's modern daily life. In an increasingly warming world, the impact of not having access to modern cooling solutions is profound. Deploying the most efficient, best-in-class technology brings huge environmental and socio-economic benefits by responding to the growing cooling demand and reducing greenhouse gas emissions. In addition, creating sustainable, efficient cold chains can reduce food loss and keep vital medicine stored safely.

The new 'Chilling Prospects: Providing Sustainable Cooling for All' report, released by Sustainable Energy for All (SEforALL) and the Kigali Cooling Efficiency Program (K-CEP), outlines recommendations on how to increase access to affordable and sustainable cooling solutions throughout the world. As an industry leader in air-conditioning and refrigeration and member of SEforALL's initiative Cooling for All, Danfoss has directly contributed to the report with technological insights. The industry has a big role in sharing expertise on how to build a vision for a sustainable future with the best available technologies.



During the panel discussion, Galyen commented 'As the report has shown, we are challenged by heat extremes for the most vulnerable people, inefficient cold chains and a warming world. It underlines that we need to act today; and the good news is that, we have proven, available solutions to do so. Danfoss has solutions that help to properly control temperature in commercial buildings, food and vaccines.'

Industry has proven we can meet technological challenges. Now we need to take a holistic approach that includes supportive regulation, incentives, education and collaboration to deploy the proven technologies that are available today to achieve sustainable cooling for all.' Danfoss is fully committed to accelerating energy efficiency as a way to provide cooling access for all. The key focus is to enhance global adoption of efficient, sustainable cold chains to keep our food fresh and safe and preserve medicine and vaccines. ■

EDPAC joins Europe's HVACR Industry Association

Following an official approval by the Eurovent Board of Directors on July 6 in Brussels, EDPAC has formally joined the Eurovent Association. The manufacturer of innovative air conditioning equipment for critical applications becomes Eurovent's first member from Ireland.

EDPAC has been associated with computer room air conditioning since 1968, having originally been an abbreviation for Electronic Data Processing Air Conditioner. EDPAC's operations in Ireland service the markets of Europe, the Americas, the Middle East, and the Far East. Having pioneered the original concepts, its name is synonymous with quality and reliability in a world, where processing and electrical technologies are

applied in critical applications. Noel Lynch, Managing Director of EDPAC, states: "EDPAC has been operating in Ireland for over 30 years, supplying air handling and close control equipment to Ireland, Europe, the Middle East and South America. Eurovent shines a light that seeks to enhance both product quality and standards within the industry, providing confidence to our clients, customers, and the market as a whole. While our products are well proven within the data centre and commercial air handling sectors, we look forward to a close association with Eurovent and are delighted to be the 1st family member from Ireland." With the joining of EDPAC, Eurovent now represents more than 1,000 associations and manufacturers from 27 countries. ■

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Nestlé Wagner Digitises Production with Getac

Getac announced that Nestlé Wagner GmbH, has selected the Getac A140 fully rugged tablet to digitise workflows and optimise productivity at its headquarters in Nonnweiler, Germany. Nestlé Wagner GmbH produces around 350 million frozen food products annually, making it one of the largest manufacturers of frozen pizzas in Europe. Using the Getac A140, the company has achieved wide-ranging digitisation of its production processes, significantly increasing efficiency and allowing greater flexibility in day-to-day



operations. Nestlé Wagner GmbH chose the fully rugged Getac A140 due to the quality assurance benefits it provides and the ability to roll it out extremely quickly to employees at the site, where it will complement existing laptops and special industrial computers already in use.

"The Getac A140 is extremely robust and reliable due to its outstanding build quality," says Christian Joseph, Team Leader Operational Excellence at Nestlé Wagner GmbH. "Its rugged design and impressive performance makes it ideally suited to everyday use on the production floor." In the food manufacturing process, it is critical that no contaminants enter the food at any point. With the deployment of the fully rugged Getac A140, Nestlé has the confidence that if a tablet is accidentally dropped, it won't break apart, ensuring production quality is maintained. The use of the tablets has also proved to be extremely user-friendly. Not only are the devices easy to handle, the 14" screen offers enough space to clearly display key software applications, ensuring they are resolved as quickly as possible. ■

ACCA Applauds Arkema Commitment to Contractors

The Air Conditioning Contractors of America (ACCA) announces an investment into ACCA's flammable refrigerant training programs from global refrigerant manufacturer, Arkema. Arkema, an ACCA corporate member, is supporting ACCA's effort and investing in ACCA's online qTech training program entitled 'Technician Training on Flammable Refrigerants.'

ACCA is leading the industry effort to create a high-quality technician training program on flammable refrigerants. As the HVACR industry works to phase down refrigerants with high-global warming potential (GWP), ACCA members have been concerned that contractors and technicians need more time to be prepared to safely handle the next generation of refrigerants, which includes flammable products.

"ACCA thanks Arkema for their commitment to contractor and technician safety by investing in this important training

program," said Paul Stalknecht, ACCA president and CEO. "When Arkema first joined ACCA's corporate program we knew they supported ACCA's quality installation message and programs. This additional investment by Arkema further demonstrates their serious commitment to the contracting industry and we look forward to working with them to ensure that the contracting industry is prepared to safely work with flammable refrigerant products."

"Arkema is proud to invest in ACCA's new qTech flammable refrigerant training program," said Anthony O'Donovan, Regional Group President, Fluorochemicals Americas. "As a leading producer of refrigerants, Arkema recognizes the importance of preparing the entire industry for the next generation of air conditioning technology. We are glad to be working with ACCA and are committed to ensuring that contractors and technicians are ready for the future as the industry works to phase down high GWP refrigerants." ■

Mitsubishi Electric India inaugurates exclusive MEQ Cooling Planet Showroom in Delhi

Mitsubishi Electric India (MEI) recently inaugurated its exclusive and unique concept showroom MEQ Cooling Planet for air conditioners in New Delhi. Mitsubishi Electric have been world leaders in air conditioning systems for residential, commercial and industrial use since decades. MEQ Cooling Planet is a unique concept showroom that clubs together Mitsubishi Electric's world-class technology and affordability. MEQ Cooling Planet offers a range of the company's products with quality and durability at a lower ownership cost. These showrooms are designed to encourage residential and commercial customers to have a touch and feel of MEI products.

Mitsubishi Electric's air conditioners are known to provide exemplary performance in diverse climatic conditions and each product is an amazing feat in its

own, delivering years of quiet operation, energy-efficient performance and minimum impact on the environment.

Speaking of the MEQ Cooling Planet concept, Yozo Ito, Director and Business Unit Head of Air Conditioners, Mitsubishi Electric India (MEI) stated, "Studies have shown that conventional stores are as relevant as ever because a large percentage



of consumers prefer to shop at such stores. Consumers prefer to shop in stores because they like to touch and feel products before they make a purchase decision and value face-

to-face interactions with store associates. In this reference, MEQ Cooling Planets is a unique idea because they encourage customers to visit the store, take a proper look and then make a decision." As of now, Mitsubishi Electric has opened more than 21 MEQ Cooling Planets in India and have 800 authorised dealers across the country. ■



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New Managing Directors for Carel in China and Spain

Xavier Pinto has been appointed as the new Managing Director of Carel Ibérica, the Group's subsidiary operating in Spain and Portugal since 2009. Pinto will replace Luciano Marzaro who, after seven years in Spain, will move to CAREL Electronic (Suzhou) Co, the Group's manufacturing and sales subsidiary in China.



Luciano Marzaro (left) will head up Carel's China operation, while Xavier Pinto (right) takes charge in Spain and Portugal



to sales results, budget items and personnel," Luciano Marzaro explained. "In my new role in China I will also need to deal with the production side, an important challenge that I am looking forward to taking on."

"Luciano Marzaro has done a great job in Spain and I am confident that he will be able to run the Chinese subsidiary with the same professionalism and skill, in line with CAREL's mission and development strategies," commented Giandomenico Lombello, CAREL Group Chief Sales & Marketing Officer. "Xavier Pinto has shown great commitment and dedication over the years, qualities that will help him successfully head the CAREL Ibérica team to achieve the ambitious growth targets on the local market." ■

"It is a great honour for me to have the opportunity to head Carel Ibérica," commented Xavier Pinto. "My goal is to keep being leaders in the sector, reinforcing our position on the market. Specifically, we aim to reach the largest possible number of customers who can benefit from our energy-efficient solutions and IoT services."

"During the seven years I spent in Spain, I was responsible for managing the subsidiary: from implementation of strategies

professionalism and skill, in line with CAREL's mission and development strategies," commented Giandomenico Lombello, CAREL Group Chief Sales & Marketing Officer. "Xavier Pinto has shown great commitment and dedication over the years, qualities that will help him successfully head the CAREL Ibérica team to achieve the ambitious growth targets on the local market." ■

Vern Klein joins Pump House

Pump House has decided to invest in the growth of the business, and what better way to do that by investing in the people. Pump House are delighted to appoint Vern Klein who will take the role as Area Sales Manager for the South.

Vern brings with him many years of sales, account management and business development in the industry having previously been employed by Advanced Engineering Ltd and Aspen Pumps. He also has a great understanding of the UK and



Vern Klein

international markets.

Vern said, "What a breath of fresh air it is to join such a down to earth company. It's an interesting time at Pump House – there's so much potential for growth. A friendly and successful company who understand customer needs, with a vast range of products to suit such a fast-changing industry – they are silent heroes! What a fantastic time to work with existing and prospective customers to increase demand and sales opportunities." ■

Lucken joins Conex Bänninger

Mike Lucken has been appointed as regional technical sales manager for the south east Conex Bänninger. He has over 22 years' experience in the ACR market, bringing a wealth of knowledge and experience to the business. Earlier he worked in various engineering and management roles for Wolseley UK, HRP and Kooltech.

Bill Barlow, Conex Bänninger's business unit director, said: "We launched our award winning



Mike Lucken

>B< MaxiPro press-fit solution to the market last year to further establish our presence in the ACR industry. The good news is that this innovative solution is going from strength to strength based on its ability to significantly reduce installation time, costs and health and safety risks on-site when compared to traditional brazing. With Mike on board in the south east, our aim is to penetrate the market further and increase brand exposure on our complete ACR range." ■

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Thermocool Receives the Outstanding Green Point Award 2018

Bitzer's Green Point service network maintains, overhauls and repairs Bitzer compressors. The network consists of numerous members who have long-standing partnerships with Green Point. This marks the second time that Green Point is honouring one of its members with the Outstanding Green Point Award.

Philippe Maratuech, Managing Director Green Point and Director Services and After-Sales at Bitzer, comment, "I am delighted to present this year's Outstanding Green Point Award to Thermocool. Its Bitzer repair workshop opened in 2002 and has repaired more than 3,000 compressors since then. We wish to thank Thermocool. For this long-standing partnership and their loyalty." Sergei Demidov, Engineer at Thermocool, adds, "It is an honour for us to be awarded the Outstanding Green Point distinction. Since joining the Green Point network, our sales have increased by 35 per cent – the award underlines this success and will spur us on further."



From left: Philippe Maratuech, Managing Director Green Point and Bitzer Director Services and After-Sales, Sergei Demidov, Engineer at Thermocool, Gianni Parlanti, Bitzer Board Member and Chief Sales and Marketing Officer.

Thermocool has been in the refrigeration business for 20 years and in this time has developed into one of the largest, most advanced refrigeration companies in Russia. All of the systems it manufactures are fitted with Bitzer compressors and pressure vessels. In 2015, Thermocool decided to expand its service centre into a fully-

fledged Green Point in order to provide its customers with higher service quality. Besides repairing and overhauling compressors, the company offers a wide range of integrated services to meet the challenging requirements of the refrigeration market.

Thanks to the expertise of its employees and the use of Bitzer original spare parts and refrigeration compressor oils, Thermocool provides its customers with a one-year guarantee on all repaired Bitzer compressors. This year's Outstanding Green Point Award was presented to Thermocool at the Green Point Conference. ■

JD Cooling Gets Recognition from London Stock Exchange

Contractor JD Cooling Group, recently named by the London Stock Exchange as one of the UK's most dynamic SMEs, has received a visit from the local mayor.

As part of the visit, Councillor Nick Daubney officially presented the prestigious award to JD Cooling Group's managing director, John Dye in front of members of the team.

He said about JD Cooling Group, "It was good to meet the management and staff behind this success story. I really appreciated the time taken to show me their operations and



welcomed the opportunity to discuss and learn of both future opportunities and forthcoming challenges. JD Cooling is a forward-thinking innovator and clearly an important and conscientious employer. The Stock Exchange 1000 Award is very well deserved."

John Dye, said, "It was a pleasure to meet the Mayor of King's Lynn & West Norfolk, Councilor Nick Daubney. On behalf of everyone, I would like to thank him for his time and the opportunity to personally introduce him to the JD team and our successes." ■

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Cruise industry embraces transcritical CO2 technology



GEA and P&O Cruises signed a contract for its new transcritical CO2 industrial refrigeration technology. (Photo P&O Cruises)

International technology group GEA signed a contract for its new transcritical CO2 industrial refrigeration technology, with P&O Cruises, part of Carnival Corporation & PLC, the world's largest commercial cruise ship operator. The green refrigeration technology has already been installed on board P&O Cruises 2,000-passenger ship Arcadia, where it will deliver the energy-efficient cooling supply for all of the ship's food and beverage refrigeration units.

Discussions between GEA and P&O Cruises are ongoing with a view to rolling out the state-of-the-art transcritical CO2 refrigeration plants to additional cruise ships in the existing fleet, and installing the technology directly in new P&O Cruises ships as they are constructed.

Cooling systems that use non-polluting CO2 as an alternative refrigerant to chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) are already in use in the retail sector. Developing flexible CO2 refrigeration systems that can be installed safely in the constrained, constantly moving environment of sea-going ships has up to the present been challenging. GEA harnessed more than 100 years of expertise in the design and construction of industrial refrigeration plants to develop the new transcritical CO2 technology specifically for use on ships.

The modular transcritical-type CO2 plants operate using multiple GEA Bock compressors which are ideally suited to the high pressures of CO2 refrigeration systems. Redundancy is built in the plant, so that failure of one or even multiple compressors will not cause the system to stop working. GEA solutions can be tailored to just about any available on-board space, and are designed to be safe, robust and reliable, however rough the voyage. Installation can be carried out while the ship is underway, without affecting continued use of the legacy system before switchover takes place.

"We are delighted to announce this major partnership for our ground-breaking transcritical CO2 technology, with P&O Cruises," comments Marc Prinsen, Head of Application Center Utilities Marine at GEA. "Every sector of industry is working hard to protect the environment, and that includes saving energy, reducing emissions, and switching to natural refrigerants. As one of the world's leading technology developers and suppliers to a wide range of global industries, we recognize the key role that we can play by developing sustainable, green technologies, which can be used in challenging processes and settings. Having signed our partnership with P&O Cruises, we are also now in discussions with major international fishing fleets." ■

Cold Chain Market USD 293.27 bn by 2023



The global cold chain market is estimated to account for USD 203.14 billion in 2018 and is projected to reach USD 293.27 billion by 2023, at a CAGR of 7.6 per cent. The global cold chain market is expanding with considerable growth potential for over the next five years. The growth of this market can be attributed to the growth of international trade of perishable foods, technological advancements in refrigerated storage and transport, government support for the infrastructural development of the cold chain industry and increase in consumer demand for perishable foods. Also, expansion of food retail chains by multinationals will enhance international trade and impact the growth of the cold chain market.

Asia Pacific to be the largest market for refrigerated storage during the forecast period

The two main types of cold chain infrastructure are refrigerated transport and refrigerated storage. The refrigerated storage market is estimated to be dominated by the Asia Pacific region. Refrigerated storage capacities are growing in the Asia Pacific due to the increased need for reducing wastage of perishable foods. In North America and Europe, the refrigerated transport industry is booming, mainly due to the advancement of technology in refrigerated trucks, vans, trailers, and maritime reefer containers.

Dairy and frozen desserts are estimated to account for the largest market share in the frozen cold chain market in 2018, due to their need for constant temperature control (being temperature-sensitive products), dust, and exposure to sunlight. Dairy & frozen desserts are witnessing high demand due to economic growth and rapid urbanisation, along with sophisticated marketing channels, which have led to significant changes in dietary patterns. Government guidelines in China state that milk is a major source of calcium and protein, and recommend regular milk consumption, which has led to milk and dairy products being incorporated into the daily diet of consumers.

The frozen products segment accounted for the largest share in the cold chain market, in terms of value in 2017. A wide variety of products such as ice cream, meat, and seafood are stored at freezing temperatures that range between -18 °C to -24 °C (-0.4 °F to -11.2 °F). Freezing preserves the taste, texture, and nutritional value of foods better than other preservation methods. Cold chain for frozen foods provides uninterrupted handling of the product within a low-temperature environment during the steps of the value chain, which include harvest, collection, packing, processing, storage, transport, and marketing until it reaches the final consumer. ■

Out of the Cold Storage

A promising outlook for the Indian cold chain logistics industry.



Photo Credit: www.pointer.com

The Indian cold chain logistics industry is transforming from traditional quantity stores for standalone commodities to quality cold chain – integrating various missing links.

– by Subhajit Roy

Cold chain logistics industry in India (para)

Cold chain logistics in India has traditionally been focused on a single commodity with a high presence of fragmented unorganised players in both warehousing and transportation. Despite the urgent need for a well-developed cold chain infrastructure, the system lacks in capacity building, market information, research and intelligence. India is short by 10 million tonnes of cold storage capacity and over 50,000 refrigerated trucks due to which over 30 per cent of agricultural produce goes waste every year apart from the fact that more than 20 per cent of produce from fields that gets lost due to

poor post harvesting facilities and lack of cold chain infrastructure. A major chunk of the cold stores is located in West Bengal and Uttar Pradesh and 80 per cent of their capacities is used for stocking potato and potato seeds. With increasing exports of seafood and pharmaceutical products, there is a constant demand for refrigerated storage and transportation system which needs to be urgently addressed. “Despite the stark gap in available infrastructure, convincing the stakeholders about returns on investment is a tricky proposition since there is limited premium for temperature-controlled services on the supply side,” PV Sheshadri, CEO, Future Supply Chain Solutions Ltd points out.

However, Atul Khanna, India Representative, Global Cold Chain Alliance (GCCA) believes, “Indian cold chain industry, once limited only to a few produce types till as late as first decade of this century, is transforming from traditional quantity stores for standalone commodities to quality cold chain – integrating various missing links. Thus, various business models utilising cold chain logistic services at different stages have been recognised and well established on commercial lines. Few worth mention are bulk stores in the areas of concentrated centers of production, multi-commodity multi-chambers cold stores around areas of consumption, controlled and modified

atmosphere cold stores, fruit ripening chambers, IQF and blast freezing, freeze stores etc. More important is the trend towards complete refrigerated supply chain for the fresh and processed items like, milk and dairy, meat, confectionary and pharma, and of course, the fresh produce.”

Though there are sectors, especially in rural sector where cold chain is hampered by its fledgling and nascent introduction, which results in supply chain losses of food and other resources. The losses in agricultural sector alone are estimated at \$14 billion annually due to inadequate infrastructure. The Government of India is cognizant of this reality and is taking steps through various public sector schemes to develop cold chain infrastructure in the country. “The future of cold-chain will tend towards systems that function as a speedy conduit to markets,” states Khanna.

According to Sheshadri, “Initiatives such as ‘Operation Green’ and allocation for Pradhan Mantri Kisan Sampada Yojana (PMKSY) are bound to attract investors to develop cold chain facilities in the country especially in remote areas near the source of produce.”

Giving an overview of the cold chain logistics industry in India, Mahendra Swarup, President, Federation of Cold Storage Associations of India (FCAOI) observes that the cold chain industry should be divided into two parts: One is which the goods are handled at above zero-degree centigrade and the other below zero-degree centigrade. He adds, “As far as both the classifications are concerned cold chain logistics industry is under developing stage. For the first part i.e. dealing with above zero-degree centigrade goods, there are few players.”

Take the case of potato, spices, carrots or other such type of products, normal trucks are hired by local stores and taken to the nearby mandis or far off consuming centers, while for goods below zero, where refrigerated vans are needed, there are few firms which are dealing, but their presence is much low, further they are available mainly in metropolitan cities. Smaller cities have to work hard and pay more to get their services, opines Swarup.

The key growth drivers

Rising middle-class

The cold chain industry in India remains underserved and presents huge potential in terms of expansion. According to CRISIL Research, the industry is expected to log a CAGR of 13-15 per cent in the five fiscals through 2022, compared with 11-13 per cent in the previous five. Commenting on the key growth drivers, Khanna said, “The Indian market is on the cusp of a revolutionary change with the expansion of middle-class and affluence coming into the middle-classes. The increase in demand for fresh produce, meat and perishable packaged foods is leading to significant growth in this sector, which is increasingly relying on sustainable cold chain network. The increasing shift to modern retail and a greater push for food safety are also key growth drivers.”

Increasing awareness about agri-logistics

India is one of the largest producers of agricultural produce and has abundant supply base of different produce. There is an



Atul Khanna

India Representative, Global Cold Chain Alliance (GCCA)

“The future of cold-chain will tend towards systems that function as a speedy conduit to markets.”

increasing awareness that agri-logistics require to develop with a delivery bias, to link with demand across regions, and not merely as a buffer against local demand. Distance and time assume importance as the disparity of prices also induces movement. Efficient transportation has an immediate effect on the factor of time, which is an element in the price factor. Thus, in Khanna’s opinion, delivery system of perishables - always fighting against time, has become another important driver of its growth.

Organised players preferred

Sheshadri of Future Supply Chain Solutions believes that the key growth drivers include growth in the organised retail market, increasing demand for processed foods led by increase in disposable income and shortage of time available for cooking. He said, “With increasing consumer awareness on the need to maintain high quality, pharmaceutical companies and quick service restaurants are increasingly giving preference to the organised players that are compliant with regulatory requirements.”

Growth in exports to drive demand

Exports is also a key focus area for cold chain services. Indian exports include processed foods, including fresh and processed fruits and vegetables, meat products and cereals, which are the main users of cold storage facilities. Growth in exports of these sectors will further drive the demand of cold chain services, Sheshadri said.

Fiscal stimulus is on

According to Sheshadri, subsidy schemes provided by the government are facilitating investments in cold chain facilities. Khanna adds, “Stimulus provided by the public sector schemes, through technical and financial assistance is another growth driver providing leverage.”

Fast food storage on rise

Swarup from Federation of Cold Storage Associations of India (FCAOI) informs that more cold storages are coming up to store products below zero degree centigrade, especially there is a rapid growth for the storage of fast food (ready to eat).

The Challenges

Produce aggregation – the big challenge

Highlighting the market challenges, Atul Khanna, India Representative, Global Cold Chain Alliance (GCCA) said, “The most important challenge for integrated cold chain supplies to various markets is the produce aggregation, either as raw material for processed food industry or for fresh supplies through cold chain, as most of the farm holdings are small. It requires a bigger



PV Sheshadri
CEO, Future Supply Chain Solutions Ltd

“Subsidy schemes provided by the government are facilitating investments in cold chain facilities.”

role for aggregators and establishment of primary processing centers in the clusters of production for minimal processing to preserve the initial quality.”

Lack of modern infrastructure

The other key challenge is the lack of modern warehousing, especially nearer to markets and that too with produce specific storage conditions. “General market effecting challenge is the lack of standards in construction and operation of facilities, low awareness of handling temperature-sensitive products,” Khanna added.

The development of refrigerated warehousing has been lopsided in the past as there was more emphasis on stand-alone commodity storages in the absence of alternate business models due to less progress on processing front owing to many reasons like poor availability of raw material, cold chain facilitates in the nascent stage, less consumer awareness even if government financial support was available. However, now different business models and chains have been developed, irrespective of the subsidies which certainly have contributed towards viability gap funding.

Likewise, number of large and modern pack houses is also not much but related more to the revenue earning business models. These are mere collection centers in the villages like vegetables on one extreme to modern pack houses for the exports of grapes, mangoes, tropical vegetables and flowers etc. through various intermediary levels collection-packing facilities linking production belts with the markets - terminal or middle level facilitating seasonal operations.

In the refrigerated transport segment, although there looks like imbalance in the data on the production volumes and number of reefer vehicles for distribution to link markets and production belts, but Khanna observes there are trends on the practical front that indicate availability of one sided load as another constraint as viability goes down while coming back empty or with non-reefer materials.

Dealing with energy issues

The cold-chain is energy intensive, because temperatures need to be regulated at desired levels. Energy expenses alone make up about 30 per cent of the total expenses for the cold storage industry in India compared to 10 per cent in the Western countries, and the unreliability of power in many areas of the country hold the sector back. The government subsidies have led to a large increase, but they are often still single commodity, observes Khanna.

Reluctance in consuming stored eatables

The growth of cold storages below zero-degree centigrade is

not coming up as fast as it should. This is because of the lack of demand. Still people are reluctant in consuming stored eatables. The basic feeling remains in their mind that stored product is not as good as fresh and has to be very costly, which is not a fact. According to Mahendra Swarup, President, Federation of Cold Storage Associations of India (FCAOI), “As the public taste would grow for stored eatables, there has to be a rapid demand for the storage of such goods and thus the need for the cold chain logistics would increase.”

Further, PV Sheshadri, CEO, Future Supply Chain Solutions Ltd summarises the key market challenges as:

- **Retention of services:** Temperature controlled services, especially transportation, have the dual challenge of being time-bound and temperature-sensitive. The customers thus expect service levels at par with express delivery with zero deviation in temperature. Much of the desired service levels and temperature adherence depends on the drivers and it thus vital that this community is treated with the respect they deserve. Ensuring their retention is one of the key challenges this industry faces. Driver cost in India is at a meagre 4-5 per cent of the transportation cost against 30-40 per cent in the developed world.
- **Skewed demand** for temperature-controlled vehicles in the long-haul sector (loads concentrated in west and north) results in reduced utilisation of vehicles since reverse haul movement becomes a challenge.
- **Lack of standards and protocols in construction and operation of facilities:** The technical standards are quite unsuitable for Indian conditions resulting in failure of achieving optimum performance of standard refrigerating systems.
- **Inadequate training** in handling temperature sensitive products is also a concerning factor which results in product damage due to temperature abuse.
- **Availability of power** is a major factor of concern in India. India currently faces about 9 per cent of peak power deficit, which enforces the use of fuel-based operations leading to a marked increase in operating costs.
- **Uneven distribution of cold storage:** Storage facility throughout the supply chain is another major challenge. Majority of cold storage facilities are located at the point of production, creating a lack of efficient supply chain to the downstream operations or markets.

Key trends impacting the cold chain industry in India

Fund flow from investing activities

A combination of increase in disposable income and the focus on increasing the longevity of agricultural produce to make them available across the country all year round is resulting in high investments in the cold chain industry. It is estimated that more than US\$ 150 million has been invested in cold chain companies by PR firms, which is expected to improve the farm level infrastructure through the development of pack houses, ripening

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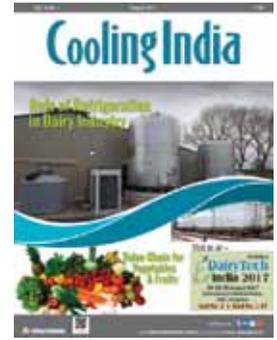
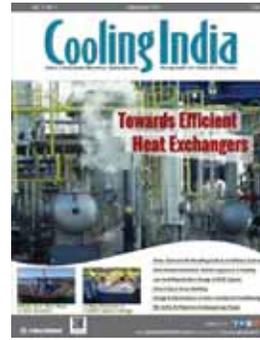
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chambers and other allied transportation services, reveals Sheshadri.

Shift towards multi-commodity facilities

The clearance of FDI in multi brand retail, which mandates procurement from local markets is expected to double the food processing levels and hence contribute to an increase in the use of cold chain facilities. "Focus of the industry will thus shift from single commodity storages to modern multi-commodity facilities with the scope of consolidation and introduction of better technology thus optimising the entire supply chain," Sheshadri added.

Increased production of perishable quality foods

Commenting on the trend impacting the cold chain industry in India, Khanna said, "Nevertheless, the increased production of perishable quality foods like fruits, vegetables, milk and dairy, meat and its products, poultry etc vis-à-vis general demand rise in middle-class affluence has importantly resulted in increased demand for foods in their fresh format as well processed form. This is also due to the prevalent awareness that perceives health benefits from consuming fresh fruits, vegetables and other products. This has in turn, generated greater need for temperature-controlled logistics."

Without the appropriate cold-chain, perishable produce cannot reach across the expanse of the country to meet such demand. To accelerate the cold-chain for such perishables, there is need to develop modern pack-houses, as well as refrigerated transport. The demand for frozen vegetables has also picked up.

Cold chain initiatives

FSC integrates technology into the core

- **Technology:** IoT is a key component of the temperature-controlled supply chain and Future Supply Chain Solutions Ltd (FSC) has integrated its transport management systems with the remote temperature and location monitoring services. This provides a real time feedback of the goods in transit thus ensuring that quality is maintained throughout the transit period.
- **Manpower training:** To ensure high level of quality standards in the warehouse, FSC ensures that all its support staff are trained on the hygiene standards required while handling products in the warehouse. A strict training calendar is followed to ensure that the personnel are clear on the standard processes for quality management.
- **Alternate reefer technology:** Traditionally, reefer technology for both storage and transportation is fuel driven. FSC is experimenting with a number of alternate technologies that use gel packs and eutectic plates to maintain the desired temperature. This not only reduces dependency on fossil fuels, but also helps use the existing dry assets for cold chain without compromising on quality.
- **24x7 monitoring** of operational aspects, such as the door opening at the warehouse, loading and unloading time, transit time, etc. to ensure that there is no impact on the quality of the



Mahendra Swarup

President, Federation of Cold Storage Associations of India (FCAOI)

“More cold storages are coming up to store products below zero degree centigrade, especially there is a rapid growth for the storage of fast food.

product.

- **Remote temperature management:** To eliminate the dependence on drivers for temperature management in transit, Sheshadri informs that FSC is in talks with OEM manufacturers of refrigerated units to develop remote temperature management technologies. This will help FSC monitor in-transit temperature from the control tower and reduce dependence on the driver for the same.
- **Real time data monitoring and incident alerts:** Customers are provided with access to FSC's tracking systems thus ensuring high levels of transparency for goods in transit. This helps in taking immediate action in case of temperature excursions thus preventing loss of quality.

FCAOI brings industry knowledge

FCAOI is trying to provide knowledge regarding latest technology and how to work on it. The industry-body also provides knowledge about the machines and equipment and from where and how to procure it. About the latest initiative, FCAOI asking cold storage owners to take the help of solar energy to solve their electric problems, which is most essential component of cold storage industry. For this, they are holding seminars and exhibitions on regular basis where the advancement in technology is discussed with experts. Machines and various equipment are also put on display.

GCCA serving as central pillar

Besides human resource development initiatives and making technical literature, GCCA has been facilitating initiatives in order to enhance and develop cold chain facilities and make warehouses meet modern standards.

A GCCA delegation also travelled to India as part of a USDA-funded project to discuss the current cold chain logistics industry in India with importers, retailers, cold storage owners, transporters, and logistics companies. Indian stakeholders shared information with great willingness and discussed the challenges in the current Indian cold chain. The delegation focused on understanding handling practices, efficiencies, education and training, and specific transport challenges. This is expected to help GCCA to develop strategies for intervention to support additional growth while enhancing knowledge of best practices. "The assessment results will be presented and discussed with Indian stakeholders in November, with follow-up activities for additional training and networking activities to support cold chain development. Thus, GCCA is serving as central pillar in cold chain development across the globe, including India in a bigger way," informs Khanna. ■



“Need to set up multi-commodity EX-IM and distribution storages”

Steve Felder, Managing Director, Maersk Line (India, Sri Lanka, Bangladesh, Nepal, Maldives and Bhutan) sheds light on various nuances of cold chain logistics and reefer business while interacting with **Cooling India**

What are the trends in end-to-end cold chain logistics in India?

According to the recent industry survey for India, which we at Maersk have conducted, the demand for refrigerated products has been growing at a rate of 18 per cent over the last couple of years. It is expected to grow to around 19 per cent during 2017-2022. The top commodities that are driving reefer exports from India are fruits, vegetables, meat and fish. There is also a growing demand globally for pharmaceuticals from India.

Fruit and vegetables are the largest commodities in terms of volumes and it requires some very specific needs in terms of sorting, grading, processing and packing. It is also crucial for domestic market and for EX-IM. Per capita availability in the country of fruits and vegetables is low as post-harvest losses are high and wastage is in the range of 25 per cent – 30 per cent approximately across India.

These specific data tells the story of huge post-harvest losses due to lack of cold-chain infrastructure. The government has taken cognizance of this aspect and last year 101 new integrated cold chain projects with a total investment of ₹3,100 crore were announced.

In October last year, the Chhattisgarh Government commenced the process for design and engineering development of Multi Commodity Cold Storage Chambers for Horticulture produce across key districts. They also announced a Post-Harvest Management to establish a network of cold storages and pack houses to prevent the damage of perishable commodities like fruits, vegetables and flowers in the entire state. This augurs well for the industry to ensure there is no wastage due to unavailability

of cold chain infrastructure.

At Maersk Line, we have been at the forefront of cold chain technology, deploying it across the world. We are on the right path in regards to the policy when it comes to end-to-end cold chain logistics in India. As a company, we will continue to bring innovative solutions such as remote container management where you can monitor the temperature throughout the journey, store-door and end-to-end solutions to enable customers hassle free logistics experience.

What are the growth drivers?

Cold chain in layman's terms is defined as a controlled environment in the supply chain which ensures uninterrupted care from source-to-the end user. The government's push with the recent investment announcements for the shipping and logistics sector and focus on integrated supply chain policies has added the much-needed momentum.

One of the growth drivers for the industry is organised retail. India has occupied a remarkable position in global retail rankings; the country has high market potential, low economic risk and moderate political risk.

Increase in income and the growing middle class is expected to change consumption pattern. India is expected to become the world's third-largest consumer economy, reaching US\$ 400 billion in consumption by 2025, according to a study by Boston Consulting Group.

Horticulture production and contract farming are experiencing growth. Pharma has small volumes but high margins; industry has been growing at high rates, with exports growing faster than domestic consumptions. Government initiatives facilitate growth

and investment in cold chain services.

Exports are increasing in several frozen commodities such as meat and seafood. Seafood production is concentrated in a few southern states, with 11 per cent of production destined to export. Having said that, a large part of fish for domestic consumption does not go through a traditional cold chain as it is consumed in proximity to the fishing location and transported in trucks with ice. While bulk cold storage is focused in a few states producing long shelf life product, EX-IM cold storages are concentrated around the major exporting ports. Therefore, there is a large capacity gap across the country, presenting tremendous opportunities for players with innovative technology and capability.

Please take us through your reefer business program.

With the growing reefer industry in India, Maersk is well ahead in understanding and offering cold specialized services and is currently catering for the Indian growing market demand. The last few quarters have been quite interesting.

One can say that the last few months have seen quite a few milestones for us in serving customers in India. At the end of the day, we provide service to customers based on their requirements.

How has the reefer business evolved over the years in India?

As I mentioned before the government has taken into account the importance of cold chain logistics in India to add to the overall economic growth. Reduction of wastage, improved profitability, capacity expansions, investments, support to industry verticals such as fruits or vegetables or seafood etc augurs well for the industry.

The current cold storage infrastructure in India is still at nascent stage and we see some challenges. Most storages built in the past focused on edging seasonality for a single commodity, thus creating an overcapacity in individual commodity in specific locations and capacity gap for modern multi-product storages for perishable goods. The technology being used to provide cold chain solutions are sub-par. Having said that, advanced technologies are being introduced slowly but steadily in India's cold chain storage infrastructure.

What are the USPs of your Reefer services?

Having pioneered refrigerated transport since 1936, we have the knowledge, equipment and expertise to streamline logistics and supply chain with optimal refrigerated transport solutions. Our expertise in store door and remote-controlled environments helps service industry verticals such as fruits, vegetables, bananas, fish, seafood, meat or pharmaceuticals. We have dedicated reefer specialities, boxed goods from origin to destination, to ensure goods arrive in high quality and safe conditions.

As a global player, we offer industry leading end-to-end solutions in logistics, A.P Moller – Maersk is well positioned to be able to cater to this growing market demand.

For years our customers requested container tracking. Remote Container Management (RCM) is Maersk Line's response. It gives

Maersk Line's initiatives in a nutshell

- First mile service for imports of refrigerated apple saplings from Verona, Italy to Sonepat (July 2018)
- Imported the first-ever consignment of frozen fruit juice to NCR, India (Nov 2017)
- Import of potatoes to Gujarat from Kuwait (Oct 2017)
- First ever consignment of groundnuts from Gujarat to Jebel Ali for (September 2017). With India being the world's second-largest producer of groundnuts, this can be considered as a major development
- Enabled import of confectionery into Rudrapur, Uttarakhand-first for the industry from Leixoes, Portugal (Sept 2017)

the customers unprecedented visibility into their supply chains, offering real time data about the state of their cargo. The data forms an asset for our customers to understand and work out ways to optimise their supply chains

We have been looking at various kinds of investments to address these emerging needs. For example, APM Terminals recently opened a state-of-the-art cold chain facility in Chennai, which helps with the transportation and storage of goods such as fish, food, and medicines. This is the first investment we have made in Chennai, and we are constantly evaluating the opportunities that exist in India.

What is that one trend impacting the cold chain industry in India?

According to our studies, cold storage segment in India is fragmented at present. There is an urgent need for multi-commodity EX-IM and distribution storages to be set up across strategic regions to add momentum to trade. As I have mentioned earlier, the government's proactive approach to this sector in general will have positive impact in the days to come. We are at the cusp of growth momentum in cold chain logistics in India and we are excited about the upcoming future.

What is your outlook for this industry?

As per a recent industry report the Indian Cold chain market is expected to reach ₹ 470 billion by 2020. This presents a huge potential for market expansion and growth. The current growth in the market is very respectable with containerised market growing at 8 per cent to 10 per cent YoY. The recent relaxation of the cabotage restrictions will only foster competition amongst Indian ports and expand the market.

The other major opportunity which I envisage is in the overall supply chain as customers are moving to offload larger chunks of their supply logistics to us. Thus, this opportunity to provide more End-to-End services to them and enable trade.

As I mentioned earlier, we are committed to India's growth story and we will continue to bring our innovation integrated logistical solutions for our customers to enable trade. Trade contributes to prosperity and development, globally and locally, and facilitating trade is our business. ■

Cold Chains, Hot Prospects

Players will focus on packaging warehouse and reefer services to deliver better margin growth



The future of cold chains lies in organised integration, value addition, and diversified user base. That is why CRISIL Research expects Rs 15,000-20,000 crore to be pumped into the cold chain industry through fiscal 2022. What more, about 90 per cent of this will go into multi-purpose cold storages. These offer higher rentals compared with single-commodity cold storages, and also early payback. However, that would still fall short to meet demand. The industry is seen riding on 13-15 per cent annual growth up to fiscal 2022 to a size of Rs 47,200 crore.

Integrated cold chains that package temperature controlled warehouse (TCW) and temperature controlled vehicle (TCV)

services to diversified end-users will lead the way. As of now, the TCW segment alone accounts for 90 per cent of the industry's revenue and that's where the bulk of growth will emanate. Within this segment, multi-purpose cold storages dominate. Their revenue share of the segment is estimated to rise from 77-79 per cent in fiscal 2017 to 84-86 per cent by fiscal 2022. Within the multi-purpose segment, we estimate organised players, which comprise less than 10 per cent of the overall cold-storage market, to grow faster than unorganised ones. Organised players that provide integrated and value-added services, have pan-India presence, and a diversified end-user base, charge premium and earn better margins. They

are strategically clubbing warehouse and reefer services to tap demand and investment.

However, the medium-term may not be as bright for the TCVs or reefers-only segment. Accounting for around 10 per cent of industry revenue, it is expected to log a relatively sedate growth of 6-8 per cent annually to Rs 2,400 crore in fiscal 2022 from Rs 1,800 crore in fiscal 2018. The main reason for subdued growth in TCVs, which provide first and last-mile connectivity to cold storages, is that all end user industries may not be willing to pay high rentals. Also, unavailability of return load leads to inefficient utilisation of vehicles, which acts as a major inhibitor. In a catch-22, investments in cold chains

and reefers themselves suffer owing to lack of first and last mile connectivity.

Besides, stiff competition and reluctance of end-user industries to transport via reefers because of higher cost restricts private players from investing in the segment. This is why it makes sense for a player providing both TCW and TCV services to offer an integrated package to clients willing to pay, rather than as standalone services. That would help improve utilisation, and thereby, draw investments in the industry. Although only a few big players offer integrated services today, the number is expected to rise in years to come. On the exports front, growth in the cold-chain industry will be driven by meat (mainly carabeef, or buffalo meat), seafood (predominantly shrimps), bio-pharmaceuticals, and exotic fruits and vegetables. These segments cater mainly to the export markets, where again, organised players are preferred owing to stringent quality requirements and regulations.

Summing up

What does the industry have?

The industry suffers from various constraints: weak energy infrastructure in the country in terms of modern technology and proper supply of power, low awareness among players that limits the adoption of new technology, low availability of skilled workers to handle modernised technology, dependence on manual labour owing to low investment, and operational challenges in maintaining sensitivity and consistency in the quality of pharmaceutical products. Organised multi-purpose cold-storage players also have to contend with realisation pressure because of intense competition and unwillingness of end-user industries to pay higher charges that makes it difficult to charge higher rentals. All these act as deterrents limiting investments in the industry.

What does the industry need?

- Investment in cold storages situated at 50-150 km from the farm gates,

production centres and TCVs or reefers, for building an efficient cold chain grid across India

- Timely support from government policies and schemes in the form of capital subsidies to boost growth

Penetration of cold chains in India is low at 0.1 cubic metre cold storage space per capita, compared with 0.35 cubic metre in the US. Less than 4 per cent of India's fresh produce is transported by cold chain, compared to more than 90 per cent in the UK, according to a study by the University of Birmingham.

This suggests there is only one way for the industry to move. Upwards and forwards. ■

Hetal Gandhi
Director
CRISIL Research



USGBC Releases Resilience Study on the City of Boston

Case study is designed to be a tool in helping cities enhance their own resiliency efforts

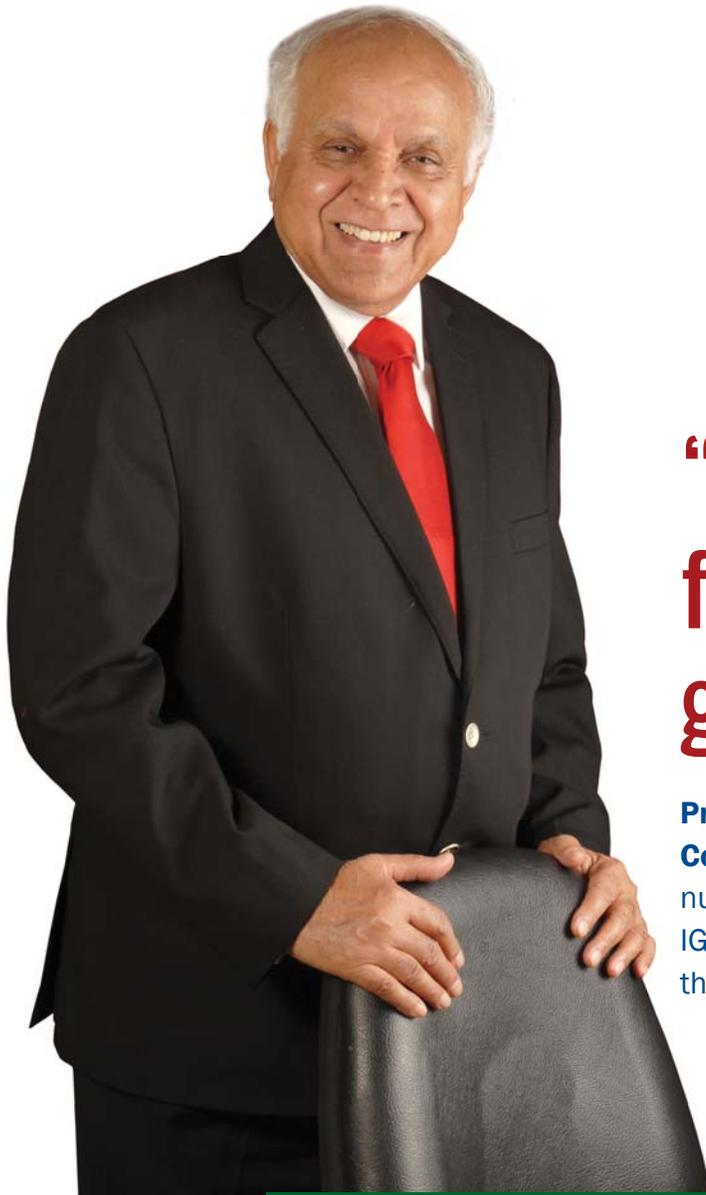
The U.S. Green Building Council (USGBC) has released a resilience case study on the City of Boston. Commissioned by E Cubed Optimizers (ECO), the study reviews the measures taken, lessons learned and challenges faced by the City of Boston in its work to create a truly resilient city. The study is the latest effort from USGBC to drive a more resilient future through education, resources and programs.

"At USGBC, we have a vision that buildings and communities will regenerate and sustain the health and vitality of all life within a generation," said Mahesh Ramanujam, president and CEO, USGBC. "And we know that in order to realise a sustainable future for all, the next generation of green building must focus on the development of smart and resilient cities and communities. This Boston case study demonstrates the factors our cities must champion – equitable, safe and healthy development policies; implementation of interoperable platforms and advanced technologies that improve the performance of their communities and cities; and incorporating concepts like wellness and human experience into city planning, development and management."

This case study is designed to help Boston and cities around the globe enhance and further their own quest for resilience. Boston has made significant progress in tackling resiliency, such as in its response and planning following the Boston bombings in 2013 and its appointment of the city's first chief resilience officer in 2015. World cities can learn many lessons from Boston's experiences to enhance ways in which they can tackle resiliency.

"In the case study of Boston, we examined 16 different resiliency factors. Although these factors are separately examined, they are strategically interrelated. No one factor can guarantee significant resiliency no matter how strong it may be," said Katherine Hammack, executive director, Ernst & Young (former CEO E Cubed Optimizers).

"We can have the most resilient infrastructure, but if the human factors are not resilient, the city is not resilient," said Les Lo Baugh, president, E Cubed Optimizers. "We call a city without people a 'ghost town.' A resilient city requires resilient infrastructure, resilient systems and resilient people. One of the reasons Boston was an excellent candidate for the case study is that Boston understands this fundamental principal." ■



“India at the forefront of green growth”

Prem C Jain, Chairman, Indian Green Building Council (IGBC) takes us through various nuances of green building in India and role of IGBC in leveraging green building movement in the country while interacting with **Cooling India**

With emphasis on zero carbon footprint, how do you envisage the growth of green buildings concept in India?

Emphasis on zero carbon footprint is indeed the need of the hour and augurs well for a greener and healthier planet Earth. India has made major strides in this direction. Today, Indian Green Building Council (IGBC) has facilitated India emerging as one of the global leaders in green buildings and is at the forefront of facilitating greening of various forms of built environment. India with over 5 billion square feet of registered green footprint stands at no 2 in the world. With various projects adopting IGBC green building standards, IGBC aspires to facilitate 10 billion square feet of green building footprint by 2022.

IGBC has demonstrated a clear business case for green buildings. A clear testimony to this fact is the spread and growth of green buildings across the country. Green Building movement in India is

well poised to lead the global green building movement; in the process facilitating zero carbon footprint. India is at the forefront of promoting innovative and futuristic concepts like net zero buildings and pre-fabricated homes. The day is not far when the place we live, work, study, play and commute, will all go the green way and will be home to some of the finest green building concepts and technologies, worth emulating by other countries.

Kindly elaborate on the services offered by IGBC.

IGBC was formed by the Confederation of Indian Industry (CII) in 2001. The Council headquarter is at CII Green Business Centre (GBC), Hyderabad -India's First Platinum Rated Certified Green Building. Today, IGBC is the country's leading body for green building services through the development of green standards for all applications of built-environment, certification and allied activities like local chapters, training programs, IGBC Accredited Professional (AP) exam, student chapters, green building

Illustration of the energy savings achieved in some of the early certified green buildings.

Building	Built-up Area (sq.ft.)	Normal Building (kWh)	Actual Building (kWh)	% Reduction	Annual Energy Savings (Rs in Lakhs)
Wipro, Gurgaon	1,75,000	48,00,000	31,00,000	40%	102
ITC Green Centre, Gurgaon	1,70,000	35,00,000	20,00,000	45%	90
CII Godrej GBC, Hyderabad	20,000	3,50,000	1,30,000	63%	9

Congress, missions, capacity building sessions, and other initiatives.

Considering that the Indian environment and geographical scenario is very different from that of the US, what is the research involved to understand what India wants?

Each country has its own environment and geographical conditions. India has a rich repository of architectural and sustainable practices and doesn't need to undertake any special research to understand what it wants. Sustainable buildings and earth-centric formulas are inherent in our ancient approach to buildings design and construction. India's monuments, havelis and courtyards are excellent examples of this approach.

All we need is to go back to our roots and imbibe the best practices which our ancestors adopted and promoted, and blend these with the latest state-of-the-art technologies. This is what we in IGBC promote. All our 24 green building rating systems are a blend of ancient architectural practices and modern technological innovations. Today, over 4,500 green building projects are adopting IGBC green building rating systems.

What kind of role IGBC India would like to play in India's 100 smart cities project?

Designing smart cities in India would go a long way in enhancing the quality of life of occupants and address ecological issues and concerns. IGBC would continue to play a catalytic role in India's 100 Smart Cities initiative.

IGBC strongly believes that if a city has to be a smart city, it has to be a green city first. A Smart Green City will facilitate enhanced quality of life; efficient use of resources; efficient land use planning and efficient mobility management.

IGBC's rich and varied experience in designing green building project and townships could be fully leveraged in the design of Smart Cities. Further, IGBC Green Cities Rating System can perfectly dovetail in developing Green Smart Cities and in the process facilitate in building a greener and healthier India. This rating encourages eco-friendly city planning that balances social, economic, and environmental dimensions, as well as good urban governance as its foundation.

While developers often cite cost as a key reason that makes them refrain from adopting the latest green technologies like solar photovoltaic panels, is there any way this technology can be incentivised? Is there a role IGBC has to play here?

Developers citing increase in cost was a scenario of past. As a

result of concerted efforts, IGBC could facilitate market transformation for indigenous manufacture of green building products and technologies. Today, India is at the forefront of developing green building products and technologies which are ecologically superior and economically viable.

Stakeholders are forging new partnerships and facilitating technology transfer, resulting in win-win situation for everyone. A classic example of deflation in cost of green product is the waterless urinal. Earlier, it is used to cost Rs 14,000/- when the CII Godrej GBC building was constructed. Today, it is available for Rs.6,000/-. Now most of the green building products and technologies are manufactured and locally available all over India. Offering incentives for green technologies will go a long way in further accelerating green building movement in the country. In the process, it shall also offer new growth opportunities to the stakeholders. IGBC estimates that the market potential for green building products and technologies will be about USD 300 billion by 2025.

Also, at the policy level in India, do you think we need more additions supporting the green building concept? If yes, what should they be and why?

Green Building movement is receiving excellent support from the Government, both at the Centre and state governments. Today, we have states including Rajasthan, Punjab, West Bengal, Uttar Pradesh, Andhra Pradesh, Himachal Pradesh, Jharkhand and Haryana incentivising IGBC-rated green buildings; these have led to a multi-fold increase in the number of such environmentally responsible projects throughout the country.

Similar, policy impetus in terms of higher FAR, faster environmental clearance from other state governments would further accelerate the spread and growth of green buildings all over India and in the process facilitate in building a greener and healthier India.

Is it possible to achieve the goal of energy efficiency during the construction of buildings?

IGBC Rating Systems provide various tools in the form of detailed reference guides, templates, checklists, intent, mandatory requirements, credits, etc. All these tools will equip the project team and designers to implement green building measures right from day one.

Further, IGBC Green Building Rating Systems encourage project teams to adopt energy modeling and other software techniques to explore various design options, material specifications, equipment and control systems. This would enable the project team to take informed decisions which would ensure sustained savings by design, and promote creativity and innovations in the projects. ■

V-Belts Handle with Care

V belts are intrinsically safe with all the in-built safety features. However, there are innumerable accidents which have been reported, some of them ghastly to the operators and technicians while carrying out repairs and inspection. The following article explores some of these accidents.



V Belts are very commonly used in air conditioning. They are used to step-down the speed of the motors driving the air conditioning blowers. They are intrinsically safe with all the in-built safety features. However, there are innumerable accidents which have been reported, some of them ghastly to the operators and technicians while carrying out repairs and inspection. The following article explores some of these accidents.

It is to be noted that these accidents are applicable to not only refrigeration equipment, but also to other machinery, wherever rotating exposed components are involved.

Incident 1: Electrical officer hand injured

due to sudden starting of AC Blower

An electrical officer was working on an accommodation AC blower of a ship. Normally, these have V Belts through which the RPM of motor is brought down to the blower RPM. The electrical officer had stopped the blower electrically and proceeded to work on the blower. Suddenly, the blower was started by someone and the electrical officer's hand had got caught between the belts and the pulley and there was a substantial injury. This reinforces the need for electrical lock out tag and care when working on rotating machinery and particularly, with AC blowers.

Normally, these V belts are provided with protective guards. Somehow, often,

these guards are removed and are never put back in place.

Fingers and Rotating V Belts Don't Mix.
Incident 2: Engineer injured due to draught from other running AC Blower
(Source: MAIB Safety Digest 1/2006)

An engineer on board a vessel was required to order spares for the accommodation fan units. As both fans were running, he switched off the power to number 1 fan, closed the delivery flap and opened the air conditioning unit access panel. He then waited for the fan to stop before checking the identification markings, condition and tension on the three vee belts.

Unknown to the engineer, number 1



Figure 1: Accommodation fan unit – delivery flap handle

fan delivery flap had not closed and sealed its duct, because the locking screws on the vent flap handle were slack. Both fans supplied a common air delivery duct, and the airflow from the running fan caused the fan on number 1 to rotate in the reverse direction soon after it stopped.

Unable to react quickly enough, the fingers of the engineer's right hand were drawn into and became trapped between the V belts and the electric motor pulley.

Lessons

1. If you are required to work on rotating or other moving equipment, ensure that all precautions are taken to isolate and prove that it cannot restart unexpectedly. By issuing warning notices, locking off starter controls, removing fuses, and fitting locking devices on the plant, you will be reducing the opportunity for an unexpected, and probably very painful, accident to take place.
2. If the equipment is linked to other operating plant, ensure that the operating plant cannot affect the



Figure 2: Motor fan unit and Vee belts

equipment you are working on. If it can, and only if safe to do so, isolate the linked plant as well, and advise a responsible officer of your actions.

3. If equipment operates unexpectedly, it will almost certainly happen when your fingers are in very close proximity to it. Where possible, make use of tools – specialist or otherwise – to carry out maintenance, and keep your fingers safe.
4. An effective risk assessment should have shown that the sealing of the common air delivery duct by the number 1 fan delivery flap was critical to prevent reverse running of the fan. This should have then identified the unsuitable precautions taken to prevent inadvertent rotation.

Incident 3: Injury to Electrical Officer while checking belt tension

A 2009 built Hong Kong registered cellular container vessel with a summer deadweight of 85760 MT, departed from Kaohsiung, Taiwan on 24 July 2013, bound for San Pedro, USA where her expected arrival was 6 Aug 2013.



Figure 3: Finger Injury

On 2 Aug 2013, while the vessel was at sea, routine maintenance on AC Blowers was planned as required by vessel's PMS. AE/O and the fitter were assigned to carry out the job.

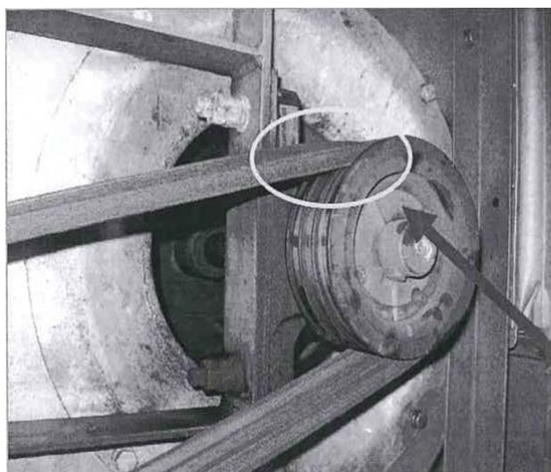
During the maintenance of No 2 blower, AE/O's fingers got caught between the belt and the wheel causing injury to two fingers of left hand.

He was given first aid on board and in consultation with CIRM, vessel was diverted to Oakland to evacuate AEO for further treatment.

No abnormality with AC blowers was reported prior commencement of the job.

Prior starting the maintenance, necessary precautions were taken by the senior engine officers. The equipment was isolated and the power was switched off to the equipment. The maintenance involved greasing of the bearing of both the blowers. The maintenance procedure was well understood by the injured officer.

With the intention of checking the belt tension, the crew member pressed the belt with his left hand while moving the belt



Apparently AE/O fingers got trapped between the belt and the pulley

Figure 4: Location where the injury occurred

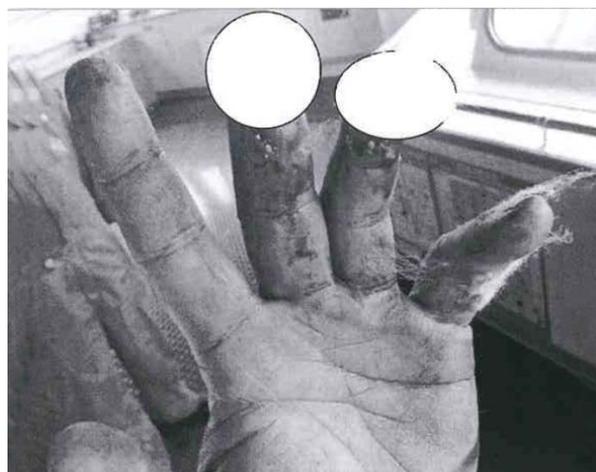


Figure 5: Extent of the injury

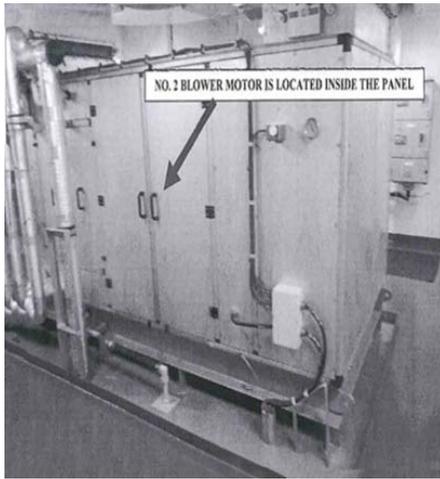


Figure 6: AC Blower Room

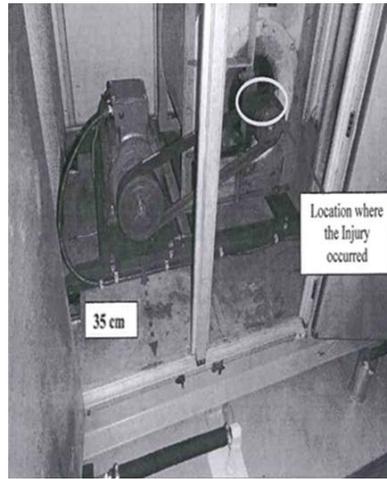


Figure 7: No. 2 AC Bower

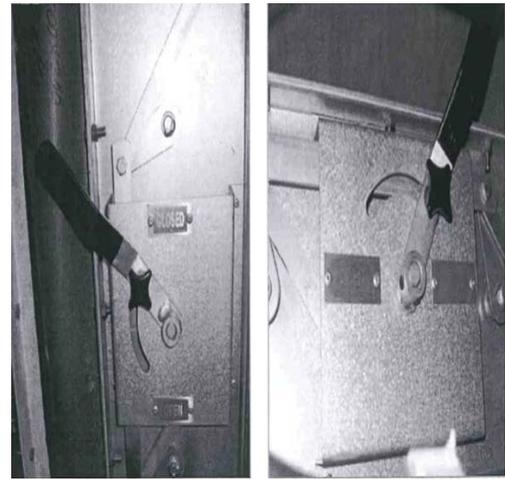


Figure 8: Air Duct Valves

with the right hand. During this process, when the belt was in motion, the crew member's hand was caught between the belt and the pulley on the fan side.

Incident 4: Injury to Electrical Officer due to air draught when AC Blower room was opened

There was another case of an electrical officer working on an Accommodation AC Blower. He had electrically locked the blower out, so there was no chance of accidental starting of the blower. Another engineer had entered the blower room. Due to the draught of the air, the blower started rotating, the bearings being very free. The Electrical Officer was caught off-guard and his hand got carried between the pulley and the belts and there was substantial injury.

Incident 5: Injury to Second Engineer's hand due to sudden cutting in of AC Compressor

On 14 August 2017, a container vessel was on her way from Savannah, USA to Cartagena, Colombia. During the evening at 2055 hrs LT the usual night rounds were carried out by the duty Second Engineer.

During the rounds, one of the V belts of the accommodation AC compressor was found loose and slipping on the pulley. The Second Engineer in an attempt to carry out the replacement of the loose V belt, decided to stop the AC by closing discharge valve of the condenser. The compressor tripped with low suction pressure but was still on standby mode. Unfortunately, the electric motor for the compressor was not switched off from the breaker before beginning to cut the belt for replacement. The compressor restarted during this time and the Second Engineer's right hand was caught in between the pulley and the belt resulting in severe injury and loss of four fingers of the right hand.

Vessel Master immediately proceeded full speed towards next port and 14 hours after the incident the injured individual was disembarked onto a Colombian coast guard speed boat and transported to the local hospital for surgery and recovery. From the above preliminary report from the vessel it would appear that the replacement of the loose 'V' belt was attempted without de-energising the

compressor's electric motor and while the compressor was stopped it remained in Stand By mode.

This incident and resultant severe injury serves to remind us, yet again, of the need to strictly adhere to safe working practices and company permit to work system. The SP-023 - Machinery Or Electrical Equipment Power Isolation Procedure and associated permit form FM-110- Machinery OR Electrical Equipment Power Isolation Permit clearly define the process to be followed and mitigating actions to be put in place in order to work on machinery and equipment which could be turned on, or started automatically or from remote control system.

Immediate Follow Up Actions

1. An extraordinary safety meeting to be held on board at earliest convenience and this safety alert discussed with all personnel on board.
2. Ship board practices pertaining to permit to work, and SP-023- machinery or electrical equipment power isolation procedure, in specific, to be reviewed by the Master and the safety officer, and any

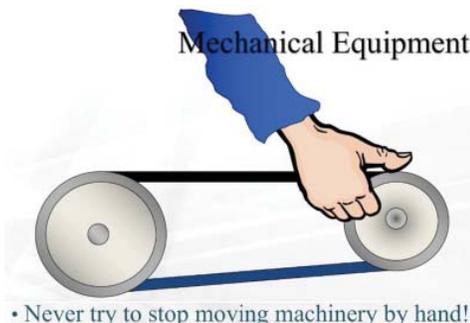


Figure 9: Hand Safety with Rotating machinery



Figure 10: Hand Injury due to V Belt accident

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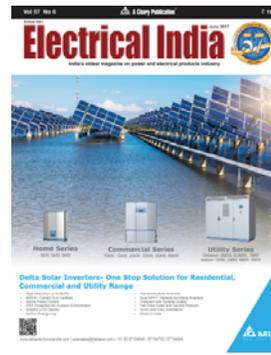
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Figure 11: Hand Injury to Electrical Officer due to V belt

shortcomings addressed immediately.

3. Master and Safety Officer to hold a training session with all personnel explaining the importance of adherence to Permit to Work system and 'Isolation permit' in particular. Any feedback on how the organization can prevent similar incidents from recurring are welcome and to be sent to your Superintendent and Marine Superintendent for further follow up and action if required.

Incident 6: Hand injury to Electrical officer (Source : MARS 201762)

The vessel was underway on the open ocean in rough weather. The electrical officer and another crew were to check the tightness of the accommodation blower's V-belts. Prior to the job the lock-out/tag-out procedures were followed and the blower suction, outlet and recirculating flaps were closed.

The blower door was opened for inspection and team started checking the

V-belts for tightness. As they were finishing their inspection the vessel took a roll due to the sea state. Both men lost their balance, and in an attempt to hold on to something the electrical officer's left hand fell on the blower's V-belt. As his weight came to bear on the belt, it caused the belt to move, trapping his hand between the V-belt and the blower pulley wheel. The victim was able to extricate his hand but not without negative consequences. Two fingers and his thumb were badly injured. After receiving first aid, he was evacuated from the ship by helicopter.

Lessons learned

Crews should take vessel movements into consideration in their risk assessments before undertaking a task. Less essential tasks should be done when there is minimal vessel movement.

In this instance, there was no securing arrangement to prevent the door from moving when it was open. A securing hook arrangement was fabricated for the

doors in order to secure them while open.
Incident 7: Crew member loses part of thumb for ignoring LOTO (Source : MARS 201737)

A lone crew member was about to do some maintenance on a ventilation duct fire closure for the hold. As he started to open the ventilation door, the cargo hold ventilators were switched on by someone else in another location. This caused the ventilation door to suddenly be sucked closed. The crew member's thumb was trapped between the handle of the cleat and the door frame causing the thumb to be severed above the first joint.

Lesson

- Always lock out, tag out (LOTO) before attempting a job. LOTO, in this instance, may not be self-evident but any job that risks a potential release of energy should be LOTO.

General Rotating Equipment Safety Precautions

- Always replace protective guards after completion of the work.
- Never wear loose clothing or jewelry when working near moving mechanical parts. They can get caught in belts, pulleys and fans causing serious injury.
- Do not try to stop moving machinery with hand. This may cause injury to fingers.
- Wear protective hand gloves during work on rotating equipment.
- Ensure equipment is electrically locked out before commencement of the work.
- Be aware that air conditioning blowers could move even with external air draught.

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REFCOLD to promote Indian refrigeration industry to the World

REFCOLD India will help Indian industry to be at par with global standards of cold chain industry.

Pankaj Dharkar, Chairman, REFCOLD India

REFCOLD INDIA 2018, India's first international exhibition and conference on cold chain, industrial refrigeration and reefer transportation, is being organised by the Indian Society of Heating, Refrigerating and Air Conditioning Engineers (ISHRAE) along with NurembergMesse India on November 22-24 in Gandhinagar, Gujarat. Here, in an interview with Cooling India, Chairman of REFCOLD India Pankaj Dharkar shares some first-hand information about the event. Excerpts:

What is the objective of REFCOLD India 2018?

The objective of REFCOLD India 2018 is to bring Indian and international refrigeration industry under one roof to bring innovative technology in this field in India which is the need of the hour and due to which we can save a lot of wastage in food. REFCOLD, being organised by ISHRAE, is planned on the

footsteps of Indian Prime Minister initiative of doubling the farmer's income by 2020. We are getting tremendous responses from international and national refrigeration related associations and industry.

What are the trends in Indian cold chain segment? What is the penetration level of temperature controlled cold storage in India?

India in terms of trends still follow the old technologies in cold chain segment and very few cold chains or cold storages are adapting international standards. But with the increase in demands of good quality fresh foods and frozen food products, there is a huge need in cold storages, cold chain and reefer transportation. So, at this juncture, REFCOLD India will help Indian industry to be at par with global standards of cold chain industry.

What role can organised retailers play in building cold chains in India?

With the change in demands of Indian consumers, retailers play very important role in building chain in India as they are the one who will be end-users for cold storages and reefer transportation to make sure that the buyers are getting fresh product.

What are the stumbling blocks faced during setting up of cold chain logistics infrastructure? How do you overcome these challenges?

The major stumbling block faced during the setup of cold chain logistic infrastructure is availability of less knowledge in terms of best practice and innovative technology. With REFCOLD India, we are trying to educate people by showcasing innovative technology and also conducting free workshops to educate about the best practices.

India is one of the largest producers of agricultural products and one of the global leaders in the pharmaceutical sector. Yet, it is known to have fledging cold chain, which results in supply chain losses of food, pharma and other resources. So, what are the solutions?

For pharma cold chain, missing link is right quality and quantities of reefer van and lack of cold warehousing infrastructure ant ports and airports. At REFCOLD, a special session is being taken up by the IITR (Paris) ASHRAE / Global Cold Chain Alliance and UNEP. We are sure that the sessions will be an eye opener.

In regards to agricultural products, huge efforts are required at all levels and we need to have "Green Revolution" like success of Amul (White revolution). The key is development of small pack houses (cold storages) which are primarily developed using combination of solar or grid and using phase transfer materials which will bring down the storage cost and make it affordable to small farmers. Unless farmers store them near to place they are produced, the food loses will never come down. This supported by strong reefer transport growth is going to be key success of cold chain.

Cold storages are dependent on steady supply of power. Apart from this, fuel constitutes a major portion of operating costs. So, what are the measures taken by the cold chain industry to make them

energy efficient and superior?

Yes, fuel constitutes the major portion of operation cost but we have to educate people that the major issue faced by cold storages is the increase in temperature due to bad insulation which in return consumes more power to maintain a certain temperature. With good insulation they can help decreasing their powers bills. The other efficient way is multi-storage cold storages where the whole cold room can be divided using insulated panel and there are small units which are running independently. So, you have to run one you can use one. The use of phase transfer material, solar power, adoption of efficient condensers for heat rejection and use of more efficient compressors are the effective road map for bringing down the energy level.

What are the technological innovations that you suggest to make the operations of cold chain logistics more efficient?

Use of solar, geothermal, phase transfer materials, high-quality insulation materials, and efficient transport systems will complement the future of growth in refrigeration and cold chain industry.

What are the growth drivers for cold chain logistics? Which sector does generate the maximum demand?

The milk produce, agro produce, fish, meat, and pharmaceuticals are growth drivers for cold chain logistics. Currently milk produce is creating maximum demand.



The major stumbling block faced during the setup of cold chain logistic infrastructure is availability of less knowledge in terms of best practice and innovative technology. With REFCOLD India, we are trying to educate people by showcasing innovative technology and also conducting free workshops to educate about the best practices.

What is your outlook for cold chain and refrigeration industry for 2018-19?

The growth in refrigeration and cold chain industry is surely going to cross over 20 per cent year-on-year for next 5 years. I do personally feel, we are in infant stage for usage of refrigeration industry. Surely there are huge work ahead for all associated in refrigeration and cold chain industry whether they are consultants, manufacturers, suppliers, or contractors – all are going to be extremely busy for the next 5-7 years. ■

IAQ Monitoring: The Basics You Need to Know

Today, an emerging trend has been the use of continuous monitoring to track and validate indoor environmental quality. This article addresses many questions about how to select and use indoor air quality monitors.



Photo Credit: www.nivanabeing.com

In recent years a war has been waged in China – one for clean air. With arguably the world's highest levels of public awareness of environmental health as well as an explosion of construction, an emerging trend has been the use of continuous monitoring to track and validate indoor environmental quality. Much of the best practices can be applied to India, which is challenged with even more polluted outdoor and indoor environments, and whose populace is similarly waking up to the health risks.

Practitioner's Perspective

This article is from the perspective of a consulting and engineering firm providing indoor air quality (IAQ) assessments, ventilation system design, and implementation of systems in both China and India.

Five years ago, a client of Sanghai-based firm PureLiving requested the ability to continuously monitor their air quality after an office-wide filtration system was installed. After a market search failed to yield suitable systems that could measure

PM2.5 levels and report over the Internet, the firm had no choice but to create its own monitor. Less than a month after the monitors got installed, Shanghai experienced some of the highest levels of pollution ever recorded locally (over 1,800 per cent higher than the WHO 24-hour health standard). The monitoring system showed that despite the high outdoor levels, the filtration system achieved 93 per cent average reduction. Instead of having to respond to employee panic, the client won staff trust and scored a PR

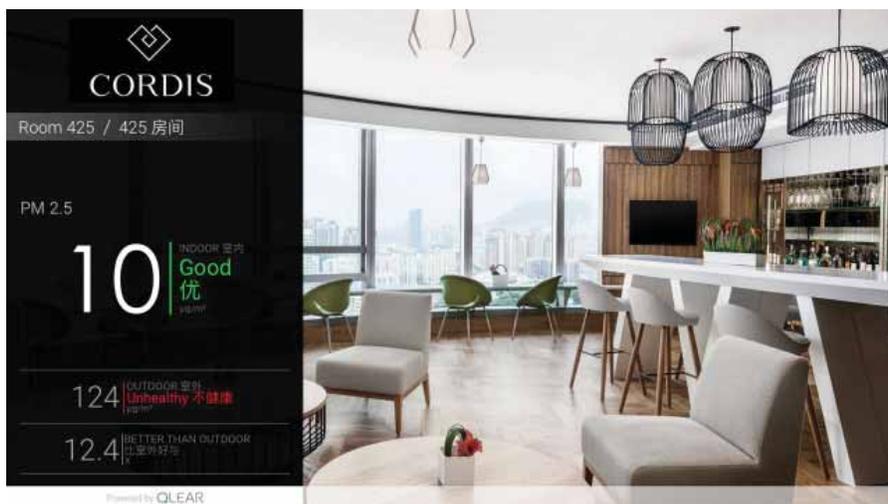


Figure 1: IAQ monitoring data screenshots as displayed in client retail/hotel public spaces

couple for employee care. Since then, PureLiving have sought to integrate monitoring into schools, offices, and buildings, and currently oversee more than 3,000 monitors streaming live data over a Cloud monitoring network.

Why Monitor?

A very fast growth in the adoption of monitors is being witnessed for a number of reasons.

- **Monitors are critical for developing recognition of an IAQ problem, which then drives improvement.** Traditionally, costly and time-consuming manual audits were necessary to diagnose baseline conditions. However, today, continuous monitors make it possible to quickly, inexpensively, and meaningfully depict the health performance of a space.
- **Moore's Law – sensors have come way down in price while increasing in performance.**
- **There is growing recognition that monitoring is critical to validate performance.** With the easy availability of inexpensive consumer grade monitors (as low as around US\$ 40), it is easy and natural for employees and tenants to test out their homes and offices. This can either be a PR nightmare or, as a marketing, selling or recruiting point.
- **Monitoring data enables self-auditing and green building certification performance validation.** Building

owners want to keep their spaces performing at a high level over time. The addition of furnishings, increase of headcount density, maintenance, and outdoor air infiltration, are all factors that impact air quality after commissioning. Increasingly, there are operations teams reviewing air quality data over time and across properties to optimise. Companies also want ROI and Green Building certification systems like LEED, WELL, and RESET, are all granting points for monitoring. In fact, the LEED standard for Existing Buildings (EBOM) now grants up to 9 points for an IAQ pilot credit that largely relies on monitoring.

- **Monitoring enables automation.** Traditionally, performance of air quality improvement systems degrade quickly

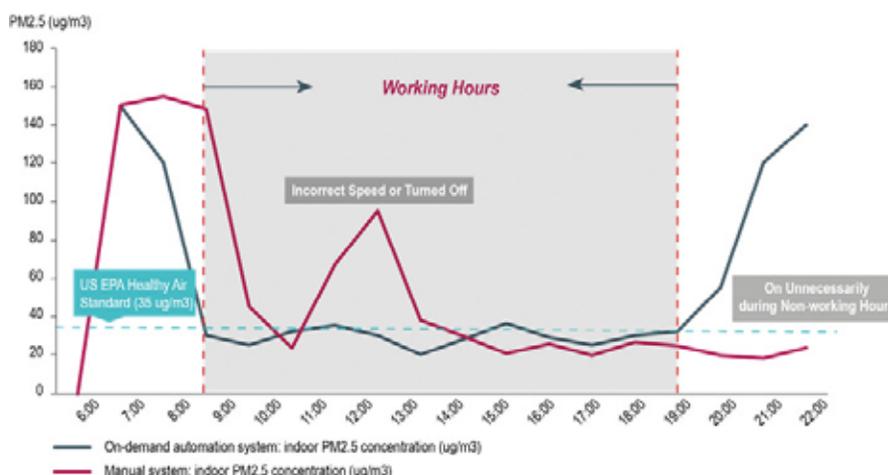


Figure 2: On-demand Automation vs. Manual Operation ($\mu\text{g}/\text{m}^3$ equals = g/m^3). [Source: "Every breath we take – transforming the health of China's office space," JLL & PureLiving Research Report, December 2015.]

after commissioning due to:

- Improper system operations – speed, on/off, filter maintenance
- Failure to control infiltration of outdoor air, or;
- Negative pressurisation bringing in unfiltered outdoor makeup air.

Training helps, but overcoming ingrained habits, staff turnover, is a challenge. The answer is to take the operator out of the equation, using automation software powered with live readings to govern filtration and ventilation system operation "on-demand" only when needed.

Today, one of the most frequent questions asked is "How do I select a monitor?" After all, monitors today may cost between \$35 to more than \$5,000. Typically, a monitor should be selected with a few considerations:

1. Pick a monitor based on the sensors needed, the criticality of performance, and how challenging the environment is. The parameters presented in Table 1 are the most important in IAQ monitoring.
2. "Paper specs" are not a good indicator of performance. Often, sensor capabilities listed in technical or marketing data sheets are used to compare and select sensors. However, sensors are impacted by design (ie. sensor proximity on a PCB may lead to elevated temperature readings and premature failure.) Sensors often also vary widely in terms of long-term stability.

Table 1: The most important parameters in IAQ monitoring

IAQ Parameter	Common Sensor Technologies	Recommended Measurement Range (Grade B)	Selection Notes
Particulate Matter (PM)	Optical particle counter (OPC)	0-300 ug/m3	Sensors should be able to provide particle count, not just mass concentration. Critical considerations: humidity compensation, stability, repeatability, accuracy over the ranges likely to be encountered.
Carbon Dioxide (CO2)	NDIR	0-2000 ppm	CO2 indicates the "quality" of ventilation and is possibly the most important IAQ parameter. Select sensors that have auto-zeroing features and that can be field-replaceable
Total Volatile Organic Compounds (TVOC)	Metal Oxide Sensors (MOS) Photoionization Detector (PID)	0.15 – 2.00 mg/m3	Both MOS and PID sensors are indicative only and used mainly to show relative change. They will not usually match lab testing. High chemical levels will also require recalibration
Temperature	Thermocouples; Resistive Temperature Devices (RTDs); Silicon diodes	0-50 degrees C	Many inexperienced manufacturers or first generation monitors suffer from inaccuracy due to heat generated from nearby components on same PCB
Relative Humidity	Capacitive	20-90%	Generally field-replaceable; important to measure due to impact of humidity on measurements of other parameters
Formaldehyde	Colorimetric, electrochemical; chemical	0.03 – 0.3 mg/m3	Currently, there are no real-time technologies known to the author that reliably match laboratory HPLC analysis. Avoid.

3. Realistic expectations of accuracy. Instead of looking for accuracy that is close to the reference source, evaluators should test by batches of at least 4 units and look for repeatability of readings and fit to the reference monitor's response curve. This indicates manufacturing and sensor quality
4. RESET monitoring standards are key to identifying the difference between

good and poor sensors. Created in China in 2011 and adopted by companies across the world, RESET is a healthy building standard for IAQ built around continuous monitoring data. RESET also certifies monitoring hardware with a set of requirements that categorize monitor quality into three groups: A for calibration-grade, B for commercial-grade, and C for consumer-grade. RESET includes

requirements that one would not normally consider such as a data buffer so that in case communications fails, data will still be stored.

5. Costs

- **Initial.** Monitors meeting RESET standards typically cost about \$100-300 for Grade C (Consumer-grade) monitors, about \$600-1,200 for Grade B (Commercial-grade) monitors, and upwards of \$3,000 for Grade A (Calibration-grade).
- **Maintenance.** Annual or semi-annual calibration is critical for maintaining accuracy, particularly in polluted environments and is generally mandatory for recertification. Generally, annual calibration and maintenance costs are typically 10-20 per cent of initial cost.
- **Software.** Most professional software is on a subscription basis and can be paired with different hardware. Annual costs may be free for limited basic versions or

All sensors are not created equal



Figure 3: Various types of continuous monitoring equipment

Monitor Standards
 General Rule: If you can't calibrate it, don't buy it.
 Only Grade A and Grade B monitors are accepted for RESET™.



Figure 4: Varying accuracy of three monitors show the difference between monitor quality grades. General rule: if you can't calibrate it, don't buy it. Only Grade A and Grade B monitors are accepted for RESET. Latest RESET standards are here: http://reset.build/resources/RESET_Accredited_Air_Monitor_Requirements

\$100-300 per monitor per year depending on total number of monitors and the sophistication of the software.

- **Hosting and connectivity.** If privacy is a concern, local hosts and networking may be required, but in most cases, monitors simply need to connect to the Internet.

Deployment Tips

Deployment location, choice of communications protocols, power supplies, should be carefully planned to ensure representative data – or data at all – is received for analysis.

1. **Connectivity.** WiFi, while ubiquitous, is least stable, due to the tendency for IT staff to change settings on the network.

2. **How many monitors are needed?** Monitors read only the nearby air quality. Therefore, the appropriate number of monitors depends on how many representative environments are in a space. In a mixed use office environment, the general rule of thumb is about one per 500 sq.m. Building standards and certification programs such as RESET may have their own requirements. Also, sensitive populations may expect monitoring around them. Generally, focus on staff areas.
3. **Location and placement**
 - **Height.** Generally in the breathing zone – 1-2 m high above the floor is ideal.
 - **What to avoid.** Monitors should not be located near windows or areas of outdoor air intrusion, near



Figure 5: Various configurations and deployments of monitors

HVAC supply ducts, or any sources of unusual IAQ pollutants. If possible, a site survey taking handheld readings to check the representativeness of planned monitoring locations should be done ahead of time.

- Tables vs wall mounted. If possible, wall mounted is preferable, as occupants are major sources of IAQ pollution and can particularly impact CO2 and VOC readings. Wall mounts do require some installation (see photos) but also are less likely to be disrupted, unplugged, or moved. For new construction, be aware that newly painted walls can impact TVOC readings.
- Ducts. Generally, we are most interested in measuring the actual ambient air that occupants are breathing. However, if our purpose is to certify the building's own ventilation system, we want to measure the air being supplied by the ducts. The use of a duct box that penetrates the duct as well as secures the monitor, can achieve this.

- Documentation. It is very important to create – and maintain – the location of monitors on a floorplan or BIM (building information management) system plan. Monitors have a way of moving and accountability can be a problem over time, especially with staff turnover.
- 4. **Validation.** Monitors must be checked against reference machines, preferably before deployment and then once again on-site. Documentation should be kept in case of challenge. Outdoor air may be used as a field expedient check for CO2 and TVOC.
- 5. **Signage.** As previously mentioned, occupants may often impact monitoring, either by moving the monitors, unplugging them, breathing on them, doing construction work near them, or even stealing them. Secure them with a Kensington loop-lock or install directly on a wall if possible.

Cloudware and analysis

Sensor data is of little value, especially to non-experts. Today, software is built on

the cloud to provide remote access, be interoperable, create easier interoperability, allow benchmarking and trend analysis, and enable automation. However, privacy issues may impact this decision. Although the focus is currently on air, software platforms are enabling us to increasingly include other environmental parameters, such as light and sound. For instance, real estate service firm JLL is already monitoring indoor air quality and sound in its offices in Mumbai and Bangalore.

Conclusions and takeaways

Continuous air quality monitoring is a critical component of effective IAQ systems, from assessing the baseline condition to optimising settings to maintenance. Much of the lessons, technology, and software that is coming out of China are applicable to India at an even lower price. ■

Louie Cheng
President
PureLiving
Shanghai, China



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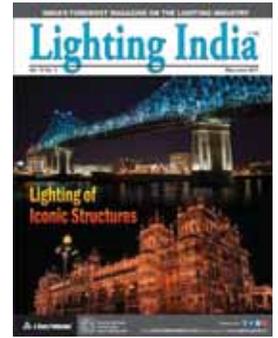
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- TES System : Thermal Energy Storage System
- Sensors & Transducers : HVAC Sensors and Transducers

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Pumping Systems: The company represents Xylem for pumping solutions, which are constantly developing and fielding new HVAC systems that work efficiently, making buildings more comfortable, productive and healthy. It provides energy efficient pumps, boosters, circulators, controls, expansion tanks, air separators and other products and systems for buildings.

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UVGI System: UVGI systems irradiate the AHU coils with UV-C rays, destroying the ability of the organisms to reproduce and multiply, thus, maintaining the indoor air quality of the air-conditioned spaces. It leads to electrical energy savings to the tune of 10 to 15 per cent by improving heat transfer efficiency of AHU cooling coil, which in turn results in reduction of chilled water requirement from the chiller. We represent Aeropure for this system who are a leading manufacturer for UV lamp systems.

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Thermal Energy Storage System: Ensavior has a strategic tie up with FTENE, Korea for Stratified Thermal Energy Storage. It helps lower operational costs by enabling the shifting of energy consumption of chillers from high cost hours to low cost hours by storing cool energy during high cost periods and utilising the stored cool energy during the high cost hours. Further, lower capacity chillers may be used, also the chillers run at optimal capacity, thereby, raising its efficiency level.

Sensors & Transducers: Ensavior have tied up with Greystone Energy Systems Inc., Canada for HVAC Sensors and Transducers for Building Automation Management Systems. Their product range (BMS Field Instrumentation) includes – BACnet Compatible Sensors - Temp, RH, Pressure & CO Sensors; Space & Duct Immersion Temperature Sensors/Transmitters; Space & Duct Humidity/Temperature Sensors; Pressure & Air Flow Sensors.

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1.1 bn people at risk from lack of cooling: Study

Report reveals major risks to vulnerable populations and global economy if investment and greater action not taken on access to sustainable cooling solutions



Photo Credit: www.kollega.se

There are over 1.1 billion people globally face immediate risks from lack of access to cooling, reveals a report titled “Chilling Prospects: Providing Sustainable Cooling for All” published by Sustainable Energy for All (SEforALL).

Cooling underpins the ability of millions to escape poverty, to keep our children healthy, vaccines stable, food nutritious, and our economies productive. Access to cooling is now a fundamental issue of equity, and as temperatures hit record

levels, this could also mean the difference between life or death for some.

These risks are both a development and climate change issue, as they pose challenges for the health, safety, and productivity of populations across the world – especially countries in Asia and Africa where access gaps are the largest. Yet this challenge also offers business and entrepreneurs the opportunity of major new consumer markets which want super-efficient, affordable technologies to meet

their cooling needs.

“In a world facing continuously rising temperatures, access to cooling is not a luxury – it’s essential for everyday life. It guarantees safe cold supply chains for fresh produce, safe storage of life-saving vaccines, and safe work and housing conditions,” said Rachel Kyte, CEO and Special Representative to the United Nations Secretary-General for Sustainable Energy for All.

He added, “This Chilling Prospects

report is a wake-up call. We must meet these needs in an energy efficient way, and without using ozone damaging substances. If not, the risks to life, health and the planet are significant. But there are equally important business opportunities for those that face up to the challenge and act early.”

Closing these cooling access gaps is essential for economic growth and development for many countries, and especially vulnerable populations. Key findings based on an analysis of 52 vulnerable countries in hot climates include:

- 1.1 billion people face cooling access risks, including:
 - 470 million people in poor rural areas without access to safe food and medicines.
 - 630 million people in hotter, poor urban slums with little or no cooling to protect them against extreme heatwaves.
- Nine countries have the biggest populations facing significant cooling access risks. These countries across Asia, Africa and Latin America include: India, Bangladesh, Brazil, Pakistan, Nigeria, Indonesia, China, Mozambique and Sudan.
- 2.3 billion people represent a different kind of cooling risk – a growing middle class, where limited purchasing options mean they may only be able to afford to buy less expensive and less efficient cooling devices, which could spike global energy demand with profound climate impacts.

It is also estimated that cooling is now responsible for about 10 per cent of global warming and growing rapidly. Future choices about refrigerants, the efficiency of cooling technologies, and how cooling is powered will have a significant impact on achieving the Paris Climate Agreement. Previous research indicates that by 2050, work hour losses by country due to excessive heat and lack of access to cooling are expected to be more than 2 per cent and a high as 12 per cent. With the destructive effects of climate change now being widely felt, Chilling Prospects issues an urgent call-to-action and specific recommendations to \ government policy-

makers, business leaders, investors and civil society to increase access to sustainable cooling solutions for all.

Specific report recommendations include:

- Government policymakers should immediately measure gaps in access to cooling in their own countries, as an evidence base for more proactive and integrated policy-making.
- Businesses, governments and finance actors should collaborate to assess and act on the enormous commercial and economic opportunities, including productivity, employment and growth gains from providing sustainable cooling solutions for all.
- Manufacturers, industry associations and lenders should actively engage and cooperate to develop products and financial solutions that meet the needs of those without access to cooling.
- All stakeholders should accelerate their innovation efforts and embrace a paradigm shift - thinking more holistically about the way we provide cooling, focusing firstly on reducing heat loads and then about how to deliver cooling affordably and sustainably.

The report was produced in partnership and supported by the Kigali Cooling Efficiency Program (K-CEP). Charlotte Pera, President & CEO of Climate Works Foundation, said: “Universal access to efficient, clean cooling is a huge prize for people and the planet, and can help achieve the SDGs. The launch of ‘Chilling Prospects’ is a big step toward that prize. Through the Kigali Cooling Efficiency Program, we look forward to supporting this crucial effort in partnership with health communities, businesses, and governments in the developing world. It is only through collaboration—across public, philanthropic, and private sectors—that we will succeed in tackling climate change and creating a prosperous future for all.”

Sustainable Energy for All produced the report as part of the Cooling for All initiative, which developed the report along with contributions from the Global Panel on Access to Cooling. The report draws

attention to the direct intersection between three internationally agreed goals: the Paris Climate Agreement; the Sustainable Development Goals; and the Montreal Protocol’s Kigali Amendment. One of the key goals of the Kigali Amendment is to limit consumption and production of hydrofluorocarbons (HFCs), a potent greenhouse gas used widely in air conditioners and refrigerators.

Kigali Cooling Efficiency Program

The Kigali Cooling Efficiency Program (K-CEP) is a philanthropic program focused on the energy efficiency of cooling to increase and accelerate the climate and development benefits of the Kigali Amendment to the Montreal Protocol to phase down HFCs. Under the amendment, 197 countries committed to cut the production and consumption of hydrofluorocarbons (HFCs) — potent greenhouse gases used in refrigeration and air conditioning — by more than 80 per cent over the next 30 years. This effort has the potential to avoid up to 0.5-degree C of global warming by the end of the century. Increasing efficiency could double the climate benefits.

Montreal Protocol Background

The Montreal Protocol is a multilateral environmental agreement that is successfully preventing massive damage to human health and the environment from excessive ultraviolet radiation from the sun by phasing out the production and consumption of substances that deplete the ozone layer.

On 15 October 2016, in Kigali, the parties to the Montreal Protocol reached agreement at their 28th Meeting to phase down consumption and production of hydrofluorocarbons (HFCs), which are frequently used as substitutes for ozone-depleting substances (ODSs). Although HFCs are not ODSs, they are powerful greenhouse gases that have significant global warming potentials (GWPs). The Kigali Amendment is a binding international agreement, or treaty, which is intended to create rights and obligations in international law.

Cold Storage for Horticulture Produce

A cold chain facility will go a long way in removing the risk of distress sale to ensure better returns on horticulture produce



Photo Credit: www.sinsoonvegetable.com

India is the largest producer of fruits and second largest producer of vegetables in the world. In spite of that per capita availability of fruits and vegetables is quite low because of post-harvest losses which are perceived to be about 25 per cent to 30 per cent of production even though CIPHET study has reported much lower values. Besides, quality of a sizable quantity of produce also deteriorates by the time it reaches the consumer. This is mainly because of perishable nature of the produce which requires a cold chain arrangement to maintain the quality and extend the shelf life if consumption is not meant immediately after harvest. In the absence of a cold storage and related cold chain

facilities, the farmers are being forced to sell their produce immediately after harvest which results in glut situations and low-price realisation. Sometime farmers do not even get their harvesting and transportation costs what to talk of the cost of production or profit. As a result, our production is not getting stabilised and the farmers after burning their fingers in one crop switch over to another crop in the subsequent year and the vicious cycle continues. A cold chain facility accessible to them will go a long way in removing the risk of distress sale to ensure better returns.

Status of Cold storage and its Potential in India

The estimated annual production of

fruits and vegetables in the country has been estimated to be about 295.2 million tonnes (fruits 120.2 million tonnes & vegetables 175 million tonnes) during 2016-17 in comparison to total food grain production of 273.38 million tonnes. Because of imperfect coordination between supply and demand, seasonality and perishable nature of horticulture crops, storage plays an important role in the marketing. A chain of cold storages is set up in different states of our country. The State of Uttar Pradesh (2285) is having highest number of cold storage followed by Gujarat (753) and Punjab (655). Although, there is a vast scope for increasing the production, the lack of cold storage and cold chain facilities is one of

the major bottlenecks in tapping the potential. The cold storage facilities now available are mostly for a single commodity like potato, apple, grapes, pomegranates, flowers, etc. which results in poor capacity utilisation. Almost 75 per cent of the total capacity is used for storing only potatoes, on a rental business model – where the farmers own the produce. A high dynamic business model coupled with use of refined knowledge based cold chain backed by expert business administrative skills is needed for highly perishable horticultural produce handling.

If the consumption level shoots up from the current 100 gm of fruit and 200 gm of vegetables per capita per day to at least the recommended dietary level of 140 gm and 270 gm respectively, the domestic market for fresh fruits and vegetables could be quite large and lucrative. Availability of timely robust post-harvest infrastructure along with marketing system in this sector will certainly improve the socio-economic conditions of Indian citizens by providing self-reliance besides environmental protection. The vast opportunities for investment in fruits and vegetable processing units exist. It is established that fresh agri-produce loss reduction is cheaper than equivalent increase in production so far as economy, energy and impact on environment is concerned. Theoretically, one per cent post-harvest loss reduction of horticulture produce is expected to save Rs 230 crore annually.

Causes of Post-Harvest Losses: Physiological and Biochemical Aspects

The quality of the harvested fruits and vegetables depend on the condition of growth as well as physiological and biochemical changes they undergo after harvest. Fruits and vegetable cells are still alive after harvest and continue their physiological activity. The post-harvest quality and storage life of fruits appear to be controlled by the maturity. If the fruits are harvested at a proper stage of maturity the quality of the fruits is excellent. Poor quality and uneven ripening are due to



Fresh tomatoes for local marketing



Tomatoes exposed to sun after harvesting



Lychee fruit handled under shade



Temporary pack house for fresh kinnow handling

early harvesting and late harvesting which results in extremely poor shelf life.

Respiration plays a very significant role in the post-harvest life of the fruits. In most of the fruits, the rate of respiration increases rapidly with ripening. The sudden upsurge in respiration is called the 'climacteric rise', which is considered to be the turning point in the life of the fruit. After this deterioration of the fruit begin. The fruits such as banana, papaya, mango, guava, jackfruit etc. belong to the category of climacteric fruits. While litchi, pineapple, grapes, pomegranate, lemon, orange, lime, etc. belong to the non-climacteric group. To extend the post-harvest life of the fruits its respiration rate should be reduced as far as possible. Thus, an understanding of the factors, which influence the rate of respiration, is indispensable to post-harvest technologies for manipulating the storage behaviour of fruits.

Poor handling, unsuitable containers, improper packaging and transportation can easily cause bruising, cutting, breaking, impact wounding and other forms of injury.

Parasitic Diseases

High post-harvest losses are caused by the invasion of fungi, bacteria, insects

and other organisms. Microorganisms attack fresh produce easily and spread quickly, because the produce does not have much of a natural defence mechanism and has plenty of nutrients and moisture to support microbial growth. Post-harvest decay control is becoming a more difficult task, because the number of pesticides available is falling rapidly as consumer concern for food safety increases.

Sites of Losses

Losses may occur anywhere from the point where the food has been harvested or gathered up to the point of consumption. For the sake of convenience, the losses can be broken down into the following sub-headings:

- **Harvest:** The separation of the commodity from the plant. In the case of roots, tubers and bulbs the commodity is lifted out of the soil.
- **Preparation:** The preliminary separation or extraction of the edible from the non-edible portion, e.g., the peeling of fruits and vegetables.
- **Preservation** is the prevention of loss and spoilage of foods. For example, the sun drying of fruit, the use of refrigeration and the use of fungicides to inhibit mold growth in fruits.
- **Processing** is the conversion of edible



Forced air precooling facility



Hydro cooling facility

food into another form more acceptable or more convenient to the consumer, for example, the manufacture of fruit juice and the canning of fruits and vegetables.

- **Storage** is the holding of foods until consumption. Most storage is common storage (ambient temperature) but there are extensive storage capacities that can hold food under refrigerated or controlled atmosphere conditions.

Transportation

All forms of transportation are used to transport food from the point of production to the ultimate point of consumption.

To summarise, transport losses are due to the following reasons:

- Unsuitable transport containers;
- Overloading of mixed fruits and vegetables (in some developing countries people and even animals ride on top of the load);
- Irresponsible driving;
- Lack of feeder roads leading to highways or collection centres;
- Rough roads;
- Heat accumulation or very poor ventilation within the transport vehicles;
- Virtual absence of refrigerated and insulated trucks;
- Delays in product procurement after harvesting or at collection centres.

Post-harvest Technologies

Precooling Good temperature management is the most effective way to reduce post-harvest losses and preserve the quality of fruits and vegetables. Products harvested from hot fields often carry field heat and have high rates of

respiration. Rapid removal of field heat by precooling is so effective in quality preservation that this procedure is widely used for highly perishable fruits and vegetables. Currently, used precooling methods include room cooling, forced-air cooling, water cooling, vacuum cooling and package icing.

Forced-air cooling is a more rapid way of using air to cool produce. Cold air is forced to flow through the inside of each container, so that it carries away heat directly from the surface of the produce rather than from the surface of the container. The airflow is produced by creating a pressure difference between the two perforated sides of each container. The containers are stacked inside a covered tunnel with an exhaust fan at one end. Highly perishable and high-value products such as grapes, strawberries and raspberries may be cooled in less than an hour using this method.

Hydro cooling is a rapid and less expensive method. Produce is exposed to cold water by means of showering or dipping. The required cooling time is often

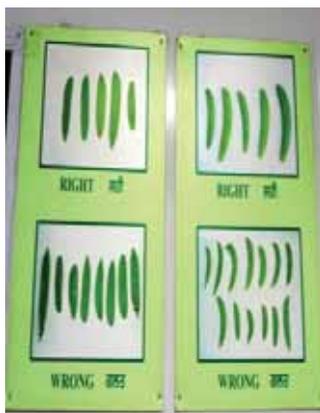
a matter of minutes. However, not all kinds of products tolerate hydro cooling. Hydro cooled products inevitably have a wet surface, which may encourage decay in some kinds of produce.

Sanitation

Sanitation is of great concern to produce handlers, not only to protect produce against post-harvest diseases, but also to protect consumers from food borne illnesses. *E.coli 157:H7*, *Salmonella*, *Chryptosporidium*, *Hepatitis* and *Cyclospora* are among the disease-causing organisms that have been transferred via fresh fruits and vegetables. Use of a disinfectant in wash water can help to prevent both post-harvest diseases and food borne illnesses.

Chlorine in the form of a sodium hypochlorite solution or as a dry powdered calcium hypochlorite can be used in hydro-cooling or wash water as a disinfectant. For the majority of vegetables, chlorine in wash water should be maintained in the range of 75-150 ppm (parts per million). The antimicrobial form, hypochlorous acid, is mostly available in water with a neutral pH (6.5 to 7.5). Organic growers must use chlorine with caution, as it is classified as a restricted material.

Ozonation is another technology that can be used to sanitise produce. A naturally occurring molecule, ozone is a powerful disinfectant. Fruit and vegetable growers have begun using it in dump tanks as well, where it can be thousands of times more effective than chlorine.



Charts at Namdhari Seed packhouse



Vegetables being sorted for size



Grading of baby corn at Pack house



Grading and preparation of broccoli at Packhouse

Ozone not only kills whatever food borne pathogens might be present, it also destroys microbes responsible for spoilage. A basic system consists of an ozone generator, a monitor to gauge and adjust the levels of ozone being produced and a device to dissolve the ozone gas into the water.

Hydrogen peroxide can also be used as a disinfectant. Concentrations of 0.5 per cent or less are effective for inhibiting development of post-harvest decay caused by a number of fungi. Hydrogen peroxide has a low toxicity rating and is generally recognised as having little potential for environmental damage.

Presizing and Storage

For many commodities fruits below a certain size are eliminated manually or mechanically by presizing belt. Undersized fruits are diverted for processing. The sorting process eliminates cull, overripe, misshapen and otherwise defective fruit and separates produce by colour, maturity and ripeness classes.

Grading

Essentially all fruits and vegetables sold in modern markets are graded and sized into two or more grades according to trade standards. Sophisticated marketing systems require precise grading standards for each kind of product. More primitive markets may not use written grade standards, but the products are sorted and sized to some extent.

Typical grading facilities in large packhouses include dumpers and conveyors. Produce is graded by human eyes and hands while moving along conveyor belts or rollers. 'Electric eyes'

are sometimes used to sort produce by colour. In small scale packing operations, one or a few grading tables may be enough. Dumping, conveying and grasping can cause mechanical injury to some products. Equipment should have a smooth, soft surface and dumping and grading operations should be gentle to minimise injuries.

Many products are sized according to their weight. Automated weight sizers of various capacities are used in packhouses. Round or nearly round fruits are often sized according to their diameter, using automated chain or roller sizers or hand carried ring sizers. An inefficient sizing operation can also cause significant injuries.

Waxing

Food grade waxes are commonly applied to replace some of the natural waxes removed in the washing and cleaning operations to reduce water loss and to improve appearance. It also provides protection against decay organisms. Waxing may be done after grading and fungicides may be added to the wax. Application of wax and post-harvest fungicides must be indicated on each container where the refrigerated

storage facilities are not available. Protective skin coating with wax is one of the methods for increasing the storage life of fresh fruits.

Packaging

Packaging of fresh fruits and vegetables has a great significance in reducing the wastage. Packaging provides protection from physical damage during storage, transportation and marketing. There are variety of packages, packaging materials and inserts available. There are two types of packaging. The first is when produce is packed in containers for transportation and wholesale. The second is when produce is packed into small retail units. Ideal containers for packing fruits and vegetables should have the following attributes. They are easy to handle, they provide good protection from mechanical damage, they have adequate ventilation and they are convenient for merchandising. They should also be inexpensive and easily degradable or recyclable. Many kinds of containers have been used but the 'ideal' is yet to be found. Users often put economic considerations first is selecting containers. Fancy containers such as fiber board boxes or wooden or plastic crates are often used for high-value products. Inexpensive containers such as bamboo baskets or nylon net sacs are used for low-priced produce. Methods of packaging can affect the stability of products in the container during shipping and influence how much the container protects their quality. In fiber board boxes, for example, delicate and high-priced products are often packed in trays, while other products are simply put in the box in groups.



Waxing plant for kinnow



Waxing of Kinnow



Shrink packaging of tomato



Packaging of mangoes in CFB box



Modified atmospheric packaging



Smart packaging for fruit

Prepackaging or consumer packaging generally provides additional protection for the products. It is also convenient for retailers as well as customers, and therefore adds value to produce. However, over-use of non-biodegradable plastic trays and wrapping materials, as often seen in modern supermarkets, which creates an extra burden of waste disposal and damages the environment.

Factors Affecting Storage Life

Relative Humidity

Transpiration rates (water loss from produce) are determined by the moisture content of the air, which is usually expressed as relative humidity. At high relative humidity, produce maintains salable weight, appearance, nutritional quality and flavour, while wilting, softening and juiciness are reduced. Leafy vegetables with high surface-to-volume ratios; injured produce and immature fruits and vegetables have higher transpiration rates. High temperatures, low relative humidity and high air velocity increase transpiration rates.

Relative humidity needs to be monitored and controlled in storage. Control can be achieved by a variety of methods:

- Operating a humidifier in the storage area.
- Regulating air movement and ventilation in relation to storage room load.
- Maintaining refrigeration coil temperature within the storage room.
- Using moisture barriers in the insulation of the storage room or transport vehicle.
- Wetting the storage room floor.
- Using crushed ice to pack produce for shipment.
- Sprinkling leafy vegetables, cool-season root vegetables and immature fruits and vegetables with water.

Temperature

Respiration and metabolic rates are directly related to room temperatures within a given range. The higher the rate of respiration, the faster the produce deteriorates. Lower temperatures reduce respiration rates and the ripening and senescence processes, which prolong the storage life of fruits and vegetables. Low temperatures also slow the growth of pathogenic fungi, which cause spoilage of fruits and vegetables in storage.

Producers should give special care and attention to proper storage conditions for produce with high to extremely high

respiration rates, as these crops will deteriorate much more quickly.

It is impossible to make a single recommendation for cool storage of all fruits and vegetables. Climate of the area where the crop originated, the plant part, the season of harvest and crop maturity at harvest are important factors in determining the optimum temperature. A general rule for vegetables is that cool-season crops should be stored at cooler temperatures (0 to 1.7oC) and warm-season crops should be stored at warmer temperatures (7 to 13oC).

Freezing injury

Temperatures that are too low can be just as damaging as those too high. Freezing will occur in all commodities below 0oC. Whether injury occurs depends on the commodity. Some can be repeatedly frozen and thawed without damage, while others are ruined by one freezing.

Injury from freezing temperatures can appear in plant tissues as loss of rigidity, softening and water soaking. Injury can be reduced if the produce is allowed to warm up slowly to optimum storage temperatures and if it is not handled during the thawing period. Injured produce should be marketed immediately, as freezing shortens its storage life.

Chilling injury

Fruits and vegetables that require warmer storage temperatures (4.5 to 13oC) can be damaged if they are subjected to near-freezing temperatures (0oC). Cooler temperatures interfere with normal metabolic processes. Injury symptoms are varied and often do not develop until the produce has been returned to warmer temperatures for several days. Besides physical damage, chilled produce is often more susceptible to disease infection.

Ethylene

Ethylene, a natural hormone produced by some fruits as they ripen, promotes additional ripening of produce exposed to it. The old age saying that one bad apple spoils the whole bushel is true. The damaged or diseased fruits produce high levels of ethylene and stimulate the other apples to ripen too quickly. As the fruits

ripen, they become more susceptible to disease. Ethylene producers should not be stored with fruits, vegetables, or flowers that are sensitive to it. The result could be loss of quality, reduced shelf life and specific symptoms of injury. Ethylene producers include apples, apricots, avocados, ripening bananas, honeydew melons, papayas, peaches, pears, plums and tomatoes.

Storage Facilities

Crops that require different storage conditions will need three different storage facilities.

- Cold Storage (temperatures 0 to 2.2°C)

- Cool Storage (temperatures 4.5 to 13°C)
- Warmer storage (temperatures 13 to 20°C)

A recording thermometer can be helpful in determining whether storage facilities are maintaining ideal conditions and are not fluctuating. A maximum or minimum thermometer could be

substituted. Relative humidity also should be monitored with a hygrometer.

Controlling and monitoring temperature and relative humidity will enable a grower to maintain optimum storage conditions for maximum storage life of the crop and to minimize crop damage from chilling, freezing or high temperature injuries and water loss from the crop. ■

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Siemens software solution helping cities improve air quality



As in most of China's metropolitan centers, Shenyang, the capitol of Liaoning province in the country's northeast, smog is an all-too-common occurrence. Picture Courtesy: Siemens

A new software solution is helping cities remedy the growing problem of air pollution and the associated lack of compliance with emission-control thresholds. Siemens presented City Air Management (CyAM) at the World Cities Summit in Singapore. CyAM is a cloud-based software suite with a dashboard that displays real-time information on the air quality detected by sensors across a city and predicts values for the upcoming three to five days. These air-quality forecasts are prepared with the aid of algorithms that tap into an artificial neural network and draw on historical and current data on air quality as well as weather and traffic patterns. Mayors and other decision-makers can then use this data and a combination of potential solution measures to derive concrete recommendations for action and define measures that help reduce concentrations of nitrogen oxides and atmospheric particulate matter.

CyAM can use the data acquired by sensors to recommend a selection of actions chosen from a set of 17 measures that can be implemented at short notice in order to improve air quality. Examples of such measures include establishing low-emission zones, reducing

speed limits and offering local public transportation services at no charge for a limited period. Cities can subsequently integrate insights gained from these actions into their medium- and long-term strategy planning. CyAM is based on MindSphere, Siemens' Cloud-based, open operating system for the Internet of Things.

Siemens signed a Memorandum of Understanding (MOU) with Sino-Singapore Guangzhou Knowledge City Investment and Development Co., Ltd. (GKC Co) and Ascendas-Singbridge to kick start the CyAM solution, through a joint development of the Green City Digital Platform in Sino-Singapore Guangzhou Knowledge City (SSGKC).

Both GKC Co and Siemens will also be exploring the establishment of The Siemens Green City Digital Exhibition Center in Ascendas OneHub GKC, an integrated business park within SSGKC. The first of its kind in Asia Pacific, the Siemens Green City Digital Exhibition Center will provide real-time air quality monitoring on a short-term and mid to long-term basis, as well as assessment, impact prediction, and recommending of technology measures. ■

Warehouse Cooling Technology

Vertical distribution of air temperature is an important aspect for indoor environment design, which must be taken into account. The aim of study is to analyse the vertical temperature gradients existing in warehouses, quantifying their value and analysing their evolution.



It is well-known fact that the industrial sector consumed around 52 per cent of global delivered energy and its energy consumption grows by an average of 1.5 per cent per year over the projection. The air conditioning of warehouses and cold-storage chambers are an important part of this type of consumption in these industries. In sectors like the agricultural industry, it is necessary to carry out a rigorous control of the air temperature in warehouses, due to the sensitivity of the stored products. It is found that during summer, the ceiling and the upper strata gets warmer, whereas the cold air accumulates in the lower levels, increasing

the stratification of indoor air. During winter, the ceiling gets cold due to its contact with the outdoor air, therefore, the colder, heavier air moves down to the lower strata, registering insignificant vertical temperature differences as shown in Figure 1. Air conditioning of the warehouse, besides controlling the temperature, limits the influence of the outdoor environment on the stratification of temperatures.

Temperature and relative humidity are the most important environmental factors affecting the sensory quality of fresh produce. Inadequate storage conditions may provoke undesired physicochemical changes

and loss of quality in the stored products. In addition, certain humidity and temperature conditions may favour the presence of insect pests which deteriorate or spoil the product. On the other hand, poor indoor environments in industries also lead to substantial costs for health care, administration and lost productivity. Therefore, more research should be directed to these issues in order to innovate new practices and strategies to achieve indoor environments desired in industrial warehouses.

Air Conditioning of Warehouses

Warehouses may generally be operated



Figure 1: Maintaining stable temperature in warehouse during winter.



Figure 2: Block-pallet storage in warehouse.

by the help of different technologies taking into account building characteristics as well as the storage and handling equipment employed that determine storage and space utilisation. The following four most common types of warehouse technology, i.e. a) block-pallet storage as shown in Figure 2 b) wide-aisle racking c) narrow-aisle racking and d) automated storage and retrieval systems. Considering benchmark figures, it becomes obvious that most material handling systems in receiving, storage, order picking and replenishment rely on conventional or conveyor-based operations; automated systems are only used in 5 per cent -9 per cent of all systems. Thus, despite potential process improvements, a future possibility for improving the warehouse performance might also be given by increasing investments in mechanisation and automation that might on the one hand improve throughput while reducing operational expenses but on the other hand influence CO₂ emissions of the warehouse by affecting the overall energy consumption. Warehouse space, thus, seems to be required for dealing with continuously increasing inventories. Due to required energy consumption for lighting

or heating, cooling, ventilation and air conditioning, this directly induces a rise in warehouse-related emissions.

The annual cooling/heating demand as shown in Figure 3 may be derived as the product of heating degree days and thermal losses due to transmission and ventilation less internal heat gains. Heating degree days, defined as the sum of daily temperature difference within a year, for warehouses it varies from a low of 2000K to a high of more than 8000K a year depending on the respective climate zone. Besides, transmission heat losses are determined by the transmission coefficient (U-value) of the building envelope and its total surface.

Conventional warehouses that mainly have low insulated brick, concrete or metal panel walls and metal or synthetic roofs feature an average U-value between 0.25 and 0.30 that might be reduced to less than 0.1 by improving the insulation. Heat losses due to ventilation are determined by the number of air changes per hour that was assumed as 0.6 for the block-place store, 0.4 for the wide-aisle store and 0.3 for the narrow aisle store. The volume of the warehouse and a constant capturing air density and specific heat capacity (note

that density of the air was assumed as 1.2 kg/m³ at 65 degree Fahrenheit whereas specific heat capacity was assumed as 1000 J/kg K). Beside health and safety regulations, which govern the required temperature or the number of air changes, the warehouse climate in many applications has to be controlled for specific products such as fresh, chilled or frozen goods. Thus, the climate factor is influenced by the energy efficiency of the heating and cooling system by building characteristics such as wall and roof insulation as shown in Figure 4, the state and quantity of windows and doors, the outdoor temperature and product requirements. Multiplying this factor with the warehouse size determines the aggregated HVAC energy.

In warehouse, an innovative design has been performed to reclaim the cold energy for a warm weather. Conventionally, this was done by installing vapour compression refrigeration systems, necessitating tremendous electrical power to drive the refrigerant compressor working in low temperature maintenance of warehouse as shown in Figure 5.

From the studies carried out previously by many researchers in the different parts

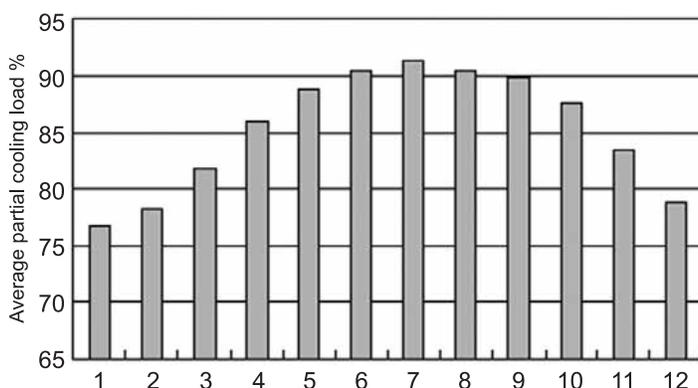


Figure 3: Annual cooling load estimation of the cold warehouse.

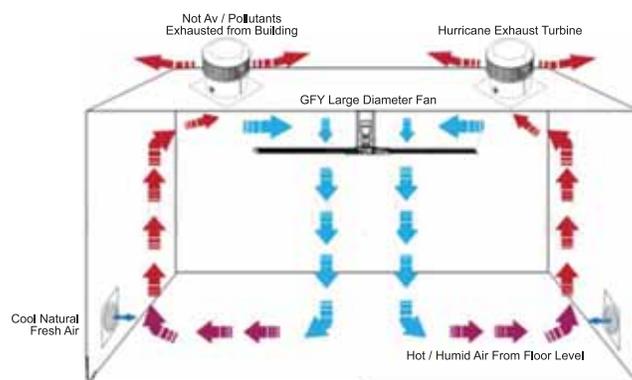


Figure 4: Airflow pattern in warehouse

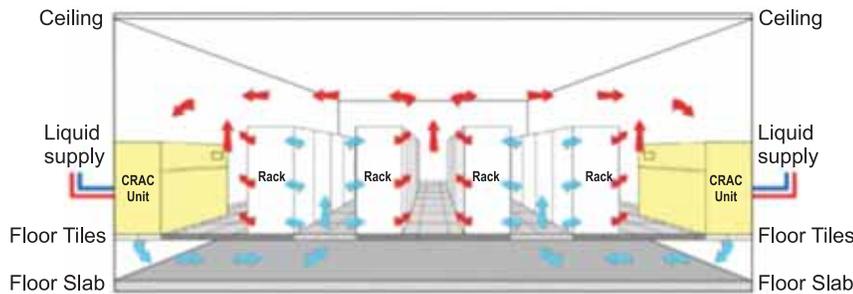


Figure 5: Vapor compression refrigeration cooling in warehouse.

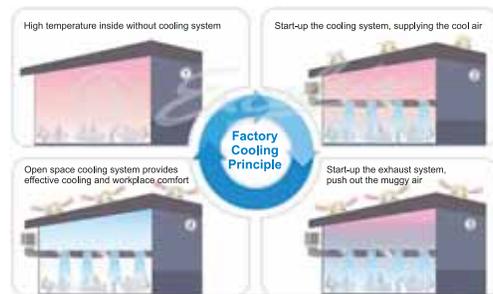


Figure 6: Cooling Principles of Warehouse Air Conditioning.

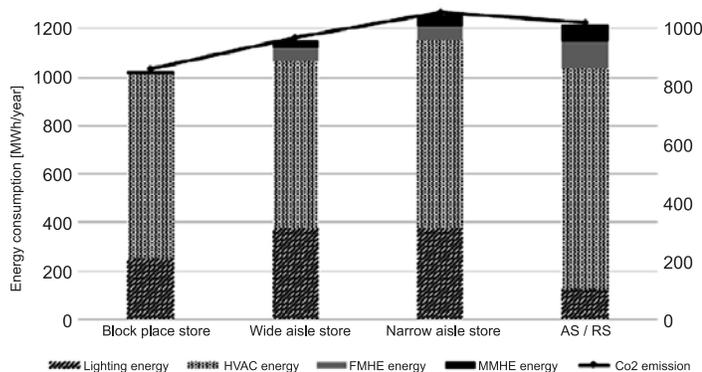


Figure 7: Energy consumptions for different warehouse types.

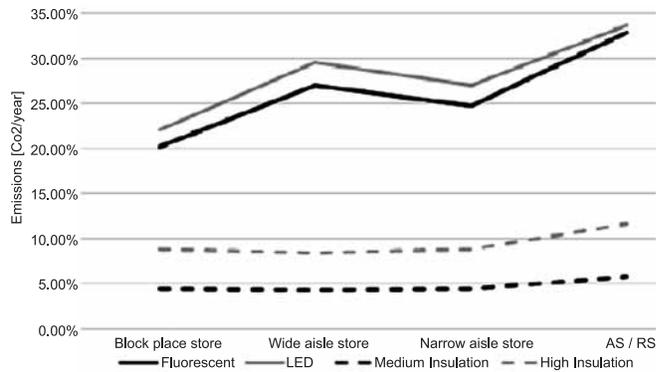


Figure 8: Emissions for different warehouse types.

of the world, it can be concluded that there is a strong influence of the outdoor temperature over the stratification of the air inside all the studied warehouses. The floor temperature increases as the outdoor temperature rises with the biggest vertical differences appearing during the hottest months. On the contrary, the stratification decreases rapidly when the outdoor temperature is low. Figure 6 shows different cooling principles of warehouse air-conditioning.

Comparison among Various Types of Warehouses

As shown in Figure 7, the block-place type warehouse exhibits the lowest consumption whereas narrow-aisle and AS/RS warehouses have the largest energy consumptions. This may be explained by comparing the operational performance and building requirements of the different technologies.

Assuming a given ground floor area,

the more efficient narrow-aisle storage or AS/RS operate a higher amount of goods per year than the block-place or wide-aisle storage. In addition, narrow-aisle storage or AS/RS require considerably larger building heights that lead to increasing building volumes and surfaces which also increase heat losses due to transmission and ventilation.

Considering the different end-use categories, energy consumption for fixed and mobile material handling only accounts for 1.3 per cent in the case of block-place storage, around 8 per cent for the wide and narrow aisle storage and about 15 per cent of total energy consumption for the AS/RS.

Thus, an efficient means of reducing warehouse-related emissions has to take into account energy-efficient lighting and air conditioning systems while minimising heat losses due to transmission and ventilation. Considering the different types of warehouse technologies, changing the

luminaries from standard incandescent lamps to fluorescents or even LEDs might reduce required lighting energy by 80 per cent to 90 per cent which leads to decreasing emissions of between 20 per cent and 34 per cent for the median warehouse. On the other hand, improving building insulation might reduce required HVAC energy by 6 per cent to 15 per cent which leads to a decrease of CO2 emissions by 4 per cent to 12 per cent for the median warehouse. As shown in Figure 8, the block-place type warehouse exhibits the lowest emissions whereas narrow-aisle and AS/RS warehouses have the largest emissions.

Conclusion

The results of the study may be of great use for warehouses for products sensitive to temperature, which may suffer a different evolution, conservation or maturation when the temperature differences are maintained for a long time. ■

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Honeywell delivers voice-directed system for U.S. Defense Logistics Agency warehouses



Honeywell recently announced that the U.S. Defense Logistics Agency has awarded the company an indefinite delivery or indefinite quantity contract to implement its voice-directed system for workers at distribution centers. The program is currently in its initial configuration phase, which involves designing and testing the technology before implementing a pilot.

Upon a successful configuration and acceptance, workers at potentially 24 distribution centers around the world would use the Honeywell Vocollect voice solution to pick orders to support the U.S. military's supply chain and readiness needs. The solution, which enables workers to listen to instructions and speak back responses, helps to simplify the user interface, reduce training times, increase safety and enhance productivity.

The Defense Logistics Agency manages the global supply chain for the U.S. Army, Navy, Air Force, Marine Corps, Coast Guard and other federal agencies. The organisation supplies 86 per cent of the military's spare parts and employs more than 25,000 military and civilian personnel around the world.

"We're honoured to support the Defense Logistics Agency as well as the men and women providing mission critical services to

U.S. defense operations," said Taylor Smith, president of Honeywell's Workflow Solutions business. "We believe this could be the largest government deployment of voice-picking technology globally. This opportunity reinforces our industry-leading position in providing productivity and accuracy gains to distribution centers using our innovative voice technology."

The Honeywell Vocollect voice solution comprises a headset with a software platform that connects to an existing warehouse management system. Warehouse workers receive voice prompts that guide them through their tasks of locating and picking inventory from shelves. Workers use voice commands to interact with the system to streamline and standardise work processes. The system supports more than 30 different languages and replaces the use of paper-based checklists and screen-based mobile applications, which can be prone to human errors.

Distribution centers that deploy Honeywell's voice solutions can also access advanced labour management analytics to better plan and schedule labour with the integration of Vocollect into the company's GoalPost labour management software. The system can extend the productivity gains from the voice technology while increasing overall warehouse labour productivity and efficiency.

Voice-directed solutions have been proven to simplify the worker training process, helping to speed up the onboarding process for temporary or seasonal workers. Warehouse workers will use the system for a range of workflows, including replenishment, picking, inventory and auditing.

Honeywell's Connected Distribution Center offering provides customers with machine-level sensors, smart controllers and connected devices to achieve maximum throughput, day-to-day flexibility, future-proof scalability and business intelligence. Honeywell offers a range of solutions – from worker productivity technology to automated material handling equipment – to both labour-intensive and machine-automated distribution centers. By collecting critical, real-time data on asset health and facility performance, Honeywell helps customers make the digital transformation to increase reliability, improve utilisation and maximise productivity. ■

Energy Conservation in Refrigeration & HVAC System

The article discusses about methods through which energy savings can be achieved. Basic refrigeration process, energy efficient selection of chiller, case study of replacement of existing VAR type Chiller with Centrifugal Chiller and other energy conservation opportunities in refrigeration systems are discussed.



Photo Credit: www.aircoolsys.net

Refrigeration process is used in chilled water, brine for processes, ice plants, air conditioning, humidification – moisture removal etc. A generalised method of refrigeration can be explained in block diagram 1.

Refrigeration systems energy balance follows the following method as shown in diagram 2.

Energy efficient chiller has the requirement of Centrifugal Chiller 300 TR and above and 0.6 ~ 0.65 KW/TR.

Screw chiller has 50-200 TR and 0.7 ~ 1.0 KW/TR.

Reciprocating chiller has 10-50 and TR 1.0~1.2 KW/TR

VAR has 50 TR and above and 2000 ~ 2575 Kcal/HR.

Energy Conservation Opportunities in Refrigeration Systems

- Use water-cooled condensers rather than air-cooled condensers.
- Challenge the need for refrigeration, particularly, for old batch processes.
- Avoid oversizing – match the connected load.
- Consider gas-powered refrigeration equipment to minimize electrical demand charges.
- Use free cooling to allow chiller shutdown in cold weather.
- Use refrigerated water loads in series if possible.

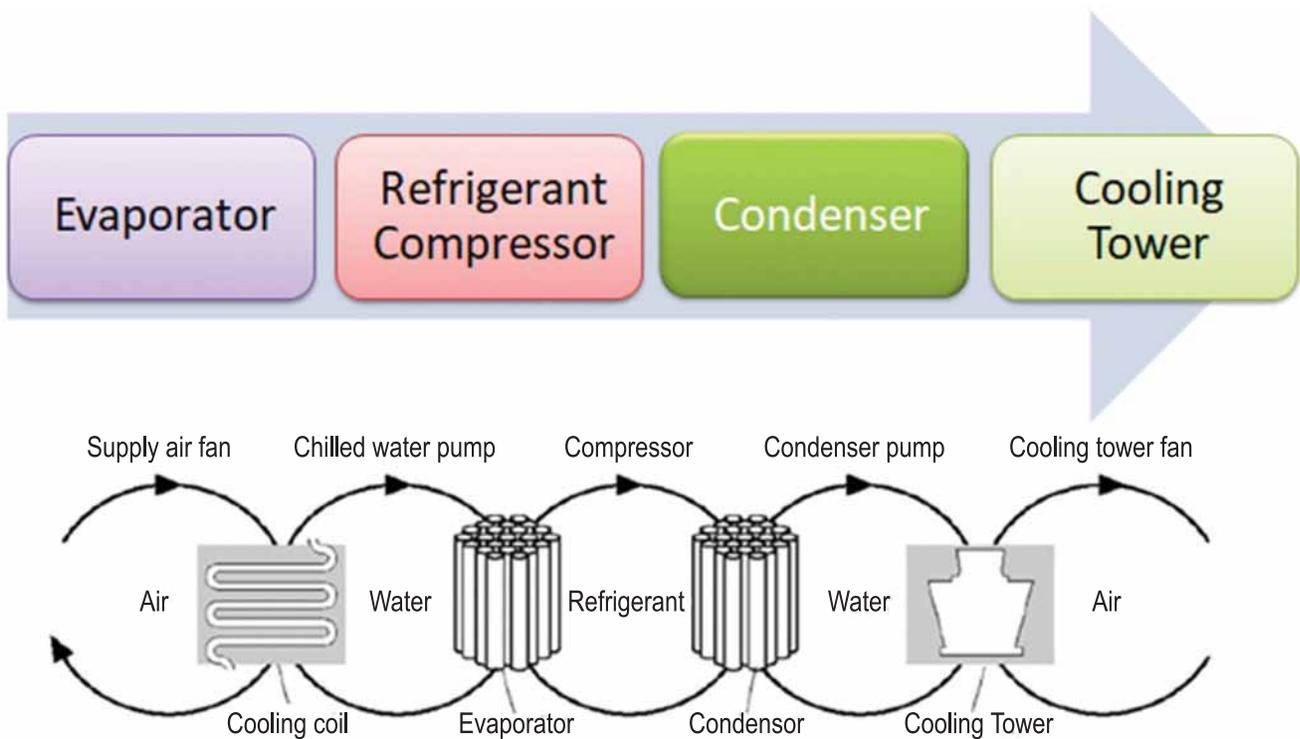


Diagram 1: Method of Refrigeration

- Convert firewater or other tanks to thermal storage.
- Don't assume that the old way is still the best – particularly, for energy-intensive low temperature systems.
- Correct inappropriate brine or glycol concentration that adversely affects heat transfer and/or pumping energy. If it sweats, insulate it, but if it is corroding, replace it first.
- Make adjustments to minimize hot gas bypass operation.
- Inspect moisture/liquid indicators.
- Consider change of refrigerant type if it will improve efficiency.
- Check for correct refrigerant charge level.
- Inspect the purge for air and water leaks.
- Establish a refrigeration efficiency-maintenance program. Start with an energy audit and follow-up, then make a refrigeration efficiency-maintenance program a part of your continuous energy management program.

Refrigeration and chiller systems may be done by proper selection of load (1200 TR or 300 TR) or by RH (10 HR or 14 HR). Optimum set point temperature (Evaporator) is also important. Having optimum or minimum driving force (temperature difference between set temperature of motive fluid (water and refrigerant temperature) help to achieve highest possible suction pressure at compressor which leads to less energy requirements. Other ENCON opportunities in refrigeration systems are such as

1. Optimise process heat exchange
2. Maintain heat exchanger surfaces
3. Multi-staging systems
4. Matching capacity to system load
5. Capacity control of compressors
6. Multi-level refrigeration for plant needs
7. Chilled water storage
8. System design features

Energy Conservation opportunities in Chillers

- Increase the chilled water temperature set point if possible.

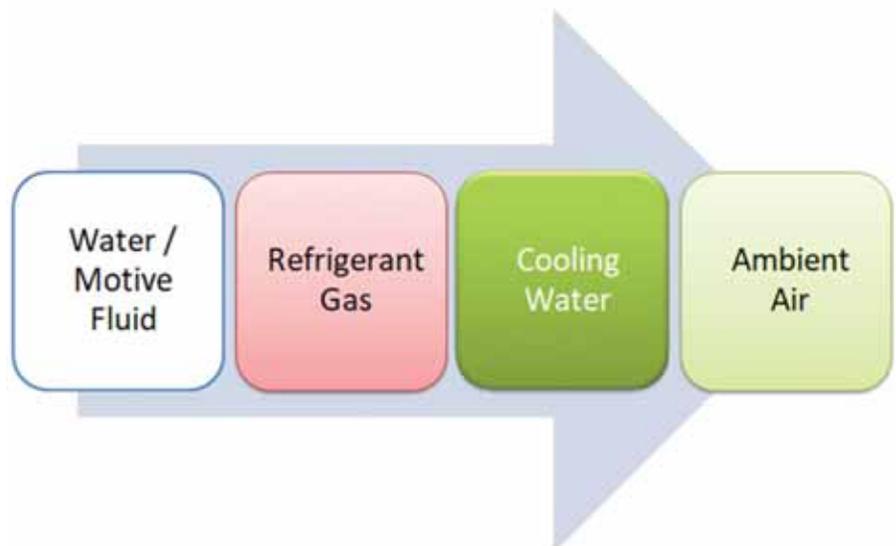


Diagram 2: Refrigeration systems energy balance

Case Study: Replacement of Existing VAR Type Chiller with Centrifugal Chiller

Energy Efficient Capacity Selection of

Case Study: Replacement of Existing VAR Type Chiller with Centrifugal Chiller

Type of System	Vapour Absorption Chiller	Centrifugal Chiller
Capacity	1000 TR (500 TR x 02 Nos.)	1000 TR (500 TR x 02 Nos)
Input Energy	Heat (Steam)	Power
Specific Consumption	4.33 Kg of Steam / TR	0.65 KW / TR
Total Consumption	4333 Kg / hour	650 KW / hour
Fuel Consumption (Furnace Oil @ 12.5 Evaporation ratio)	345 Kg / hour	-
Rate of Input Energy	Rs. 40,00 per kg	Rs. 7.00 per KWh
Cost of Input Energy	13800/-	4550/-
Savings in Operating Cost	9250 Rs. / Hour	
% Reduction in Operating Cost	67%	

- Use the lowest temperature condenser water available that the chiller can handle. (Reducing condensing temperature by 5.5 OC, results in a 20 – 25 per cent decrease in compressor power consumption)
- Increase the evaporator temperature (5.50C increase in evaporator temperature reduces compressor power consumption by 20 – 25 per cent)
- Clean heat exchangers when fouled. (1 mm scale build-up on condenser tubes can increase energy consumption by 40 per cent)
- Optimise condenser water flow rate and refrigerated water flow rate.
- Replace old chillers or compressors with new higher-efficiency models.
- Use water-cooled rather than air-cooled chiller condensers.
- Use energy-efficient motors for continuous or near-continuous operation.
- Specify appropriate fouling factors for condensers.
- Do not overcharge oil.
- Install a control system to coordinate multiple chillers.
- Study part-load characteristics and cycling costs to determine the most-efficient mode for operating multiple chillers.
- Run the chillers with the lowest energy consumption. It saves energy cost, fuels a base load.
- Avoid oversizing – match the connected load.
- Isolate off-line chillers and cooling

towers.

- Establish a chiller efficiency-maintenance program. Start with an energy audit and follow-up, then make a chiller efficiency-maintenance program a part of your continuous energy management program.

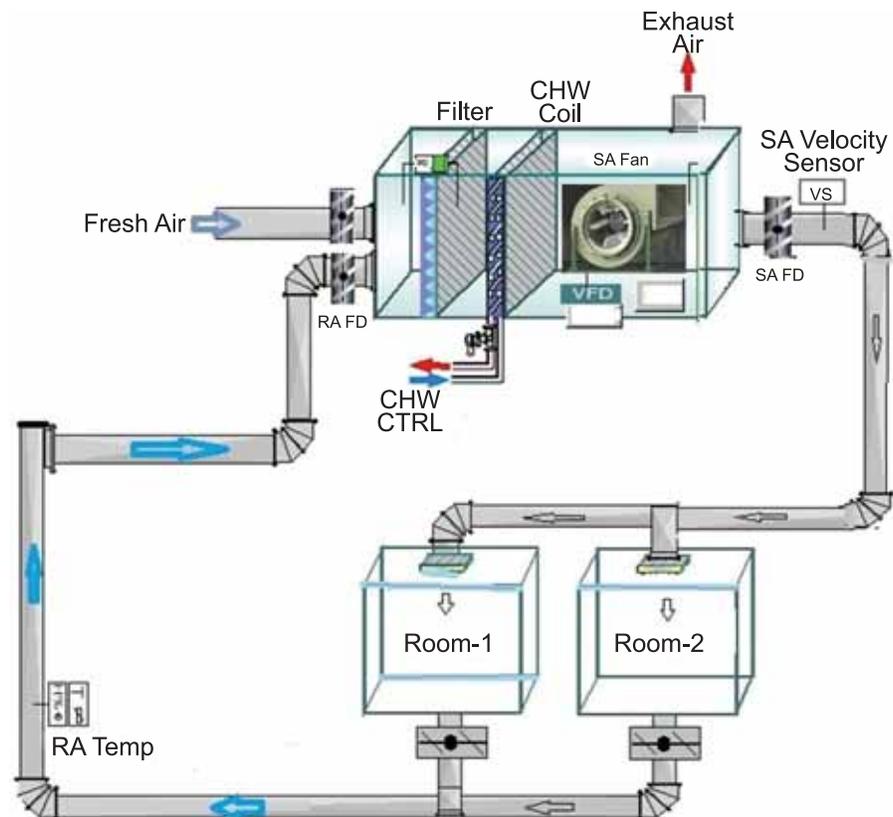
HVAC Systems

HVAC System consists of a chain of components designed to cool or heat, ventilate a specific area while maintaining

a defined environmental cleanliness level. Purpose of HVAC system is to To Control/ Maintain Temperature - Heating, To Purify the Air – Ventilation and To Control/Maintain Humidity - Air Conditioning.

Energy Conservation Opportunities in HVAC Systems

- Optimum Design (Heat Load and Air Flow Requirements)
- Monitoring & Control
- Automation
- Effective Preventive Maintenance
- Minimisation of Heat Energy Losses
- Minimisation of Leakage Losses
- Energy Efficient HVAC Components
- Waste Heat Recovery
- Tune up the HVAC control system.
- Consider installing a building automation system (BAS) or energy management system (EMS) or restoring an out-of-service one.
- Balance the system to minimise flows and reduce blower or fan or pump power requirements.
- Eliminate or reduce reheat whenever possible.



A general lay out of HVAC system



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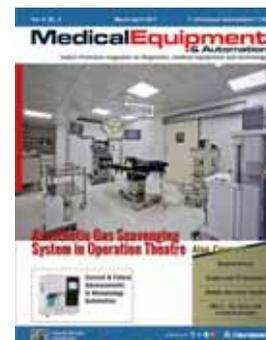


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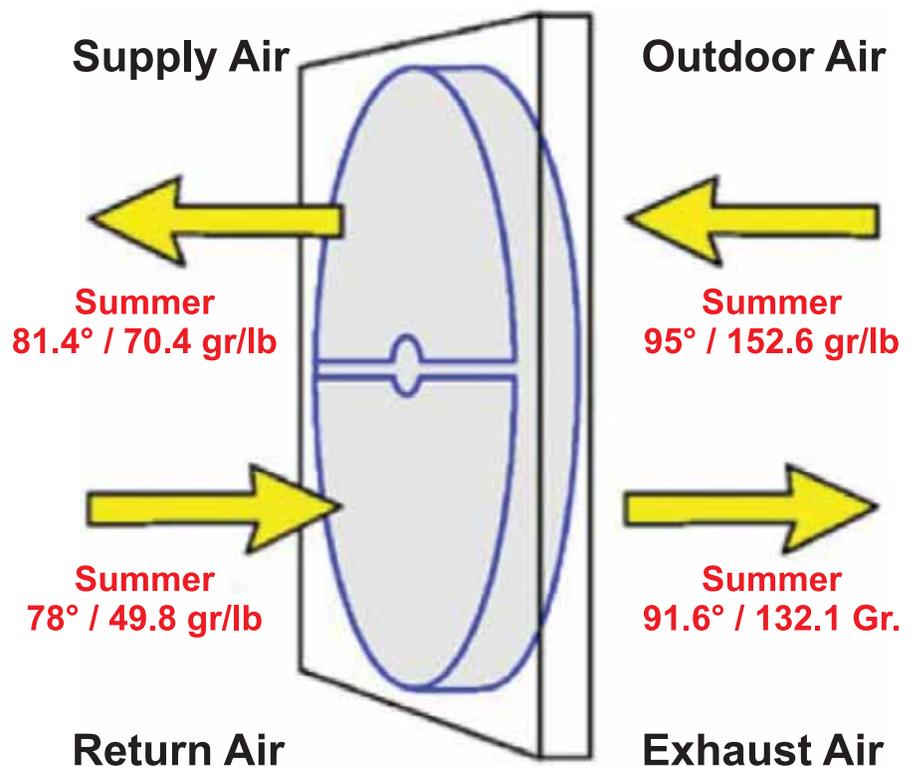
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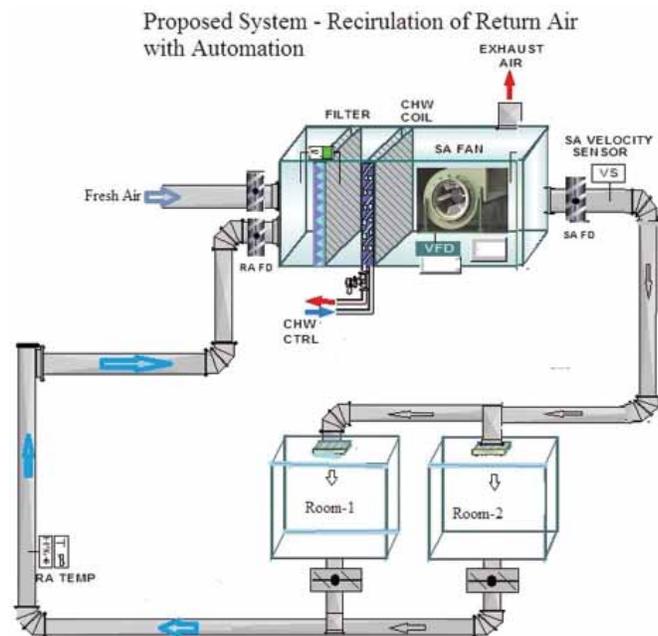
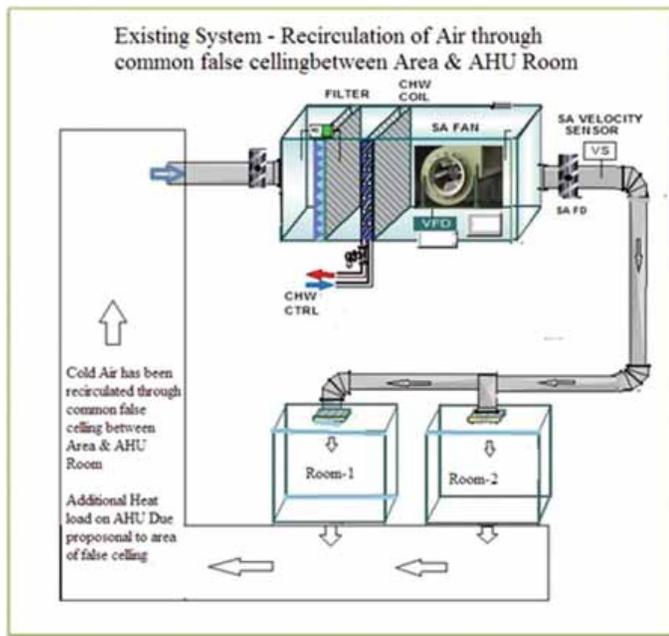
System	AHU with 100% Fresh Air requirements
Capacity	10000 CFM / 25 TR
Ambient Air Temperature	35°C
Room Temperature Requirement	25°C
Exhaust Air Requirement	27°C
Reduction in Fresh Air Temperature by heat transfer between exhaust air & fresh air	30 – 32 °C
% Reduction in Heat Load by Utilization of heat in Exhaust Air	8.5% - 10 %

- Use appropriate HVAC thermostat setback.
- Use morning pre-cooling in summer and pre-heating in winter (i.e. – before electrical peak hours).
- Use building thermal lag to minimise HVAC equipment operating time.
- In winter during unoccupied periods, allow temperatures to fall as low as possible without freezing water lines or damaging stored materials.
- In summer during unoccupied periods, allow temperatures to rise as high as possible without damaging stored materials.
- Improve control and utilisation of outside air.
- Use air-to-air heat exchangers to reduce energy requirements for heating and cooling of outside air.
- Reduce HVAC system operating hours (e.g. – night, weekend).
- Optimize ventilation.
- Ventilate only when necessary. To allow some areas to be shut down when unoccupied, install dedicated HVAC systems on continuous loads (e.g. – computer rooms).
- Provide dedicated outside air supply to kitchens, cleaning rooms, combustion equipment, etc to avoid excessive exhausting of conditioned air.
- Use evaporative cooling in dry climates.
- Reduce humidification or dehumidification during unoccupied periods.
- Establish an HVAC efficiency-maintenance program. Start with an energy audit and follow-up, then make an HVAC efficiency-maintenance program a part of your continuous energy management program.
- Use atomisation rather than steam for

- humidification where possible.
- Clean HVAC unit coils periodically and comb mashed fins.
- Upgrade filter banks to reduce pressure drop and thus lower fan power requirements.
- Check HVAC filters on a schedule (at least monthly) and clean/change if appropriate.
- Check pneumatic controls air compressors for proper operation, cycling, and maintenance.
- Isolate air-conditioned loading dock areas and cool storage areas using high-speed doors or clear PVC strip curtains.
- Install ceiling fans to minimise thermal stratification in high-bay areas.
- Relocate air diffusers to optimum heights in areas with high ceilings.

- Consider reducing ceiling heights.
- Eliminate obstructions in front of radiators, baseboard heaters, etc.
- Check reflectors on infrared heaters for cleanliness and proper beam direction.
- Use professionally-designed industrial ventilation hoods for dust and vapor control.
- Use local infrared heat for personnel rather than heating the entire area.
- Use spot cooling and heating (e.g. -- use ceiling fans for personnel rather than cooling the entire area).
- Purchase only high-efficiency models for HVAC window units.
- Put HVAC window units on timer control.
- Don't oversize cooling units. (Oversized units will short cycle which results in poor humidity control.)
- Install multi-fueling capability and run with the cheapest fuel available at the time.
- Consider dedicated make-up air for exhaust hoods. (Why exhaust the air conditioning or heat if you don't need to?)
- Minimise HVAC fan speeds.
- Consider desiccant drying of outside air to reduce cooling requirements in





Figures of Waste heat recovery and saving energy.

- humid climates.
- Consider ground source heat pumps.
- Seal leaky HVAC ductwork.
- Seal all leaks around coils.
- Repair loose or damaged flexible connections (including those under air handling units).
- Eliminate simultaneous heating and cooling during seasonal transition periods.
- Zone HVAC air and water systems to minimize energy use.
- Inspect, clean, lubricate, and adjust damper blades and linkages

Energy Efficient System Design & Selection

The greatest opportunities for energy

efficiency exist at the design stage for HVAC system. HVAC Design should not be tailor made as its operating cost and performance in totally depended on local environmental condition, optimum capacity by considering season variation as well as energy efficiency is the most important part of any pharmaceutical HVAC systems.

Energy Monitoring & Control System

An energy monitoring and control system supports the operation of HVAC system by monitoring, controlling and tracking system energy consumption. Such system continuously manages and optimises HVAC System energy

consumption while also providing valuable tool for tracking energy consumption and identifying potential technical problem in HVAC system.

Example: For monitoring and control of HVAC, BMS System should be preferred along with configuration of current or power measurement HVAC System also for maintaining room pressure motorised damper should be installed to maintain the required parameter with energy efficiency.

Automation and Loss Minimisation

Installation of VFDs for Air Blower Modulation accordingly air flow requirements will reduce energy consumption at part load operations.

Installation of 2-way or 3-way valves will modulate chilled water flow as per indoor environmental condition which reduce load on chiller.

Heat energy losses from leakages through door and windows lead to lowering energy efficiency in HVAC systems.

Example:

- Door Size: 1800 x 1500 (Area = 2.7 sqm),
- Air Velocity: 0.25 – 0.3 m/s, Air Losses = 715 CFM
- If door remains open for 5 sec, Air losses = 60 CFM
- Equivalent Power = 0.08 KWh,

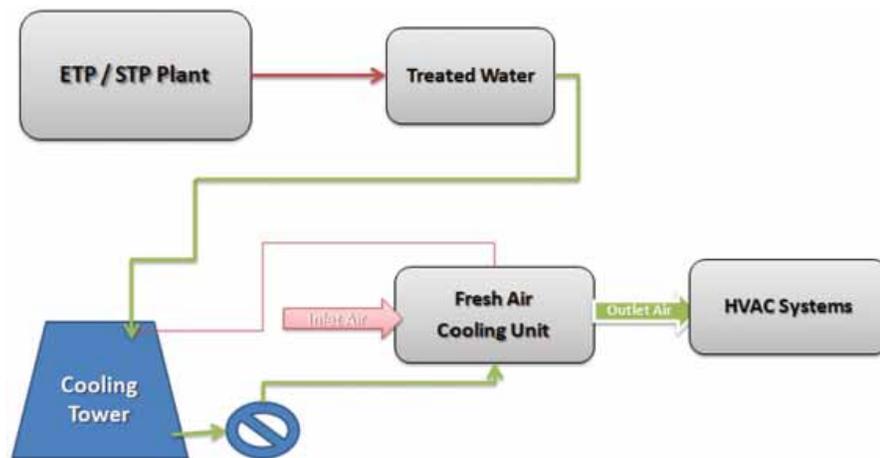


Figure of Case Study: Evaporative Cooling System

- Door Open Frequency = 50 -70 Times / Shift
- Equivalent Power = 4 KWh/Shift

Case Study: Waste Heat Recovery

Utilisation of heat energy available in exhaust air by reducing fresh air temperature through heat transfer between fresh air and exhaust air.

- If existing return air is through common false ceiling area between AHU room and conditioned area, additional load (of above false ceiling area) approximately 15 to 18 per cent has been added in actual requirement of HVAC System.
- Appropriate size of return air duct required which is to be connected with AHU inlet with provision of fresh air duct with damper on both return air as well as fresh air duct.
- Fresh air damper and return air damper open or close position to be set accordingly temperature of return air

temperature and fresh air temperature.

- Lower temperature air intake rate to be increased by setting damper accordingly
- Provision of return duct in place of return through false ceiling for recirculation Type HVAC System.

Case Study: Evaporative Cooling System

Objective

- Utilisation of ETP/ STP treated water to maintain zero discharge condition and simultaneously utilisation of treated water for fresh air cooling media.

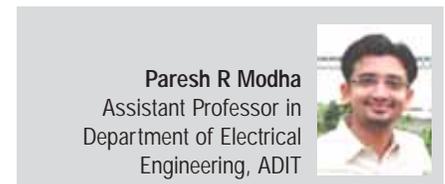
Principal of Operation

- After being cooled by Cooling Tower Treated Water has been recirculated in fresh air cooling unit to reduce the Inlet Air Temperature (Ambient).
- Air Cooled by Fresh Air Cooling System has been supplied to main HVAC Systems instead of taking fresh air directly at ambient temperature HVAC System have inlet air with reduced temperature than ambient air which in

turns reduction of reduction of heat load on chilled water cooling coil, ultimately, saving in power consumption of chilling plant.

Conclusion

In this article, author has tried to explain the methods of energy conservation and saving energy and at this era, the labour cost, material cost and transportation cost is increasing much in India and worldwide. So, it is important that by doing proper energy conservation and audit, industry can enhance its profit margin. These case studies and simplified block diagram can be useful for understanding chiller, refrigeration and HVACR systems. ■



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Mitsubishi Electric Trane HVAC US Announces Updates to Residential Business Leadership Team

Mitsubishi Electric Trane HVAC US LLC (METUS), a leading supplier of Zoned Comfort Solutions and Variable Refrigerant Flow (VRF) cooling and heating systems, announces two changes to its sales leadership team. Tim Burnette has been appointed as Vice President of residential business and Steve Scarbrough has been promoted to senior director of residential business.

As Vice President, Tim Burnette will lead residential business activities nationwide, developing and implementing strategies for sales and profit growth. He will lead the strategic accounts and utilities and performance construction teams, and direct product management for the M-Series and P-Series product lines. Burnette will also oversee the integration and management of co-branded residential ductless sales activities through the Ingersoll Rand channels. "Tim will play a vital role in the continued success of our residential channel," said Steve O'Brien, senior vice president at Mitsubishi Electric Trane HVAC US. "He will be integral in supporting our residential ductless customers through changes resulting from the formation of our recently announced joint venture. We believe his strong experience and background in previous leadership roles will be a great asset in his new position."

Previously, Burnette led the industrial and controls business units at NIBCO Inc., and held sales and marketing leadership

positions with Parker Hannifin, Pentair and Victaulic. He holds an MBA from Notre Dame University.

In his new role, Steve Scarbrough will lead the South, Southwest, and Central residential business units. He will also oversee HVAC contractor development and training activities, as well as lead the inside sales team. In addition, he will serve as the main liaison to the Trane Dealer Sales Office channel, which has a concentrated presence within the regions he will lead.

Scarbrough joined Mitsubishi Electric in 2010 and has held a variety of roles of increasing responsibility within the company. Most recently, Scarbrough was director of contractor development and training, and spearheaded significant improvements to the Diamond Contractor program and residential training activities. Prior to his tenure at Mitsubishi Electric, Scarbrough served as president of Climatic Comfort Products.

"Steve brings a wealth of knowledge to this new role, both about industry demands and trends, and about Mitsubishi Electric practices and products," said O'Brien. "We are pleased to announce this well-deserved promotion and are confident that Steve will contribute to more success stories and better sales numbers for our residential business."

Burnette and Scarbrough will both be based in Suwanee, Georgia. ■

How Can We Breathe Better?

The article focuses on strategies to enhance indoor air quality



Photo Credit: www.ragnair.com

Indoor air pollutants have been ranked among the top five environmental risks to public health. Stagnant indoor environments allow pollutants to build up and stick around in greater amounts than we humans should be breathing in. Thereby, in continuation with the last article where we discussed about basic concept about Indoor Air Quality (IAQ) and various types of indoor air pollutants; this article is focused on strategies to enhance indoor air quality.

Even though the factors that affect quality of indoor environment are numerous, the good news is that most indoor environmental problems can be prevented or corrected. Achieving better IAQ in buildings requires proper application of science and technology. It calls for an optimum combination of proper buildings materials, effective ventilation systems design and indoor pollutant control

mechanism. Some broad guidelines for better IAQ are briefly described below.

Materials Selection

Selection and use of low-emitting, non-toxic materials to construct and furnish the buildings is one of the key elements to meet a goal for good air quality. The evaluation process for materials calls for understanding the emission potential of each product under consideration. Several categories are considered in a standard testing procedure, including amount of particulates, total volatile organic compounds (TVOCs), and formaldehydes. Materials and products that are third-party certified for conformance with accepted IAQ standards are the most recommended. Examples of IAQ third-party Certification Programs include certified laboratories.

Whether or not a product is certified by

a third party, the designer can receive copies of the Technical Data Sheet and the Material Safety Data Sheet (MSDS) associated with each product from the product manufacturer. These resources provide a bank of information on a product, including hazardous ingredients, toxicological properties, other potential product hazards and safe working procedures.

Product or technical data sheets are often the best sources for finding the VOC content of a material, which is key to IAQ considerations. This information is given in grams per liter (g/L) or in pounds per gallon (lbs/G), and most standards list the permissible VOC content in g/L.

A hazardous chemical component measured as less than one per cent of the material's content does not have to be listed on the MSDS; however, if it is an OSHA-identified carcinogen, then limit

Common Building Materials with Potential IAQ Impact

Material	Associated IAQ Issue
Wood & Plastics, Prefabricated Carpentry, Plastic laminate	Potential for high VOC emissions
Thermal and moisture protection sealants	Potential for high VOC emissions
Doors and windows, flush wood doors	Potential for high VOC emissions
Furnishings	Potential for high VOC emissions
Acoustical Panel Ceilings	Potential for VOC emissions or VOC sink effect
Wood Flooring	Potential for high VOC emissions
Resilient Flooring	Potential for high VOC emissions
Carpets	Potential for VOC emissions or VOC sink effect
Wall coverings	Potential for creating conditions for mold growth and high emitting VOCs
Fabric Wrapped Panels	Potential for acting as VOC sink
Paints	Potential for high VOC emissions. Paint products contain a wide variety of VOCs, many of which are known to be harmful to human health and many of which persist in indoor air for months after application of paint.

drops to 0.1 per cent.

General Principles of Materials Selection

- Avoid materials with high emissions rates.
- Eliminate specification of materials that contain known carcinogens and toxins.

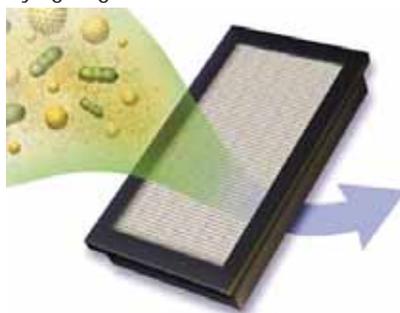


- Take special care in selecting materials that will be used in large quantities.
- Check for high VOC levels in materials associated with 'wet' processes, including paints and coatings, adhesives, sealants, sealers, caulks, etc.
- Specify materials that can be installed with nails, screws, mechanical fasteners instead of adhesives.
- Specify durable products that are easy to maintain without the use of toxic solvents or cleaners.
- Applications like flooring and furniture often use manufactured or composite wood products, such as plywood, particleboard or chipboard. Use only composite wood products made without urea-formaldehyde resin, which off-gasses formaldehyde at room temperature.

- Avoid the 'VOC sink effect,' in which porous materials with large surface areas such as carpets and upholstery, adsorb VOCs and release them over a long period of time, thereby, becoming another VOC source. One way to minimise this problem is to install porous materials only after wet-applied finishes have cured.

Ventilation Systems

Traditional way to improve poor IAQ is to increase ventilation to purge the contaminants. This works well for volatile organic chemicals and bio-effluents like CO₂ and odours. But what do you do when the outside air quality is worse than the inside air? In these cases, the pollution is coming indoors from outside, as opposed to the traditional indoor air quality problem of pollution being inside and trying to get it out.



Ventilation systems involve introducing exterior air into an interior space while exhausting stale interior air to the outside. Thereby, mechanical system with adequate ventilation rates and efficient air-filtration is

one of the key strategies for better IAQ. In case of a centralised air-conditioning system, this can be done at fresh air units and/or air handling units. Whereas, in case of spaces with unitary air-conditioning systems, air purification units or air purifiers will be the available choice.

Indoor Plants

All plants release oxygen through photosynthesis, but some special species may have built-in air-filtering systems, too. In 1989, NASA discovered that several common houseplants may actually remove carcinogenic chemicals like benzene and formaldehyde from the air especially in enclosed spaces with little air flow. This study has been the basis for newer studies about indoor plants and their air cleaning abilities. While plants have less horsepower than air purifiers, they're more natural, cost effective, and therapeutic.

Plants are also known to:

- Increase mood and productivity
 - Enhance concentration and memory
 - Reduce stress and fatigue.
- NASA recommends two or three plants in 8 to 10-inch pots for every 100 square feet. Some plants are better at removing certain chemicals than others. Household chemicals come from objects and materials like:
- Carpets
 - Glues
 - Ovens
 - Cleaning solutions

Table below provides the list of commonly used indoor plants along with their respective benefits:

Botanical Name	Common Name	Benefits
Dypsis lutescens	Bamboo palm/ Areca palm	<ul style="list-style-type: none"> • Cleans air borne toxins • Removes formaldehydes, benzene, trichloroethylene
Raphis excelsa	Lady Palm	<ul style="list-style-type: none"> • Improves Indoor air Quality • Resistant to pathogens
Ficus elastica	Rubber Plant	<ul style="list-style-type: none"> • Emits high oxygen • Removes formaldehydes, benzene, trichloroethylene
Spathiphyllum wallisii	Peace Lily	<ul style="list-style-type: none"> • Removes air pollutants • Removes formaldehydes, benzene, trichloroethylene • Removes household chemicals & carcinogens
Ficus Alii	Ficus A1 Gold	<ul style="list-style-type: none"> • Overall air purifier • Resistance to insects
Philodendron oxycardium	Heart leaf philodendron	<ul style="list-style-type: none"> • Removes all kinds of VOCs, particularly from particle board.
Epiremnum aureum	Money Plant	<ul style="list-style-type: none"> • Removes formaldehydes, benzene, benzene
Aloe barbadensis	Aloe Vera	<ul style="list-style-type: none"> • Sun loving succulent helps clear formaldehyde & benzene
Dracaena Marginata	Dragon Tree	<ul style="list-style-type: none"> • Reduces benzene, formaldehyde, xylene and toluene from air
Ficus benjamina	Weeping fig	<ul style="list-style-type: none"> • Filters pullutants from carpeting, furniture

(Source: IGBC Green Interior Rating System)

- Synthetic materials such as plastic, fiber, and rubber.

Most benefit is achieved by including a variety of plants in a particular room.

The champion plants in removing benzene are ivy, gerbera daisies, pot mums, peace lily, bamboo palm, and Mother-in-law's Tongue.

Trichloroethylene (TCE) is largely employed in the metal degreasing and dry-cleaning industries, printing inks, paints, lacquers, varnishes, and adhesives. The best TCE removers are:

- Peace lily (for TCE from cleaning products)
- Dracaena (TCE from adhesives, ink, dyes, lacquers, paints and varnishes)
- Gerbera daisy (TCE from adhesives)
- Bamboo palm.

During Construction

The indoor air in buildings and homes can be compromised by construction activities even before occupants move into a space. In both residential and commercial sustainable projects, a 'Construction IAQ Management Plan' should be prepared by the contractor and approved by the client or designer prior to commencement of the work. IAQ strategies should then be

implemented during interior construction works to avoid health issues for workers (during construction phase) and occupants (during occupancy phase).

During Operations

Both workers and management can take steps to help maintain good indoor air quality. For employees, EPA recommends the following:

- Refrain from blocking air vents, as doing so can unbalance your office's HVAC system and affect the ventilation of neighboring offices.
- Comply with your building's smoking policy and smoke only in designated areas.
- Clean up spills immediately and report any water leaks to management to avoid the possibility of mold growth.
- Dispose of all garbage promptly in the proper receptacle.
- Store food properly. Do not leave food in your desks or on shelves.

Contact building management if you suspect an IAQ problem.

EPA's tips for employers include:

- Maintain a good working relationship with building management regarding IAQ issues.

- Regularly check your building's HVAC system to ensure it's in good working order, and coordinate with building management when responsibility for design, operation and maintenance of the ventilation system is shared, EPA states.

- Create a policy that protects non-smokers from secondhand smoke exposure.
- Refrain from using products that can cause IAQ problems.
- Use pest control products only when necessary, and non-chemical methods if possible.

While above strategies can be a good start, there can be several other more elaborated strategies applicable to different type of buildings or applications. As experienced in such IAQ projects, a thoughtful and integrated design approach is required to be applied in a building design to achieve enhanced IAQ. ■



Ashish K Jain
Partner – AEON Integrated
Building Design Consultants

List of Approved Cold Chain Projects in Maharashtra

S. No.	Project	Sector	District	Project cost (Rs. In Cr)	Approved mount (Rs. In Cr)	Amount of grant released (Rs. In Cr)
Maharashtra Total 53, completed 28, ongoing 25						
1	Freshrop Fruits Ltd.	F&V	Nashik	32.75	8.47	8.47
2	I.G. International	F&V	Chennai, Amravati	22.25	8.96	8.96
3	Saastha Warehousing Ltd	F&V	Raigad	42.81	9.21	9.21
4	Savla Foods & Cold Storage Pvt Ltd	F&V	Mumbai	27.00	7.20	7.20
5	Warana Dairy & Agro Industries Ltd,	Dairy	Sholapur	43.31	9.15	9.15
6	Blue Fin Frozen Pvt. Ltd.	Fishery	Raigad	25.46	6.16	6.16
7	B. Y. Agro & Infra Pvt. Ltd.	Mixed (Dairy, F&V)	Nagpur	34.94	7.25	7.25
8	Western Hill Foods Ltd	F&V	Pune	20.96	7.42	7.42
9	Haldiram Foods Intl. Limited	F&V	Nagpur	28.00	6.11	6.11
10	Cold Star Logistics Pvt. Ltd.	F&V	Raigad	23.26	9.24	9.24
11	Baramati Agro Limited	Meat & Poultry	Pune	9.11	3.89	3.89
12	Elaf Cold Storage	Mixed (Meat, F&V)	Raigad	17.56	7.16	7.16
13	Indapur Dairy & Milk Products Ltd	Dairy	Pune	16.03	7.07	7.07
14	Mhetre Foods Pvt. Ltd	F&V	Pune	12.51	4.78	4.78
15	Omni Fresh Agro	F&V	Nashik	19.63	5.65	5.65
16	Saikrupa Industries	Dairy	Nashik	5.44	2.06	2.06
17	Satec Envir Engineering (I) Pvt. Ltd	F&V	Nashik	22.62	7.41	5.47
18	Shivirth Dairy & Agro Producers Company Ltd	Dairy	Sangli	8.20	2.45	2.45
19	Sunfresh Agro Industries Pvt. Ltd	Dairy	Ahmednagar	46.18	9.55	9.55
20	Tirupati Balaji Agro Products Pvt. Ltd.	F&V	Pune	50.41	7.66	7.66
21	D.J. Exports Pvt.Ltd.	F&V	Thane, Pune	18.31	5.19	5.19
22	Forstar Frozen Food Pvt. Ltd.	Fishery	Navi Mumbai	36.68	10.00	10.00
23	Global Foods	Pulses, F&V, Spices	Nagpur	24.28	9.55	9.55
24	VaishVik Foods Pvt.Ltd.	F&V	Satara	26.53	9.85	7.39
25	Swaraj India Industries Ltd.	Dairy	Satara	26.21	8.46	8.46
26	Gonglu Agro Pvt Ltd	F&V	Nashik	20.47	7.69	7.69
27	Western Superfresh Corporation	Meat, Poultry & Dairy	Raigad	38.70	8.46	8.46
28	Rishi Ice and Cold Storage Pvt. Ltd.	F&V	Navi Mumbai	24.87	7.85	7.846
29	Farmico Cold Storage Pvt. Ltd.	F&V	Nagpur	31.29	7.83	
30	Ananth Dudh Pvt Ltd	Dairy	Pune	27.41	7.25	
31	Prabhat Dairy Ltd	Dairy	Srirampur	26.48	9.96	6.47
32	P.D. Shah and Sons Cold Storage Pvt. Ltd.	F&V	Satara	22.79	4.88	
33	Manganga Dairy Industries	Dairy	Solapur	5.31	1.71	
34	Kisan Mitra Cold Storage Private Limited	F&V	Latur	17.45	4.00	1.00
35	Balmer Lawrie & Co. Ltd.	F&V	Raigad	57.27	7.46	1.81
36	Vaishno Devi Food Products Pvt Ltd	Dairy	Osmanabad	23.80	10.00	2.50
37	Seasaga Enterprises Pvt. Ltd	Marine	Raigad	48.08	10.00	6.50
38	Swapnapurti Food Products Pvt. Ltd.	Dairy	Chandrapur	4.68	2.55	0.64
39	Sri Sri Milk and Food Product	Dairy	Pune	12.88	4.21	
40	Nature Delight Dairy & Dairy Products Pvt. Ltd.	Dairy	Pune	33.74	9.54	2.38
41	Kool Solutions India Pvt. Ltd.	Mixed	Mumbai	63.30	9.42	2.50
42	RGA Fresh Fruits Pvt. Ltd.	F&V	Thane	35.74	8.26	2.06
43	Siva Sai Exports	F&V	Nashik	23.38	10.00	2.50
44	Royal Cold Chain	F&V	Solapur	27.49	5.86	
45	Varun Agro Processing Foods Private Limited	F&V	Nashik	28.35	6.92	
46	Kaira District Co-operative Milk Producers' Union Ltd	Dairy	Pune	80.78	10.00	
47	Vaishnavi Grape & Pomegranate Processing Pvt. Ltd.	F&V	Solapur	24.32	9.18	
48	Bharti Global Food Products Pvt. Ltd.	Dairy	Beed	22.98	2.07	
49	SVI & SSK Cold Chain	F&V	Raigad	15.50	3.21	
50	Icee Box Integrated Cold Chain	F&V	Nagpur	14.26	3.03	
51	Fortune Dairy Industries Pvt. Ltd.	Dairy	Pune	31.81	7.46	
52	Taksh Cold Chain	F&V	Amravati	22.56	9.68	
53	VKM Foods Pvt. Ltd.	Marine	Thane	16.25	5.50	
Total				1442.38	373.87	227.88

Source: www.mofpi.nic.in

Extech RD200: Refrigerant Leak Detector

Detects leaks from air-conditioning units and cooling systems

Extech's Refrigerant Leak Detector is easy to use and is ideal for detecting leaks from air-conditioning units and cooling systems that use all standard refrigerants. The multi-coloured LED light bar indicates the level of refrigerant detected by the RD200. Features a field replaceable heated diode sensor and low/high sensitivity range selection for accurate leak detection. The 16-inch (406-mm) flexible gooseneck provides easy access in difficult to reach locations.

Features

- Detects all standard refrigerants using a heated diode sensor (SF6, HFC, CFC, HCFC refrigerants, halogen gas, ethylene, tetrafluoroethylene, trichloroethylene, and most other compounds containing halogen).
- User-selectable sensitivity level:
 - Low - 1.05oz (30g) per year
 - High - 0.2oz (6g) per year.
- Multi-coloured LED light bar indicates the level of refrigerant leakage detected.
- 19.8-inch (50.2 cm) flexible gooseneck retains its shape and provides easy access in difficult to reach locations.

- Audible and visual alert.
 - Low battery indicator.
 - Convenient field replaceable sensor (RD200-S).
 - Leak test bottle included for a quick and easy self-test on meter performance.
 - Dimensions:
 - Meter - 7.3x2.8x1.4-inch (185x72x35mm)
 - Sensor with Gooseneck - 20.5-inch (520mm) long
 - Probe Diameter - 0.32-inch (8mm)
 - Weight: 12oz (340g)
- Complete with sensor (installed), leak test bottle, 9V battery, and protective hard carrying case ■



Email: flirindia@flir.com.hk

Ammonia Refrigeration by Ice Make Refrigeration

Ice Make Refrigeration Limited is a leading manufacturer & exporter of industrial and commercial refrigeration equipment, located in Gujarat (India). Ice Make is an ISO 9001: 2015, ISO 14001:2015 & BS OHSAS 18001:2007 certified company and also has CE certified product range that shows high standard of quality with a good after-sales service.

Ice Make provides total solution for cold storage, blast freezer & chillers, industrial chillers, dairy & ice cream machineries, and refrigerated transport etc.

Ice Make manufactures products with HCFC and HFC refrigerants and has now entered into Ammonia Refrigeration Segment in equipment manufacturing, project engineering and project management. Ice Make will extend its services into

designing, engineering, manufacturing, assembling, fabrication, installation, testing and commissioning with best quality after-sales services for ammonia-based water chillers and large cold storages for various industries.

To have successful entry, Ice Make has support of Kishor Manglani as Head - Ammonia Refrigeration & Projects who is specialised in Refrigeration and Air Conditioning. He has a rich experience of over 35 years in sales and marketing, contracting, engineering & execution, after-sales services, R&D etc. from various reputed organizations. Now Ice Make Refrigeration Limited will now be a one stop solution provider for all types of refrigeration needs of all industries.

Website: www.icemakeindia.com

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Forthcoming Events At A Glance

DairyTech India 2018

Venue: Bangalore International Exhibition Centre (BIEC)

Date: 31st August to 2nd September 2018

Website: www.dairytechindia.in

Food Logistics India

Venue: Bombay Convention & Exhibition Centre, Mumbai

Date: 27th to 29th September 2018

Website: www.foodlogisticsindia.com

Chillventa

Venue: Nuremberg, Germany

Date: 16th to 18th October 2018

Website: www.chillventa.de

Refcold India

Venue: Mahatma Mandir Convention Cum Exhibition Centre, Gandhinagar, Gujarat

Date: 22th to 24th November 2018

Website: www.refcoldindia.com

Company Name	Page No.
ALM Engineering & Instrumentation Pvt. Ltd.	IFC
ALMI International	9
Embraco	37
Ensavior Technologies Pvt. Ltd.	BC
FLIR Systems India Pvt. Ltd	11
Fu Sheng Industrial Co. Ltd	5
Hitachi Air Conditioning India Limited	7
India Cold Chain Show	13
Lubi Industries LLP	3
Mist Resonance Engineering Pvt. Ltd.	IBC
RefCold India	15

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LEED Platinum for the First Mall in Italy

The new Adigeo Shopping Centre in Verona, is close to city's main highway exit. The 47,000 m² shopping centre has just been awarded the highest level of LEED, the Platinum certification. This is the first LEED certification for ECE, the property owners, and the first Platinum certification for any shopping centre in Italy.

The USGBC reviewers assessed both the design and specific aspects of the property such as energy consumption, socio-cultural projects, and mobility. Several factors contributed to obtaining Platinum level, the shell of the building exceeds the legal requirement for energetic quality by 20 per cent, eight



charging points for electric vehicles, bicycle parking spaces as well as changing and shower rooms for centre personnel commuting by bike. Another exemplary aspect is the resource-saving utilisation of water and electricity: water-saving fittings for sinks and toilets as well as the use of rainwater to water outdoor facilities help reduce water consumption. Together with the photovoltaic system, the high percentage of available daylight reaching

the mall through the generously sized glass surfaces and the use of energy-saving LED to illuminate the facade and the mall interior provide for low electric consumption. ■

Smart & Sustainable Factory

The building has a total surface area of 25,000 m² and is highly sustainable. Its structure is made of laminated wood and the use of concrete is very limited, to allow easy recycling of materials in the case of changes to the structure, in terms of total or partial expansions. The large



windows allow a considerable amount of natural light and let the workers to enjoy the view of the green hills and the surrounding mountains, which contributes to ensuring a high level of internal well-being for the building's occupants. Finally, the mechanical and electrical systems are highly efficient and do not produce local CO₂ emissions, thus effectively eliminating the impact of the factory on the surrounding environment.

In designing the new factory flexibility was key: the building and systems were designed to respond intelligently to present and future needs of production and logistics, so as not a limit to the company's activities. The wooden structure and having the mechanical and electrical systems in plain

sight, allow for future modifications, while ensuring continuity of production even in case of breakdowns or malfunctions. Even the HVAC plant room, built in a lofted space under the wooden roof, allows maximum flexibility for the air conditioning and air treatment system. Its central position helps optimize the length of ducts and pipes, reducing pressure losses and thus maximising overall system performance. ■

Energy Efficient HUL

'We are changing the way business is done,' is the tagline of Unilever. Standing true to it, the company, while retaining its status as one of the world's largest fast-moving consumer goods (FMCG) manufacturers, also ensures it reduces its impact on the environment. Unilever has been practicing sustainability since the last century, during which time it has also grown to serve 2.5 billion users for over 400 brands on any given day.

In keeping with changing times and technology, the global FMCG giant has committed to using the LEED green building rating system for all its projects around the world, not just manufacturing facilities, but also office spaces. In India, Hindustan Unilever Limited's (HUL) corporate headquarters in Mumbai and its manufacturing facility in Khamgaon, Maharashtra, have both achieved LEED Gold certification and serve as remarkable



examples of sustainable campuses. Apart from scoring high on energy and water efficiency, waste management and indoor air quality, Unilever has been rigorously following its 'Sustainable Living Plan,' which requires the making and use of its products and the operation of its office spaces in an environmentally conscious way. ■

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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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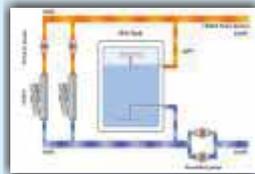
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