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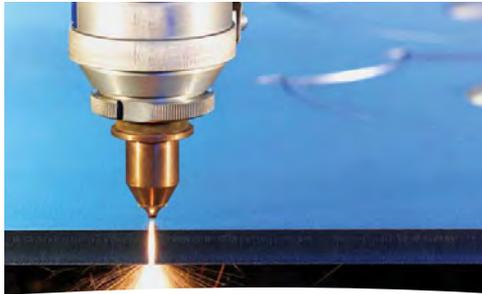
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Publisher's Letter

Hello and welcome once again to *Cooling India*.

Driven by population growth, rising incomes, falling equipment prices and rapid urbanisation, an air-conditioned environment has become an almost inseparable part of our daily life. In the case of shopping areas that include supermarkets and retail malls, today it is essential to ensure comfortable air-conditioned surroundings to deliver a quality shopping experience.

Of late, India is witnessing an upsurge in the number of shopping malls as overseas retailers are now expanding exuberantly thanks to the government decision on easing the FDI norms in the retail sector. According to property consultant Anarock, more than 85 malls are expected to come up in India by 2020. It has also been reported that Singapore's sovereign wealth fund GIC to construct India's largest shopping mall in Gurugram partnering with property developer DLF.

However, amidst an upward supermarket and shopping mall trend, maintaining indoor air quality (IAQ) remains a major challenge as they are prone to high indoor air pollution. This time we present to you an in-depth analysis on how to maintain IAQ in supermarkets.

Large supermarkets may face refrigerant leaks as long runs of refrigerant piping is involved. This is becoming a growing environment concern globally. Further, refrigerant phase down regulations are also driving the changes in the type of refrigerants used in supermarkets. Here, industry expert Vikram Murthy explains why it is essential to use low GWP refrigerants in supermarkets.

While effective cooling and refrigeration are integral parts for food and beverage (F&B) processing and preservation, properly designed air handling systems are essential to control airborne particulates and odours in F&B manufacturing units. This issue sheds light on food industry HVACR.

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




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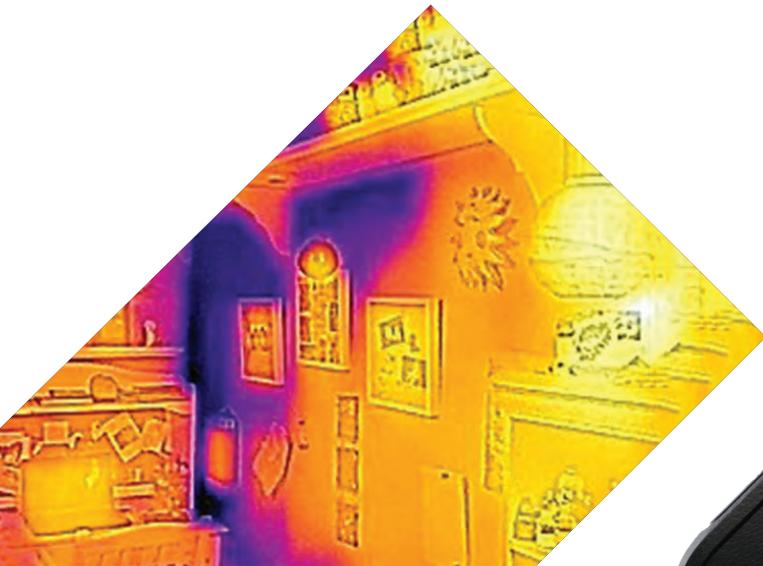
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Voltas launches new brand shop at Chackai, Thiruvananthapuram

Voltas and Voltas Beko, collectively showcase their range of air conditioning and cooling products, along with their latest range of home appliances at the new Brand Shop Thiruvananthapuram.

The brand store features a well-designed and visually appealing display of new range of Voltas and Voltas Beko' products, comprising air conditioners, air coolers, commercial refrigerators, water dispensers, water coolers, refrigerators, washing machines, microwaves and dishwashers. Conveniently located near the city centre, the new brand shop would enhance Voltas' brand experience and visibility.

The Brand Shop is launched to meet the expectations of consumers from a growing city like Thiruvananthapuram with technologically advanced products of Voltas and Voltas Beko. Speaking on the occasion, Pradeep Bakshi, Managing Director & CEO, Voltas said, "We are delighted to announce the launch of a brand shop, which will house the entire range of Voltas and Voltas Beko products. Customer centricity is at the core of all our offerings and Voltas Beko has been built on the same principles. Voltas is the No.1 AC brand with close to 24 per cent market share and we aim to make Voltas Beko also a market leader in the white goods space."

The overall Voltas 2019 AC product range includes over 100 SKUs, with 39 SKUs in Inverter ACs, 26 in Split ACs and 32 in Window ACs, besides Cassette and Tower ACs. The Company has also launched 39 new SKUs of its Voltas Fresh Air Coolers with Smart Humidity Controller, under various sub-categories such as personal, window, tower and desert air coolers. The company also strengthened its overall portfolio by introducing 43 SKUs of commercial refrigeration products, including convertible freezer, freezer on wheel and curved glass freezer. The company has launched 25 SKUs of Water Dispensers, and 22 new SKUs of Water Coolers. ■

USGBC's 2020 Greenbuild India Conference heads to Bengaluru

The US Green Building Council (USGBC) announces that the third annual Greenbuild India conference will take place in Bengaluru on February 6-7, 2020. The conference brings together green building leaders from throughout India and celebrates the industry's accomplishments in creating a more sustainable built environment and a better quality of life for all. The call for proposals to submit new and compelling sessions for the conference is now open.

"While there is a prevailing water crisis in India, there is also a new government that is committed to sustainability," said Mahesh Ramanujam, President & CEO, USGBC and Green Business Certification Inc. (GBCI), the global certifying body for LEED. "The pressing environmental issues in India underscore the importance of events that unite the community to work together and help raise the living standard for everyone. Greenbuild India will do just that by convening hundreds of sustainability professionals to address the critical issues impacting human health and the environment."

Greenbuild India will feature sessions covering all aspects of sustainable design, construction and operations practices for buildings and communities, including their



impact on people, the environment and the economy. Greenbuild attendees will learn about LEED, building performance, energy efficiency, codes, market trends, health and wellbeing, the business case for green building and more.

Founded in 2002, Greenbuild is presented by USGBC – the creators of the internationally recognised LEED green building rating program – and is the world's largest conference and expo dedicated to green building. The event provides a forum for the community to unite, change lives, revolutionise business and address the world's most pressing issues. Today, the conference takes place in several countries and regions throughout the world each year, including North America, Latin America, China and Europe, in addition to India.

As the fourth largest market in the world for LEED, India is home to more than 3,100 projects participating in LEED comprising 1.6 billion gross square feet of space. India also has 40 USGBC member companies and 1,135 active LEED credential holders. Greenbuild features thought provoking and inclusive programming for all green building practitioners in the region, wherever they may be in their green building career and journey. ■

Bitzer Benelux moves to new location

Bitzer Benelux is relocating its activities from the Belgian city of Hasselt to Breda in the Netherlands. The specialist for refrigeration and air conditioning technology will retain a slightly smaller office in Hasselt. As of today, the main office of Bitzer Benelux is located in the Dutch city of Breda. The company continues to be represented in Hasselt, Belgium, by two experienced employees. Eighty per cent of this Bitzer subsidiary's customers are based in the Netherlands, but Hasselt as a site was not able to offer the necessary infrastructure to assist Dutch customers adequately. Thanks to the more central position of

Breda with three highways close by, Bitzer can now support its customers much better. Bitzer Benelux was founded in 2007 and has been present in Hasselt ever since.

As Gianni Parlanti, Chief Sales and Marketing Officer and Board Member at BITZER, puts it: 'The Netherlands are, just like Belgium and Luxembourg, very important for BITZER. That's why it was time to move closer to our Dutch customers. We opted for this new location in Breda only after careful consideration. With the new offices, the renowned BITZER support and services for our partners will achieve new heights.' ■



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Emerson helps industry enable digital transformation with new cybersecurity lab

Emerson, a global technology and engineering company, opened its newest cybersecurity lab to help manufacturers confidently adopt digital transformation strategies, while protecting the integrity of their plant operations, networks, systems and data. The facility, part of Emerson's larger global cybersecurity network, reinforces Emerson's commitment to offer the most advanced automation solutions to its customers worldwide.

The new center, staffed by a team of cybersecurity experts in Pune builds on existing capabilities and further strengthens Emerson's technology portfolio to support the highest levels of product security across the development lifecycle. The Pune lab will focus on defining security requirements, designing threat models and security walkthroughs, maintaining security practices and simulating cyberattacks in industrial environments to identify and address potential vulnerabilities.

"Cybersecurity is frequently cited by customers as a top consideration for Industrial Internet of Things adoption," said Lal Karsanbhai, Executive President of Emerson's Automation Solutions business. "Emerson's investment in a broad portfolio of technologies and services is helping global leaders accelerate their digital transformation with confidence."

The latest addition to Emerson's global network of cybersecurity facilities is located at the Emerson Innovation Center in Pune, which houses 900 employees focused on innovating for the future and coordinating training for development engineers.

"Our customers are looking for a partner to help navigate the complex technology landscape so they can design a secure and robust digital ecosystem for their operations," Karsanbhai said. "This new center further extends our leadership in industrial transformation and enhances our ability to collaborate with customers on the critical element of cybersecurity as they adopt the latest digital technologies to optimize performance." ■

Grundfos India promotes need for climate-resilient infrastructure

Grundfos India, a company in advanced pump solutions and water technology, is the Gold sponsor of the Climate Leadership Conference organised by Confederation Indian Industries (CII). The conference scheduled on August 1, 2019 in Delhi discussed possible solutions for the Indian industries to combat climate change.

Grundfos is committed to promoting the United Nation's Sustainability Development Goal (SDG) 13, which focuses on climate change. With sustainability as a key part of the company's DNA, Grundfos recognised the relevance of the SDG's and the need to develop solutions to mitigate the negative impact. Through its association with this conference, Grundfos hopes to encourage Indian industries' adoption of sustainable solutions, energy efficiency, renewable energy and green buildings.

Moderating the session on 'Building disaster resilient infrastructure for the nation



against climate change impacts', Ranganath N. K., Area Managing Director, INDO Region, Grundfos said, "Climate change is impacting us in many ways. We see the effects of climate change through increased flooding, drought, and drastic weather fluctuations. While we all work towards mitigating the negative impact of climate change, it is important to also focus on adopting intelligent and efficient solutions and technologies that can help us build stronger disaster resilient infrastructure. It is also critical for key stakeholders such as the Government and industries to come together to address these challenges." ■

Lake Erie College partners with Trane for new HVAC curriculum

Lake Erie College (LEC) has joined forces with Trane, a provider of indoor comfort solutions and services and a brand of Ingersoll Rand to provide students the opportunity to enroll in an eleven-month HVAC training program working inside a brand new, state-of-the-art NC3 lab. The program was originally created last year as a beginner's guide to commercial heating and cooling controls and relied on existing equipment already serving campus buildings. During the program's successful first year, students were able to help identify and fix issues and equipment on Lake Erie's campus. The course's upcoming session will be the first one offered in the new Trane Lab, allowing students the unique experience of working with real-world equipment.

LEC's President Brian Posler shared, "Although it may be a bit unusual for a liberal arts college to host a technical certification course," this is a wonderful opportunity to complement LEC's academic offerings with a much-needed skilled trade program, further connecting us with the



communities we serve. There is a significant demand for skilled individuals in the HVAC trade, both in Northeast Ohio as well as across the United States," said Michael Bryan, general manager, Trane Northeast Ohio. "This partnership became an immediate match as the vision of our three organisations are all aligned in driving innovation in our industry." Trane's sponsorship and involvement with NC3 provides an opportunity to build and maintain relationships with top leaders at community technical colleges that participate as members of NC3, a non-profit organisation, addressing the need for collaborative industry partnerships with educational institutions. ■



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7-Eleven and Honeywell collaborate to reduce carbon footprint in US & Canada

Honeywell and 7-Eleven announced the adoption of Honeywell Solstice N40 (R-448A) refrigerant as 7-Eleven's standard for remote condensers supporting their refrigeration cases installed across the United States and Canada.

7-Eleven also selected Honeywell's lower global warming potential (GWP) alternative for retail refrigeration in Japan last year, becoming the first leading retail chain in the country to adopt the refrigerant. Solstice N40 is the most widely accepted, lowest GWP, non-flammable replacement for R-404A in stores globally.

The world's largest convenience retailer, 7-Eleven, set measurable corporate social responsibility (CSR) goals in 2016 to reduce its environmental footprint. The company's CSR mission has three focus areas – planet, products and people. Using 2015 as a baseline, 7-Eleven committed to continuing to reduce its carbon footprint and increase community engagement in the US and Canada by concentrating on energy, packaging and philanthropy.

"In the past few years, we've implemented several innovative measures such as LED lighting, energy management systems, wind energy in select stores and high-efficiency HVAC units to reduce our CO2 emissions," said Ann Scott, 7-Eleven Director of Energy, Engineering & Store Planning. "The use of Solstice N40 is an environmentally preferable alternative for 7-Eleven. Joining forces with Honeywell, which also embraces a mindset and goal to serve as environmental stewards, was a natural fit."

"7-Eleven has responsibly elected to adopt Solstice N40 to help lower their carbon footprint, save energy and meet regulatory requirements without undertaking massive changes to their systems," said Sanjeev Rastogi, Vice President, Honeywell Fluorine Products. ■

LU-VE announces construction of new plant in Texas

The company, based in the Italian province of Varese, is listed on the Milan Stock Exchange and is the third player in the world in the market segment of ventilated equipment. After completing the closing of the acquisition of the air heat exchanger division of Alfa Laval in April 2019, the Italian multinational, in line with its global investment plan in strategic areas, now announces the construction of a new facility of approximately 25,000 square meters at its subsidiary company Zyklus (Jacksonville, Cherokee County, Texas) in the USA.

Crowning a strategic project aimed at entering the biggest market in the world for refrigeration and air conditioning, in June 2018 LU-VE bought Zyklus, which produces and sells heat exchangers. This was the first indispensable step in a medium-term plan for growth in the North American continent. In response to the favourable conditions in the local market, LU-VE has decided to speed up the expansion process by increasing the size of the existing plant.



The plan received a warm response from JEDCO – the Jacksonville Economic Development Corporation (a local public body that deals with the economic development of the area). In the last few days in fact the Jacksonville City Council unanimously approved a package of incentives which will enable the construction of a production facility of approximately 25,000 square metres in the Norman Industrial Park in the city. The agreement between JEDCO and LU-VE Group includes the concession, free of charge, of 80,000 square metres of ground and a long-term policy of tax credits in return for the creation of at least 50 new jobs within 48 months from the end of construction. ■

Star Refrigeration install new greener plant for Primula cheese

Star Refrigeration has helped a world class cheese spread manufacturer upgrade its refrigeration plant to comply with F-gas regulations. The company has overseen the replacement of two refrigeration plants serving Primula's principal cheese store facility in Team Valley in Gateshead, near Newcastle.

As the UK and Europe continue to phase down harmful refrigerants in an attempt to slow global warming, plants across the UK require upgrading to remain compliant. Star successfully transitioned the plant from R422D – which will soon become untenable under new F-Gas Regulations – to the more future-proofed R513A. The two businesses have been in a successful partnership for over 15 years, and in 2008 Star had already converted the original R22 plants to enable operation with R422D refrigerant which extended the

life of the plants by over 10 years.

From January 1st 2020, the EU will introduce a service ban on all refrigerants with a Global Warming Potential (GWP) of over 2,500. Since R422D has a GWP of 2,729, it would have become problematic to Primula to continue running their cheese

store. This, in conjunction with the age of the plant, prompted Primula to opt for a complete replacement of the two plants to achieve regulatory compliance, optimise efficiency and ensure its viability going forward.

Star replaced the plants with new equipment utilising a refrigerant with a far lower GWP. In this instance, Star determined that R513A has a comparatively low GWP of just 631, which is well below the 2,500 threshold and should ensure the plant remains viable in its current state for the foreseeable future. ■



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Carrier's new heat pump harvests energy from rivers

Carrier has introduced a new high efficiency water-to-water heat pump for harnessing energy from rivers, lakes and industrial process applications that can deliver high temperature water up to 65 degrees Celsius for sanitary use or radiator heating. Carrier, a company in high-technology heating, air-conditioning and refrigeration solutions, is a part of Carrier, a global provider of innovative heating, ventilating and air conditioning (HVAC), refrigeration, fire, security and building automation technologies.

The Eurovent-approved Carrier AquaSnap 61WG monobloc water-to-water heat pump is available in six sizes with heating capacities ranging from 29kW to 235kW at typical water conditions of 30C to 35C, or 26kW to 200kW at higher temperature water conditions of 55C to 65C. It is designed for medium to large commercial applications requiring high temperature sanitary hot water, such as hotels, hospitals, universities and leisure facilities. Alternatively, it can be used for heating with traditional radiators appropriately sized for up to 50C, in line with current industry best practice guidance. ■

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Cooling India invites HVACR professionals and industry experts to write articles on their area of expertise and interest.

Carel inaugurates new plant in China

The new Carel Group plant has been inaugurated on July 16, in the Suzhou area, one of the most innovative and important technological districts in China. The cutting of the ribbon was attended by the company's founders Luigi Nalini and Luigi Rossi Luciani and Group CEO Francesco Nalini, representatives of Suzhou New District, Wang Mo, Huang Feng and Simon Xie, and the Italian Consul in Shanghai Michele Cecchi, who opened the ceremony.

Other officials attending the inauguration were the president of the Chinese Association of Refrigeration Jin Jiawei and representatives of the Italian Chamber of Commerce in China, Lorenzo Riccardi and Emanuela Vizzaro, as well as the two CAREL managers directly involved in the development of the new plant: Alberto Catullo, CEO North APAC and Luciano Marzaro, Managing Director CAREL China.

The new plant at the CAREL Electronic Suzhou subsidiary, established in 2005, has been created with the aim of strengthening



production for the Chinese market. In the more than 15,000 square metres of the new complex, a significant area will be dedicated to R&D, the true excellence of CAREL Electronic Suzhou, which through its innovative laboratory will focus on the development of new technologies.

"When we built the first plant in 2005, we were convinced of the importance of investing in this market," commented Francesco Nalini, CAREL Group CEO during the ceremony. "Today, the inauguration of the new production plant confirms that we made the right decision in the past, and opens up great prospects for the future. This new site symbolises our dedication and continuous commitment to creating a centre of excellence in China." ■

Chemours and Axima Refrigeration France partner on use of Opteon XL

Chemours announced that Axima Refrigeration France, a company of ENGIE Axima, a contractor in HVAC, refrigeration and fire protection, and headquartered in Paris, has chosen to partner with Chemours to evaluate the use and future adoption of Opteon XL low global warming potential (GWP) hydrofluoroolefin (HFO) refrigerants in commercial refrigeration before the next European F-Gas HFC cap and phasedown in 2021. As a first step towards the reduction of CO2 quota, Axima Refrigeration France has already adopted Opteon XP40 (R-449A) for retrofitting existing R-404A systems.

The collaboration between Chemours and Axima Refrigeration France around the future adoption of Opteon XL refrigerant aims at providing the commercial refrigeration market with long-term solutions under the F-Gas regulation that have a low environmental impact while ensuring performance, safety, reliability, and cost-

efficiency. Both companies are committed to jointly investigate the use of A2L refrigerants in commercial refrigeration and support the transition by performing trials and developing case studies, as well as best practices they will be jointly delivering through training.

The recent adoption of Opteon XP40 (R-449A) by Axima Refrigeration France is the first step towards this transition and enables the company to ensure its customers business continuity. Opteon XP40 (A1 class refrigerant) is currently the refrigerant of choice among supermarkets, retailers, contractors, distributors and end-users in the EU for retrofit, delivering performance with a more sustainable environmental footprint, and offering over 65 per cent reduction in GWP.

"Our two companies share the same objective to help the commercial refrigeration market prepare for the 2021 HFC phasedown that will reduce the CO2 by 55 per cent," says Diego Boeri, Vice-President, Chemours Fluorochemicals. ■

LG Electronics' Multi VS System Receives Top HVAC Industry Honours

LG Electronics' innovative Multi VS – a powerful single-phase, Variable Refrigerant Flow (VRF) heat recovery system – has received a number of noteworthy industry accolades, most recently being named 'Green Innovation of the Year' by Green Builder as well as a TechHome Brilliance Award honouree.

Named 'Green Innovation of the Year,' heat recovery system recognised for superior performance, design flexibility, and industry-leading efficiency.

The 5-ton multi VS continues to be recognised for its compact design, advanced heating and cooling capability, and enhanced energy efficiency – providing the market a sustainable single-phase heat recovery system for light commercial and residential applications.

Green Builder's award program spotlights the industry's most authentic, advanced, beautiful, sustainable projects and the professionals who design and construct them. The 'Green Innovation of the Year' award specifically recognises the product that enhanced the sustainability of the built environment. The TechHome Brilliance Award honours manufacturers who are implementing game-changing innovations in home control, energy efficiency and connected appliances; LG's Multi VS system was recognised as the top product in the zone-controlled heating or cooling systems category back-to-back in 2018 and 2017.



Featuring a compact and lightweight design and only requiring single-phase power, the Multi VS 5-ton heat recovery system provides excellent energy efficiency and the versatility of simultaneous heating and cooling. In the smallest footprint available for a heat recovery system, the Multi VS supports up to twelve indoor units, ensuring user comfort and providing a viable heat recovery solution for residential and light commercial applications.

Incorporating LG's high efficiency inverter scroll compressor, the Multi VS boasts a wider

operating range with cooling capabilities in ambient temperatures up to 122 F as well as heating operation down to -13F, making it a great solution for year-round comfort, even in extreme climates. The Multi VS is compatible with ducted and duct-free indoor units including LG's award-winning Art Cool™ mirror, art cool gallery, standard wall-mounted and several other models, giving contractors the flexibility to offer the best solution for the application.

"The experts have spoken with leading industry authorities recognizing LG's Multi VS system for its advanced functionality, design flexibility and energy efficiency," said Kevin McNamara, Senior Vice President and General Manager, Air Conditioning Technologies, LG Electronics USA. "It's a true testament to our innovative thinking and industry-leading technologies throughout our product offerings." ■

Modine Gets FCA 2019 Supplier of the Year Awards

Modine Manufacturing Company, a diversified global company in thermal management technology and solutions, was recognised in July month by Fiat Chrysler Automobiles (FCA), as one of three finalists at the 2019 Annual Supplier Conference and Award Ceremony in the Engine Systems Supplier category. FCA's Supplier of the Year awards recognise companies that have shown exceptional commitment to FCA, providing innovative, high quality, products and services.

Award recipients were determined based on an evaluation of each company's supplier External Balanced Scorecard (EBSC) performance in 2018. The EBSC is a rating system that measures operational metrics, such as cost, delivery, quality, and warranty, along with Strategic Metrics like diversity,



partnership and sustainability. Senior leaders at FCA nominate suppliers to be recognized.

"We are extremely proud of this nomination from FCA as it demonstrates the hard work and efforts of employees at our Lawrenceburg, Tennessee facility, along with the positive partnerships we've fostered with FCA engineering and FCA purchasing," said Tom Burke, Modine President and Chief Executive Officer. "It is an honour to be recognised for our commitment and performance."

"Our team has worked very hard this past year to increase our EBSC performance metrics, ultimately achieving a score of 97 out of 100," said Joel Casterton, Modine Vice President,

Vehicular Thermal Solutions. "Having FCA name Modine as a finalist for this award in the Engine Systems Supplier category, reaffirms our hard work is paying off." ■



Need for Clean Cold Chain

The article talks about the need for new cold-chains that must transport food produce from farm gate to end consumers sustainably and relay demand from consumers to farm gate efficiently, with minimal environmental impact.

The Government of India (GoI) has put forth substantial emphasis on doubling farmers' income, by 2022, through productivity gains. The GoI has set out a seven-point strategy in 2016 and launched Operation Green (in line with Operation Flood) to support agri-logistics, food processing units and food producer organisations. Though Indian agriculture sector has transformed in terms of agricultural volume, the sector keeps on grappling with structural issues such as average farm size, modernisation of farm practices, marketability or handling of post-harvest produce (Robin Singhal and Shalini Saksena). Due to this system level

inefficiency, about Rs. 92,000 crore worth of major agricultural produce at 2014 wholesale prices is lost in India every year (Central Institute of Post-Harvest Engineering and Technology, 2016). The actual economic loss will be manifold if we consider retail price, hunger, farmer distress and farm loan wavers.

It is pertinent to mention here that food wastage is a global phenomenon. However, in developed economies, maximum food is wasted after reaching the consumers whereas in developing economies food produce is lost before it reaches the consumers. It is estimated that better handling, storage and

processing of food produce can feed around 11 per cent of global population. India produced 263 million tons in 2013-2014 and required 225-230 million tons of food in that year (A. Sarkar et al.). In spite of producing enough, there is difficulty in feeding people due to food loss. While many factors contribute to post-harvest losses in India, one of the major causes is the lack of effective and efficient cold-chains.

Developing an integrated cold-chain is one of the key measures under 'Operation Green' to modernise farm practices and handling of post-harvest produce and minimise food loss. Cold-chain is an integrated and immaculate network of refrigerated and temperature-controlled pack houses, distribution hubs and freight used to maintain the safety and quality of food, thus, building efficient market links. Cold-chains reduce post-harvest food loss and increase farm income by storing and transporting high quality produce to distant cities throughout the year.

The National Centre for Cold-chain Development (NCCD), set up by the Ministry of Agriculture has undertaken specific steps towards promoting cold-chains throughout the country. The NCCD-NABARD Consultancy Services (NABCONS) study published in 2015 highlights substantial gaps in the pack-houses, bulk cold-storages, refrigeration vehicles and ripening chambers. There is an estimated shortfall of 96 per cent pack-houses, 85 per cent refrigeration vehicles, 10 per cent bulk-storage and 91 per cent ripening chambers. Hence, a massive capacity addition in pack-houses, refrigeration vehicles and ripening chambers is required by 2022. Because of the impetus provided by Operation Green, cold chains in India are expected to proliferate rapidly. While the growth in cold-chain infrastructure brings hope to improve market connectivity and reduce food loss in the agriculture sector, this is likely to come with substantial energy and environmental costs. Hence, there is a need to leapfrog the conventional, polluting, energy

inefficient technology and move towards energy efficient, affordable, and clean cold-chain system. Operation Green is an excellent opportunity to introduce clean cold-chain technologies and prevent long-term lock-in of fossil-fuel intensive technologies. Such technologies will increase energy efficiency and promote the use of renewable energy and low GWP (Global Warming Potential) and zero ODS (Ozone Depletion Substance) refrigerants.

However, past failures like the potato mission indicates that the conventional approach of creating cold storages will neither solve the problem of farmer's distress nor stop the post-harvest food wastage. Due to consecutive policy implementation failures, the country ended up creating many large, fragmented and inefficient cold storages, which often run on diesel power due to the unavailability of reliable electricity supply. With 60 per cent of cold storages located in four states i.e. Uttar Pradesh, West Bengal, Gujarat and Punjab wherein majority of the cold storages are for a single commodity – potato, the existing cold storage infrastructure is unable to meet the huge demand supply gap which persists for various non-potato farm produces across the country (Centre for Public Policy Research).

The new cold-chains must transport food produce from farm gate to end consumers sustainably and relay demand from consumers to farm gate efficiently, with minimal environmental impact. It is necessary to explore new ideas like creating Agri-IT infrastructure which enables market data driven harvesting of produce to avoid unnecessary storage. Encourage private sectors to provide 'cooling as a service'. Rather than the conventional approach of selling cooling equipment to farmers and traders, an alternative approach in which the cooling requirements is delivered efficiently by a third party. The University of Birmingham in its report on 'India's Third Agricultural Revolution – Doubling Farmer's Income through Clean Cold-chains', suggests the creation of a series of regional 'living

labs' called the India Clean Cold-chain Centres as a means of solving the interlinked challenges of clean cold-chain development. These clean cold-chain Living Lab and Innovation Centres will test, validate and demonstrate innovative and integrated solutions (technology and business model). While designing a cooling infrastructure, engineers should start thinking 'Thermally First'. Locally or easily available thermal energy (like biomass, solar, phase change materials, free cooling) options should be optimally explored before introducing electric refrigeration systems. (MPEnsystems, et al 2019. Promoting Clean and Energy Efficient Col-Chain in India).

The country may also be able to fulfil the cooling need of rural India by creating community cooling hubs. Under the new model, Shakti Sustainable Energy Foundation will assess various thermal (hot and cold) requirements within the supply chain and the local community. We design cooling as a service infrastructure rather than as a product, which could be funded by entrepreneurs and farmer producer companies. The cooling infrastructure could then be utilised for multiple purposes: storage of vaccines and medicines, support to secondary agriculture and food processing activities, preparation and use of ice for fisheries, etc. Thus, increasing the commercial viability of a cold-chain infrastructure and widening its social impacts. Finally, all future development of cold-chain infrastructure should harness the potential of renewable energy resource, new thermal focused technologies, choice of refrigerants along with optimising electricity and fuel consumption. ■



Shubhashis Dey
Program Manager,
Shakti Sustainable
Energy Foundation

Global heat pump sales fall 3.3%

The recent US-China trade war has put more pressure on the local economic expansion, leading to rising prices on raw materials and a slower new residential construction market real-estate.

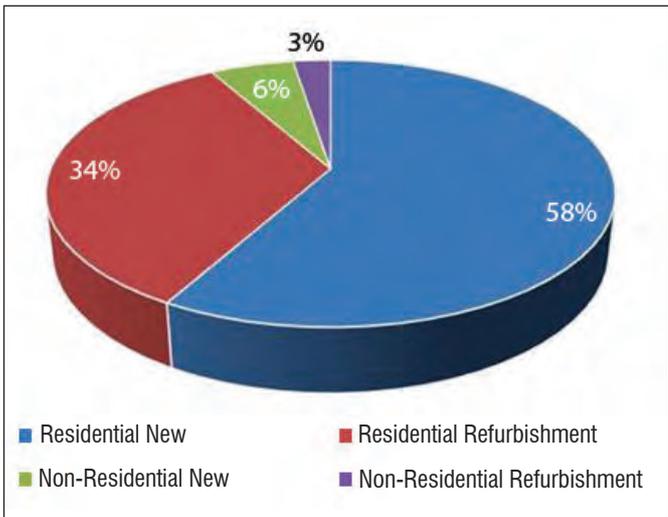
The series of research carried out by BSRIA (Building Services Research and Information Association) on the Global Heat Pumps Market published in May 2019 recorded a volume of sales slightly over 3 million units. Following a record year in 2017 with sales jumping 18 per cent, the global market was down by 3.3 per cent in volume terms in 2018.

Aline Breslauer, Senior Market Intelligence Analyst, BSRIA, said, “The global heat pump market suffered from the slowing economy in China in 2018. The recent US-China trade war has put more pressure on the local economic expansion, leading to rising prices on raw materials and a slower new residential construction market real-estate. The environmental measures to reduce CO2 emissions have kept supporting the heat pump market although the competition from gas boiler is on the rise in the country.

“In Europe the sales of heat pumps accelerated in 2018 reaching almost 650 thousand units sold. This is a 12.9 per cent increase from the previous year, which gives a sales value of 5.1 billion euros.

Air-sourced units maintained strong growth rates with splits systems increasing at the fastest pace: +19.1 per cent by volume followed by monobloc (+18.2 per cent). Air-sourced units designed for the production of sanitary hot water only were also on the rise in 2018, mostly driven by the demand from the French market.

The promotion of Heat pumps has been supported at a European level by the Building Regulation Directive, which has



Market breakdown by end-user sector, 2018 by sales volume

the objective of limiting the average energy consumption in most new buildings. Sales are primarily being driven by residential buildings. Suppliers in the Netherlands recorded high growth in terms of volume (+62.8 per cent) followed by the Republic of Ireland (+47.0 per cent) and the UK (+19.7 per cent). Public awareness is rising across Europe thanks notably to financial support avail to the availability of financial incentives. The recovery in the construction sector was another factor behind the latest development.”

Anil George appointed as CFO of Voltas

Anil George, Deputy Managing Director, has taken over the responsibility of Chief Financial Officer of Voltas in place of Abhijit Gajendragadkar and re-designated as Deputy Managing Director & CFO with effect from 1st July, 2019. Anil George, a qualified Chartered Accountant, joined Voltas in July 2010 as Executive Vice President, Corporate Affairs and CFO (designate). He was appointed as the CFO of the company in May 2011 and promoted as President (Corporate Affairs) and CFO in August 2013. Thereafter, he was



Anil George

appointed as Executive Director with effect from 1st September, 2017 and as Deputy Managing Director with effect from 10th February, 2018. Anil George is also on the board of various subsidiary or joint venture companies of Voltas in India as well as overseas.

Prior to joining Voltas, Anil George has worked with Union Carbide India Limited for six years and with Hindustan Unilever Limited for 20 years. He has also worked with Tata Services Limited for three years during 2007-2010. ■

Johnson Controls appoints Jeff Williams as Vice President & President Building Technologies

Johnson Controls International plc announced it has named Jeff Williams as Vice President and President, Global Products, Building Technologies & Solutions effective immediately. Williams succeeds Bill Jackson to pursue other opportunities.

Williams recently served as Vice President, Building Solutions, Europe, Middle East, Africa and Latin America (EMEALA) for Johnson Controls where he led sustained growth and improved margins across the region. "Jeff is a proven leader, who understands how to help our customers win every day and help drive our company's growth platform," said George Oliver, Johnson Controls Chairman and CEO. "I am excited for Jeff to take on this new role and I look forward to his further contributions as we solidify our position as the global leader in building technologies and solutions."

In his new role Williams will lead the Global Products segment which reported fiscal 2018 annual revenue of USD 8.5 billion, which includes Building Management Systems, HVAC



Jeff Williams

and Refrigeration Equipment and Specialty Products. Williams, who joined Johnson Controls in 1984, previously served as Vice President of enterprise operations and engineering. He led the company's USD 16 billion automotive experience spin-off resulting in a separately traded company known as Adient. Prior to that, he was Group Vice President and General Manager, Product Group Complete Seat and Supply Chain, Automotive Experience. He also drove standardisation in design, manufacturing processes and equipment to establish global

best practices for cost, quality and efficiency.

Williams has a bachelor's degree in business administration from Western Michigan University and an MBA from the University of Detroit. "We wish Bill all the best and appreciate all of his contributions to Johnson Controls and his leadership throughout the integration of Johnson Controls and Tyco in helping to transform our Global Products business into a market leader," said Oliver. ■

Cauz is Carel CEO in EEMEA

Mirco Cauz, the MD of Carel Central and Southern Europe, has been appointed regional CEO for the Eastern Europe, Middle East and Africa Region (EEMEA). In this new regional organisation, the managing directors of Carel Russia, Carel Middle East, Alfaco Poland, Carel Ukraine, Carel South Africa and Carel Central and Southern Europe subsidiaries will all report to him. Cauz will report directly to Carel CEO Francesco Nalini. He is replaced as MD of Carel Central and Southern Europe by Marco



Mirco Cauz

Galluppi, formerly part of the team as business development manager for Turkey & West Asia.

"It is an honour for me to be appointed to this prestigious position in a growing group such as CAREL", Mirco Cauz commented. "Our colleagues in the Eastern Europe, Middle East and Africa region stand out for their experience and professionalism: it will be a privilege to work with them and together find the best synergies for organising the team and consolidating our presence on the market, by anticipating our customers' requirements". ■



MAINTAINING AIR QUALITY IN SUPERMARKETS

Being complex buildings, supermarkets face tremendous challenges especially with regard to heating and ventilation that can affect the IAQ. Here's a critical analysis on how to maintain IAQ in supermarkets.

Supermarkets are designed to make the shopping experience better compared to traditional retail stores. Today people visit supermarkets (and malls) to buy food, goods and services, or simply to go window shopping in a comfortable environment. Supermarkets can be thought of as closed environments that not only offer products, but that in many cases also stimulate us to purchase them. Indeed, people buy products either when they need them or when they are enticed to do so.

The former case seems quite straightforward at first: a person simply enters the supermarket, buys the products they need and leaves. Naturally, however, the supermarket has to present the products in a way that gives shoppers confidence in their apparent quality, otherwise they wouldn't spend their money. Additionally, the supermarket needs to offer an acceptable level of comfort to create shopper loyalty, otherwise they may change stores.

The latter case, i.e. tempting people to buy products regardless of whether they really need them, exploits the emotional side of humans, as anything that gives us satisfaction makes us feel better. Consequently, in CAREL HVAC/R Corporate Business Manager Raul Simonetti's opinion, the supermarket's internal environment must be designed to make people feel so comfortable and relaxed that they focus their minds on the goods displayed,



The challenge has always been high capital expenditure involved in adding high quality filters to AHUs or ACs and a lack of data driven approach to managing air quality.

Udayan Banerjee,
Head of Operations and Founding
Member, Clairco

temporarily forgetting other thoughts, so that some of the products become the exact objects that can give them that much sought-after, and induced, satisfaction and happiness.

He says, both situations require architectural solutions that can be summarised as: proper lighting, low noise, comfortable indoor air quality (IAQ), spaces for merchandising the products, spaces for resting (food courts, cafes and so on), spaces for leisure (for instance, where kids can play, with or without supervision), bathrooms, ample parking, etc.

Focusing on IAQ in particular, this represents the best temperature and humidity values and the lowest concentration of pollutants (CO₂, VOCs, dust, others) that are suitable for both human comfort and the correct preservation of food, where this is displayed.

Even in India, a host of leading supermarkets are offering the best deals on food, fashion and accessories, home appliances, groceries etc. However, being complex buildings, these supermarkets face tremendous challenges especially with regard to heating and ventilation that can affect the IAQ.

“Supermarkets are prone to high indoor air pollution because of the hindrance to proper ventilation and increase in humidity, especially during peak hours, and thus the impact on customers increases with increase in

number of customers,” says Udayan Banerjee, Head of Operations and Founding Member, Clairco – a Bengaluru-based clean air start-up.

According to Banerjee, the factors that contaminate air in supermarkets are:

- Building materials, paints, and floor tiles contains asbestos and formaldehyde which are leading sources of volatile organic compounds (VOCs) and fine particles called Particulate Matter of 2.5 micron (PM_{2.5}). These are one of the most hazardous pollutants and prolonged exposure to these can cause serious respiratory diseases including lung cancer.

- Pollutants in outside air also contribute significantly to the pollution inside, specially PM_{2.5}, which is generated due to construction activities, vehicular emissions etc.
- Humidity is another factor which causes high concentrations of these pollutants.

Around the wet areas like pantry deep freezers and AC units, formation of slime is often observed which contributes to production of different kinds of harmful germs and bacteria. These get mixed in the return air of HVAC system and contaminate the indoor air, opines Manish Kumar, Regional Service Manager, Reliance Digital Services (HVAC), Reliance ResQ.

How to maintain indoor air quality in supermarkets

Talking about how to maintain IAQ in supermarkets, CAREL's Raul Simonetti explains, since supermarkets and shopping malls are closed environments, the indoor air needs to be regularly changed, introducing outdoor air and removing the “used” indoor air, in order to:

- Control the indoor temperature and humidity, at roughly 17-25-degree C or 63-77-degree F and 30-50 per cent rh (winter-summer).



Both the outdoor air and the recirculated air need to be filtered and conditioned by heating or cooling, humidification or dehumidification before being delivered into the supermarket...

Raul Simonetti,
HVAC/R Corporate Business Manager,
CAREL



The basic of disinfecting the contaminated air is to remove or kill the harmful germs or bacteria.

Manish Kumar,
Regional Service Manager, Reliance
Digital Services (HVAC),
Reliance ResQ

- Control the concentration of pollutants: these are produced both by people (CO₂, VOCs, dust from clothes and brought in from the outside) and by the various activities taking place inside the premises, such as moving goods, baking bread, and so on.
- Abate the heat gains from the sun, the lighting and internal processes (e.g., cooking in food courts).

The supply air is often a mix between outdoor air and recirculated air, the latter being reused to save energy, as it is already close to the desired indoor conditions. In Raul Simonetti's opinion, both the outdoor air and the recirculated air need to be filtered and conditioned by heating or cooling, humidification or dehumidification before being delivered into the supermarket in order to accomplish the three tasks listed above.

"The exhaust air can be partly recirculated and partly discharged, depending on where it is extracted from – it may be filtered to remove particulates and pollutants that cannot be recirculated (such as airborne grease particles from kitchens) or it can be fully expelled being unsuitable for recirculation," he adds. "In general, however, recirculation is the easiest way to achieve energy saving; as

regards the air being expelled, it is useful to have it pass through an energy-recovery system (for example, a cross-flow heat exchanger or equivalent) so as to recoup as much energy as possible, before it is sent back outside."

Raul Simonetti also suggests: "Dedicated sensors can be used to measure temperature, humidity, CO₂ (more commonly), some VOCs (not so common): their readings are collected by controllers or supervisory systems to decide, based on the algorithms implemented, how to manage the ventilation system/systems serving the shopping centre and thus guarantee the optimum indoor conditions while minimising energy and water usage (note that water is an efficient cooling medium exploited by evaporative coolers)."

As per Manish Kumar of Reliance ResQ, the basic of disinfecting the contaminated air is to remove or kill the harmful germs or bacteria. It is known that the majority of air supplied to any space is returned to the AHU for reconditioning or exhausted from the building. This return air may be conveyed in a return air duct system or through plenums formed by various elements of a building. An induct device can be placed to in the plenum to maintain IAQ.

Most supermarkets are air-conditioned. To maintain clean air at all times, air filtration capabilities need to be added to the air-handling units (AHUs) or ACs as well as the fresh air ducts. Additionally, it is very critical to monitor air quality data (PM_{2.5}, PM₁₀ etc) in real time so that the air filters can be cleaned and replaced before the air quality degrades below acceptable levels.

However, according to Banerjee of Clairco, the challenge has always been high capital expenditure involved in adding high quality filters to AHUs or ACs and a lack of data driven approach to managing air quality.

Clairco has addressed this problem through low drag air filters which can be retro-fitted to existing AHUs without affecting the performance of ACs. They also have an IoT-based Air Quality Monitor which enables to monitor the real time air quality data and display it on any connected screen. Additionally, Clairco has a patent pending technology through which it is possible to predict when the filter needs to be replaced thus maintaining clean air at all times, thus guaranteeing clean air.

Clairco provides all this in a much affordable monthly-subscription based model which makes them 3-5 times more affordable than the existing industry solutions, claims Banerjee.

Solutions

Supermarkets, especially larger ones, and malls rely more and more on the best indoor environmental conditions to attract visitors and boost the sales of correctly displayed and preserved products. As per Raul Simonetti, among the equipment installed in shopping centres, modulating ventilation systems play an important role in maintaining the required indoor conditions (main goal) while reducing the energy and water consumption (secondary goal), through the use of modulating components (pumps, heating and cooling devices) and real-time proactive monitoring systems, designed to adapt the components' outputs to current indoor requirements. ■

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Ingersoll Rand aspires to help reduce the customer carbon footprint by one gigaton by 2030, informs Randal Newton who is responsible for leading refrigerant technology strategy for the company. He also explains how to make business profitable while contributing to sustainability. Edited excerpts from his interview with Subhajit Roy:

Sustainability is a major global concern considering threats of climate change and emission growth. Where exactly would sustainability be on your agenda? Also, for industry, how to make business profitable while contributing to sustainability?

At Ingersoll Rand, sustainability is at the very foundation of our business. Our commitment to sustainability extends to the environmental impacts of our people, operations, and products and services. For any business, it is critically important to enhance shareholder equity. If we just focus on sustainability and don't care about making money for our shareholders, we



Our 2030 commitments are designed to meet the challenge of climate change, resource constraints, provide world-class systems and service performance for buildings, homes, transportation and industrial customers.

**- Randal Newton,
Vice President, Enterprise Engineering, Ingersoll Rand**

wouldn't be in business anymore. So, return to shareholders has to be on top of the list. At the same time, we believe that the best way to give return to our shareholders is by introducing breakthrough ideas to market to enhance sustainability of our products and solutions, and ultimately make a positive impact to communities around us. In the case of Ingersoll Rand, the work that we have done on sustainability has actually resulted in increased organic revenue growth. It has given us a leading position and voice in the industry, increased margins on our products and as a result increased shareholder equity.

How Indian market is reciprocating to the sustainability goals?

It is very interesting because first of all customers in India are not very different from customers in the rest of the world. So, from the standpoint of energy efficiency and sustainability of products, even though regulations in India don't require customers to buy new low global warming potential of refrigerants for a long time, we still see a number of evolved customers that are demanding the latest technologies which include low global warming potential refrigerants. Similarly, in our air compressor business, many of our customers are demanding energy efficient and sophisticated products. I think it is a combination of the strain on the energy grid, air compressors tend to be one of the highest consumers of energy in factory and shop. Additionally, it makes good business sense to also be buying the latest and best-in-class technology in the industry.

What kind of roadmap do you have for the Indian market especially when you talk about sustainability as an important business factor?

We do not see a huge difference in the roadmap for the Indian market vis-à-vis the rest of the world. On the air-conditioning side of the business, we continue to work on two priorities: putting the right refrigerant in the products that is safe, energy efficient and enhancing system efficiency. It is our priority to work and have more efficient products in systems. We believe, if we want to reduce the energy intensity of a building, we have to take a systems approach. In the Indian market too, our emphasis is on product efficiency and we are working to move that to system efficiency. We are also focused on connected buildings to ensure efficient functioning of a building throughout its lifecycle.

In addition, in the truck trailer refrigeration, we are focused on connected vehicles to monitor its performance in real time.

Ingersoll Rand has an ambitious target of reducing 35 per cent greenhouse gas footprint of its own operations by 2020. What's the current status?

In 2014, we established long-term sustainability targets to address one of the biggest issues to our environment and society, including the company's operational footprint.

One of our goals was to reduce greenhouse gas emissions from our own operations by 35 per cent – we exceeded that goal in 2018, two years early, and to date have reduced emissions by 45 per cent and energy consumption by 22 per cent.

Additionally, we have announced \$500 million investment in product-related research and development to fund long-term GHG reduction and we already spent in excess of \$400 million. At Ingersoll Rand, we have met all our sustainability goals early.

So, what's next?

To take the Sustainability Goals further, we recently made a 2030 commitment which is broader than our 2020 commitment. It includes goals tied to urbanisation because we know that a large percentage of the world will be urbanised by 2030. So, our 2030 commitments are designed to meet the challenge of climate change, resource constraints, provide world-class systems and service performance for buildings, homes, transportation and industrial customers. It also improves the quality of life for the people and communities where we operate and serve. The company will continue this momentum and create positive impact through three actions by 2030.

Firstly, scale technology, innovation and sustainability strategies to enable more efficient customer solutions. This includes reducing the customer carbon footprint by one gigaton CO₂e – equivalent to the annual emissions of Italy, France and the United Kingdom combined.

Secondly, transform its supply chain and operations to have a restorative impact on the environment including achieving carbon neutral operations, zero waste to landfill and a 10 per cent absolute reduction in energy consumption, and giving back more water than we use in water-stressed areas.

Thirdly, increase opportunity for all, strengthening economic mobility and bolstering the quality of life of our people and those in the communities where we operate and serve. This includes achieving gender parity in leadership roles and a workforce reflective of our community populations, maintaining livable market-competitive wages and progressive benefits; and broadening community access to well-being services including food/nutrition, housing and shelter, transportation, education and climate comfort. ■



Ripening is a must when it comes to commercial climacteric fruit although what is behind the good practice of professional ripening? How can quality products be guaranteed? Is there a key determining factor for uniform batches of perfect ripe fruit?

Non-climacteric fruits can only ripe fully when remaining attached to the parent plant; by contrast, climacteric fruits such as banana, avocado, kiwi, papaya, pears,...keep on maturing once harvested, which provides good opportunities and benefits on a trading level. Greater access to fruits not produced locally is now feasible thanks to the development of transport and modern ripening facilities. However, this democratisation of the consumption should come about through quality product; homogeneous airflow distribution is the actual key for a successful process.

While other determining factors as temperature, humidity, carbon dioxide or even ethylene are normally well known and managed nowadays, air circulation is too often a pending subject in professional chambers around the world...pending from both performance and efficiency points of view. Hot areas, insufficient

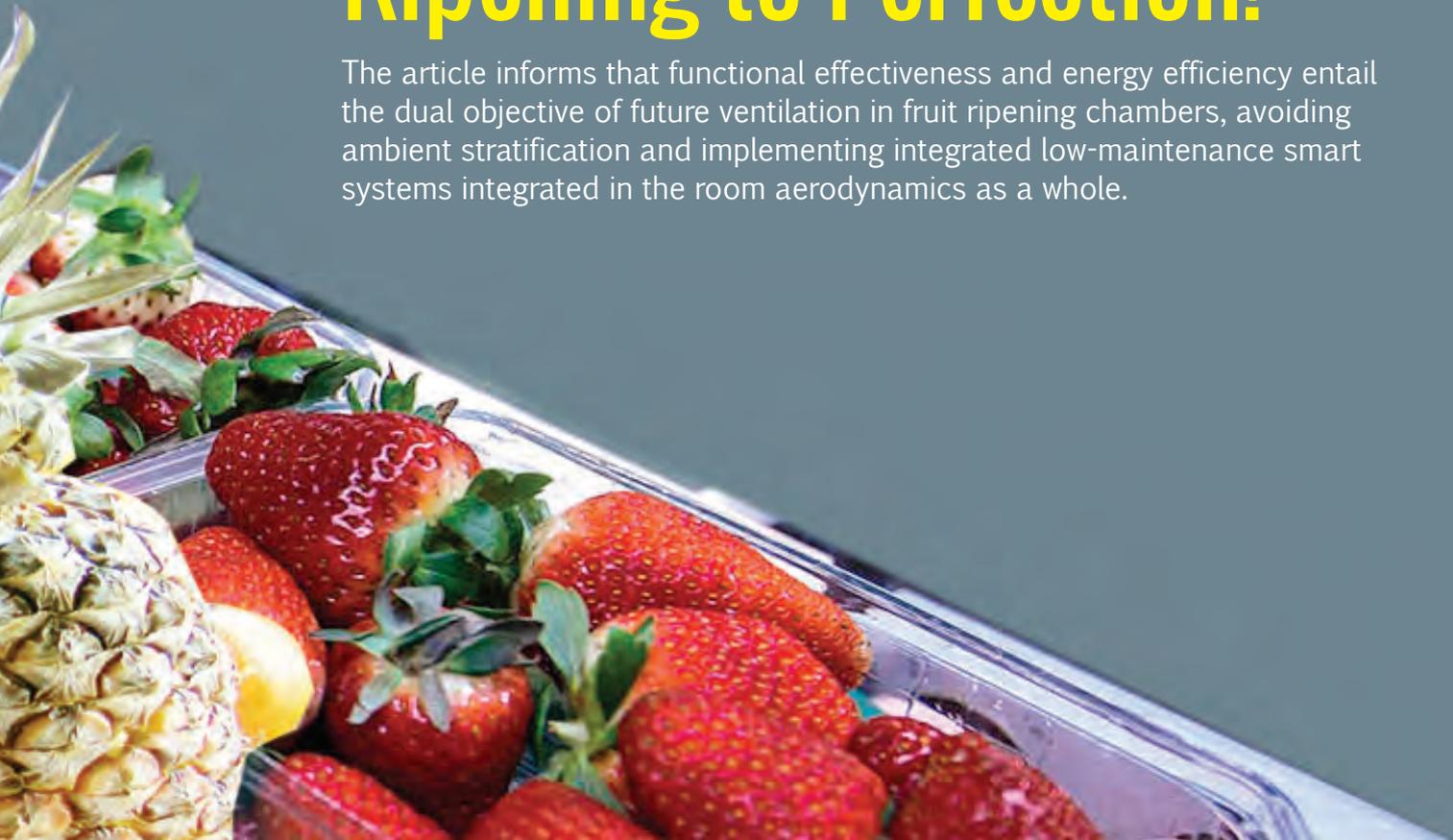
aeration and finally lack of maturation uniformity come along with energy-intensive facilities frequently demanding unreasonable service levels.

Reversible airstream is one of the preferred solutions to achieve equivalent distribution through the boxes from both sides. Unfortunately, it goes together with very low system efficiencies and the inconvenience of motor and brackets in the way, which prevents these fans to provide real equivalent airflows on both spinning directions; weight could be a handicap also both for the chambers structure and for the maintenance operations. Nevertheless, even based on reversible impellers, there is great room for efficiency improvements in the other main components of a ventilation system; the optimisation of motors (EC technology), supports and housing aerodynamics can reduce energy consumption and weight by 30 per cent in most of the current ripening fans worldwide.

Tens of billions of kWh are spent globally on ripening chambers every year, mostly on air movement and climate control, not always getting the expected results. Functional Effectiveness and Energy Efficiency entail the dual objective of

Ripening to Perfection!

The article informs that functional effectiveness and energy efficiency entail the dual objective of future ventilation in fruit ripening chambers, avoiding ambient stratification and implementing integrated low-maintenance smart systems integrated in the room aerodynamics as a whole.



future ventilation in fruit ripening chambers, avoiding ambient stratification and implementing integrated low-maintenance smart systems integrated in the room aerodynamics as a whole.

All this above can only be possible through a consistent and accurate supervision and operation system that leverages the optimised performance of structure plus equipment, enabling rather than just controlling. The ripening management must harmonise climate parameters, sensors, ventilation systems and channels, air movement speed working together; wireless technology already provides the opportunity to collect and handle all the potent data from expertise on the ground to manoeuvre on time today and learn for tomorrow, empowering the advancement in the future.

Intelligent motors and fans, smart sensors, interconnection of networks, internet of things, clouds, predictive analytics, machine learning, artificial intelligence, the future is already knocking the door!

The main question of ripening is ignoring what happens to the fruit before it arrives in the chamber. What if we knew? What when we actually know? Luck will not be part of the equation anymore; those ripening chambers capable to integrate data from all along the supply chain, analyse and predict properly in the market context to take coordinated, timely and decisive actions and learn for the future will succeed.

And this business model will radically change into higher operational efficiency

(automation, remote monitoring and control, better workforce productivity and satisfaction, optimising decision making, no routine tasks, qualification) and enhanced customer experience (accessible, transparent data and communication, integration of the physical and digital for tailored communication and devoted service); getting the work well done, ripening to perfection!

Will we be prepared for this scenario? ■



Paz García
Branch Manager Food,
Ziehl-Abegg



USE OF LOW GWP REFRIGERANTS IN SUPERMARKETS

This article gives a glimpse of three natural refrigerants that apply to supermarket refrigeration.

Supermarket refrigeration systems will be very different in the future, predict industry experts. Low GWP Refrigerants applied in refrigeration systems will soon replace the use of HFCs or even HCFC, wherever they are still in use in legacy systems.

Large supermarkets have central direct-expansion (DX) systems consisting of display cases on the floor that are

connected by long runs of refrigerant piping to condensers and condensing units located outdoors or in a remote mechanical room or on the roof. These systems are designed to be easy to access and service, as all the mechanical equipment is located in one area; however, the sizeable amount of piping can mean a greater chance for refrigerant leaks, which is becoming a growing environment concern.

A typical, large supermarket refrigeration system has a refrigerant charge of 2000 kg with an average annual leak rate of about 25 per cent based on high operation pressures and less than perfect maintenance. That means leaks could cause a supermarket to annually emit up to 500 kg of refrigerant – usually HFCs or even HCFCs -- every year. Multiply that by thousands of supermarkets across

India, and it is possible to see how this may be cause for concern.

Refrigerant phase down regulations are another reason why change is coming, as HCFCs are already mandated to be phased out, given their high global warming potential (GWP) and HFCs will likely be phased down by 2030 as well. At some point, supermarkets will need to start considering low GWP alternatives such as HFO blends, as well as zero GWP refrigerants such as propane R 290, ammonia R717, or CO₂ R744 for their refrigeration systems, that work 24 hours a day and 365 days a year.

Multi-national food brands favour the use of propane refrigerant systems in self-contained refrigeration units such as display shelves. The use of multiple self-contained refrigerated display shelves is far more flexible than central DX systems. So, if a supermarket decides to highlight a brand-new soft drink, they could move a propane refrigeration case to a prominent place near the front without disrupting the floor plan or making costly changes to the rest of the refrigeration equipment in the store.

In addition, self-contained propane units have been designed for safety. They contain only a small charge (no more than 150 grams per refrigerant circuit) and have a very low leak rate of about 2 per cent. Depending on the size, a supermarket using only self-contained refrigeration equipment could theoretically only have 50 kg of propane.

Another factor leading to change is that young people are increasingly moving to densely populated cities to live in remote suburban areas where they may not have ready access to supermarkets. Supermarket owners are likely to start opening smaller stores to cater to suburban markets.

Self-contained refrigeration cases may be a good solution, particularly, if a supermarket is taking over an existing building that offers less flexibility with the layout.

Supermarket owners may have even more choices of self-contained units in the near future, because several industry groups are trying to raise the maximum



charge size for flammable refrigerants such as propane in commercial self-contained cases from 150 to 500 grams. That is because while 150 grams of propane is adequate for small-to-medium-sized display cases, the larger display cases need more propane for cost-effective operation. Safe design and more efficient systems will allow larger charge systems to be acceptable.

Larger self-contained propane units will take time to become available because of current limitations on maximum charge and supermarket owners await that. Refrigeration contractors, however, may not be as excited about the widespread adoption of self-contained units. That's because these units typically require less

maintenance than large rack systems, and since they're virtually plug-and-play. Supermarket owners may choose to buy a new unit rather than pay to have an older one repaired. Although in a world with a shrinking base of service technicians, perhaps that's a good thing. That way experienced service techs could be used to work on the complex refrigeration systems that will likely still be used in the large megastores for many years to come.

Another natural refrigerant that is fast gaining application in refrigeration systems is carbon dioxide. Carbon dioxide as a refrigerant is not a new concept. CO₂ as an operating fluid in refrigeration systems was in use until the second half of the 19th





century. It is with the development of synthetic refrigerants like CFC, HCFC and HFC that CO₂ was put to rest as a refrigerant.

But with such unique properties, CO₂ has made a comeback as a refrigerant with the development of Transcritical CO₂ Systems since early 2000s. Such systems put CO₂ in a transcritical cycle, meaning CO₂ is made to undergo different phases with varying pressures and temperatures.

One of the main advantages of the transcritical system is that CO₂ is abundantly available in the environment. Waste produced CO₂ can also be used in this system reducing the overall greenhouse gases in the environment.

With all these advantages, the transcritical system is still not perfected. But we might be closer with India's first transcritical refrigeration system developed at IIT Madras.

Researchers from the Department of Mechanical Engineering in the Indian Institute of Technology, Madras, presented India's first CO₂ transcritical system recently. It is the first of its kind in India, and it is operating successfully in very high ambient temperatures of up to 45C according to Professor Maiya, a member of the research team.

The researchers tweaked the system by adding a liquid ejector and flooding the evaporator in the system. This resulted in an improvement of the CO₂ cooling stability and an overall reduction in power.

In recent years, there is a rapid increase in the cooling demand. Hence, not only the consumption of energy, but also the quantity of the refrigerants released into the air is increasing globally leading to planetary heating. Carbon dioxide (CO₂, R744) is a natural refrigerant which is emerging as a potential replacement for HFCs and HCs nowadays because of its attractive properties.

However, to avoid liquid entry into the compressor, conventional systems are designed and optimised to keep the exit part of the evaporator dry ensuring no liquid exits the evaporator. This requires superheating of the fluid which also contributes to internal irreversibility leading to lower COP. Hence, the liquid ejectors appeared as the potential option to improve the system COP by facilitating complete use of the evaporator by avoiding superheating and securing a safe return of liquid refrigerant.

It is observed that the increment in evaporator pressure and decrement in compressor power consumption are 4.5 per cent and 5.5 per cent respectively. From the reduced superheat, the design reduces the heat transfer area in the evaporator due to nonlinear refrigerant distribution and thus, contributes to energy saving.

This design shall result in commercial applications such as in refrigeration systems for supermarkets typically used in supermarkets, hospitality catering and

medical storage with significantly lower energy consumption.

Synthetic refrigerants – HCFCs and HFCs are very harmful to the environment. Natural refrigerants including Propane, CO₂ and Ammonia shall soon be the green replacements that the world is looking for.

So, perhaps the refrigerated supermarket facilities of the future will turn out to be a win-win for everyone based on changes in the refrigerants they use.

A third natural refrigerant is ammonia. The use of ammonia is on the rise as a choice of refrigerant not only because it is safer for the environment, but it is more energy efficient than other traditional refrigerants. It absorbs large amounts of heat during evaporation, it can pass through smaller pipes, but maintain the same amount of refrigeration capability as other refrigerants.

Its thermal capacity enables it to use less energy than other refrigerants, particularly when used in industrial applications, like supermarket refrigeration systems. This is a good thing since supermarkets are high energy users. In fact, more than half of their energy usage is attributed to refrigeration.

Supermarket owners that look to apply ammonia should be confident that a properly implemented system can be extremely safe and efficient. Beyond this, there are no deterring code restrictions preventing its use. Utilising ammonia commercially doesn't require the reinvention of the wheel. Ammonia systems have been used in India and around the world for many years in various types of industries and applications – and more recently – in supermarkets.

With the success of ammonia-based refrigeration systems so far, it makes sense for supermarkets to take a further look at the new technology.

To date there are at least five US supermarkets that have installed a refrigeration system that use ammonia, along with CO₂. This makes an NH₃ or CO₂ system one of the most unusual of natural refrigeration technologies (propane or CO₂ is in use too), with the efficiency and environmental advantages it offers.

However, supermarket owners have a reason for slow adoption of ammonia namely fear. The fear stems from ammonia's toxic properties as well as the noxious odour it exudes; an ammonia leak is not something they would accept,

From a safety standpoint, there is no need to be overly concerned about having 100 kg of ammonia at multiple locations in a supermarket when correct equipment location and easy venting can be a part of the installation design.

One US Store, is the first all-natural refrigerant store that uses ammonia on the roof on the high side with CO2 circulated in the store in a cascade configuration. It also employs a redundant R407A system to run energy-efficiency comparisons with the ammonia or CO2 system. The energy consumption of the ammonia or CO2 system and versus the redundant R407A system, found the former to be 12 per cent -16 per cent more efficient than the latter.

This study is certainly good guidance for early adoption of natural refrigerants in an extended central refrigeration system in a supermarket.

While anxiety about ammonia appears to be an obstacle that can be overcome, the high cost of hybrid ammonia or CO2 systems remains a major deterrent to the implementation of these systems by food retailers, who operate in a very low-margin business.

Some of the ammonia or CO2 systems in US supermarkets have demonstrated energy-saving capabilities just via the refrigeration cycle efficiency. At one particular store, an ammonia refrigeration Unit consumed 22 per cent less energy on an average compared to similar application HFC refrigeration unit, during a four-month period.

Natural refrigerants – Propane, CO2, ammonia and hybrid ammonia CO2 refrigeration will soon be common in supermarkets in Europe and the US,

because of the rapid push to phase down HFCs there. It may take longer in India but good research and regulation will hasten the process. Installation and operation safety protocols must be in place before their adoption.

Synthetic refrigerants – HCFCs and HFCs are harmful to the environment. Natural refrigerants including Propane, CO2 and ammonia shall soon be the green replacements that the world is looking for.

So, perhaps the refrigerated supermarket facilities of the future will turn out to be a win-win for everyone based on changes in the refrigerants they use. ■





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Smart Cold Storage for

Organic Food

An in-depth article on how important is efficient storage of organic food having huge demand for reaching to the end customers with good price.

Smart food parks are the new requirement of New Indian market where new players like Patanjali, Amazon and Big Basket expanding their operations and old players like Food Corporation of India, Future Group updating themselves. Organic food and beverage are great in demand where traditional foods like rice, sugar etc required to be hygienic and cheaper to fight the market price. People are ready to pay 20 per cent extra amount to get organic food which are claimed as pesticide free. Our neighboring country Bhutan is a good producer of organic food. In India, Sikkim is only state which produces all organic foods. While the demand of these food is more considering the large population and its demand but at same time the production

space and distance from the farm to the consumer is also more. In this scenario, proper storage of organic food is very important as its production cost is more and any damage to the food will be huge loss to the producers. Smart cold storage system plays very important roles in maintaining quality and cost of these foods.

Technology

- Cold storage system is used in many countries of the world to store various types of foods. It is suggested here that along with cold chain facilities, it is required to maintain the quality due to high ambient temperature prevalent in the country.
- Onion, sugar, rice, poha, vegetables, pulses etc should not be stored unless adequately dried either in the field or by artificial means. It is necessary to dry the neck tissue and outer scales until they rustle when handled, otherwise the bulbs will rot in storage.
- Sprouting of dry foods is controlled by lower temperature. The temperature between 10-25°C increases sprouting. Rooting is influenced by relative humidity (RH). More the relative humidity more is rooting. For effective long storage of these foods in cold storage, the parameters essential to be looked after are the bulb size, choice of cultivars, cultivation practices, time of harvest, field curing, removal of tops, drying, grading, packing, storage conditions (optimum storage range of relative humidity 65 per cent to 70 per cent with the temperature ranging between -4C to -6C).

Most important features of cold storage structures are:

- Use of RCC roof or other suitable materials with insulation to prevent built up of high temperature inside.
- Increased centre height and more slope for better air circulation and preventing humid micro climate inside cold storage chambers.
- Providing bottom and side ventilations for free and faster air circulation and to

avoid formation of hot and humid pockets between the onion layers.

- Avoid direct sunlight or rain water falling on foods to reduce sun scald, fading of color and quality deterioration.

Types of HVAC System

- Latest technology for ventilation, dehumidification and RH controlling and monitoring equipment from the best manufacturer.
- Ammonia Liquid Overfeed Refrigeration System for Cold Chambers.
- Air-conditioned ante rooms on each floor with separate entry through cold store doors on each floor.
- Efficient ammonia liquid overfeed system is provided which improves the performance of refrigeration system culminating into power saving.
- The entire cold storage unit along with their testing labs can be connected with a proper integrated building management system (IBMS).

IBMS connectivity of cold storage data for smart users

In any cold storage building, there are number of mechanical equipment such as chillers, AHU, pumps, valve, electrical equipment such as switch gears, generators, panels, transformers, PHE equipment such as pumps, STP, boilers, treatment plants can be seen in any building along with measuring devices such as Btu meters, DB meters and energy meters. When this equipment gets connected with one central point for a common goal, it will be known as Integrated Building Management System. IBMS takes care of each equipment for their operation, time management and saving energy. Different equipment of an organic food cold storage building which can be connected as below:

- LED fixtures
- Proper DG Back up
- Water and power efficient chillers
- VFD in pumps, AHUs
- Temperature sensor for conditioned area
- Water saving fittings
- STPs with sensors

- CO and CO2 sensors
- Oil Indicators
- Material sampling unit
- In coming material testing machine data points
- Material outgoing data points

There are lot many mechanical and electrical equipment not listed above which are found in any building and have optimised by design engineer in terms of power and water saving. But the main object will fulfill only with the help proper and adequate IBMS. Latest technology with proper sensors, DDC controllers, RS 485 ports and with smart storage data will keep the food safe. It will reduce power consumption and will always give history of the storage process also. The user can check and track product quality starting from the date of storage till the time they are taking back their foods which gives them a satisfactory level regarding the storage process. The store manager can get a proper costing of electricity bill, other operation cost, maintenance cost etc to find out the cost to be invoiced for each product along with their profit.

Conclusion

The traditional way of food storage in India is not efficient and ends up in huge damage to the product. In the above article, we just highlighted dry foods and its storage process whereas liquid foods need different process altogether. We often see in news channels how tons of foods get wasted in rain every year in the government warehouses. Proper storage of the food in a proper way will give a better return of investment. The actual return of investment will be nearly four years. Organic food is very good for health and has huge demand and with proper storage it can reach to the end customers with good price. ■



By Firoj Jena
Chief Executive
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The article sheds light on how important is fruits and vegetables grading for enhancing its marketing efficiency.

Advantages of Fruits & Vegetables Grading

Agricultural produce particularly fruits and vegetables form an important part of trade both nationally and internationally. Among the post-harvest operations applied during handling of fruits and vegetables, grading plays an important role to remove undesirable or foreign matters from the harvested crops into various fractions. Grading is sorting or categorisation of fruits and vegetables into different grades according to the size, shape, colour, and volume to fetch high price in market. Besides grading, the other post-harvest operations such as precooling of produce to remove field heat, post-harvest treatments and packaging etc are also critical to marketing success.

Produce brought in many markets often has variable characteristics and sometimes it may be delivered immature or contain shrivelled, damaged and rotten materials. Delivering such produce generally results in lower prices. Thus, systematic grading is pre-requisite for efficient marketing of fruits and vegetables. The bruised, damaged and mis-shapen produce should be sorted out and healthy fruits or vegetables should be graded according to their size, weight, shape, colour, maturity etc. The fruits or vegetables can be graded in extra fancy, superior and

standard grades or class I, II and III, respectively. Various advantages of grading are outlined below:

Advantages of Grading

- The graded produce fetch better price in the market.
- Grading helps to develop greater confidence between buyers and growers.
- Increase the marketing efficiency by facilitating buying and selling a produce without personal selection.
- Heavy marketing cost in packing and transportation can be avoided by grading.
- Increasing distributors' profits.
- Increasing producers' profits.
- Grading improves product uniformity within a particular grade and serves as the basis for price.

Methods of Grading

Grading of fruits and vegetables is generally done on the basis of physical characteristics like weight, size, colour, shape, specific gravity, and freedom from diseases. For fresh marketing,

the known methods of grading of fruits and vegetables are manual grading, or machine grading. In both the methods, the produce is graded on the basis of size. However, electronic grading systems are gaining impetus in the horticultural sector and have been used successfully in pilot scale studies. Grading process is fully mechanised but in India it is still done manually. Basic process behind mechanical grading consist of a conveyor belt with a bag at the end wherein smaller produce fall through the chain making grading process less extensive. Fruits and vegetables are generally graded on the basis of state, federal, and international standards. Every country has set their own standards of different grades as per the market requirements. However, for international market three general grades are considered as: Extra class, Class I and Class II.

Extra Class: The extra class is of superior quality poses the shapes and colour of the variety and without internal defect likely to affect the inherent texture and flavour. A 5 per cent tolerance is allowed for errors. It must be carefully presented taking into accounts the uniformity of the produces in size, colour, and condition arrangement of the produce in the package, quality and appearances of the packing or pre-packing material.



Grading of capsicum



Different Grades of Kinnow

Class I: Almost having a same quality is like the Extra Class except that a 10% tolerance is allowed. Individual fruit is allowed a slight defect in shape, colour and minor skin defect which do not affect the general appearance for keeping qualities.

Class II: This class product may exhibit some external or internal defects provided they are fit for consumption while fresh. This class is the best fitted for local or short distance market. This category will satisfy the needs of customers who are not too demanding and for whom price is more important than quality.

Grades of different fruits & vegetables as suggested by Directorate of Marketing and Inspection (DMI)

Directorate of Marketing and Inspection (DMI) under Ministry of Agriculture and Farmers Welfare, Government of India was set up in the year 1935 to frame the grade standards in a scientific manner. The different grades used in some important fruits and vegetables with respect to weight, diameter or length as applicable are given as under. For grading information on other fruits and vegetables, following site i.e. www.dmi.gov.in can be accessed.

Fruits



Grapes

Grade	Size of berries	
	Large bunch weight (g)	Small bunch weight (g)
Extra Class	200	150
Class I	150	100
Class II	100	75

Litchi

Grade	Diameter (mm)
Extra class	33
Class I	28
Class II	23

Kinnow

Size code	Diameter (mm)	No. of fruits in 10 kg pack
A	60-64	84
B	65-69	72
C	70-72	60
D	72-74	54
E	75-79	51
F	80-85	45

Apple

Size code	Weight (g)	Diameter (mm)
A	More than 241	More than 80
B	211-240	76-80
C	181-210	71-75
D	151-180	66-70
E	121-150	61-65
F	91-120	56-60

Guava

Size code	Weight (g)	Diameter (mm)
A	>350	>95
B	251-350	86-95
C	201-250	76-85
D	151-200	66-75
E	101-150	54-53
F	61-100	43-53

Mango

Grade	Weight (g)
A	200-350
B	351-500
C	551-800

Pear

Grade	Diameter (mm)
Extra class	60
Class I	55
Class II	50

Vegetables



Potato

Size Code	Diameter (mm)
A	18.1-28.0
B	28.1-45.0
C	45.1-65.0
D	65.1-80.0
E	More than 80

Chillies

Size Code	length (cm)
A	less than 2.6
B	2.6 – 4.0
C	4.1 – 7.0
D	7.1 – 10.0
E	10.1 and above

Cabbage

Size Code	Weight (g)
A	201-600
B	601-1200
C	1201 and above

Tomato

Size Code	Diameter (mm)
1	30-34
2	35-39
3	40-46
4	47-56
5	57-66
6	67-81
7	82-102
8	102 and above

Onion

Size Code	Diameter (mm)
A	10-20
B	21-40
C	41-70
D	71 and above

Okra

Size Code	length (mm)
A	40.1 – 65.0
B	65.1 – 90.0
C	90.1 – 115.0
D	115.1 and above

Sweet pepper

Size Code	Diameter (mm)
Elongated (pointed)	20
Square (blunt)	40
Square tapering (pegtop)	
Flat (tomato pepper)	55

Cucumber

Size Code	Weight (g)
A	Upto 180
B	181-250
C	251 and above



Graded Fruits and vegetables in market

Conclusion

Manually grading is costly and grading operation is affected due to shortage of labour in peak seasons. Human operations may be inconsistent, less efficient and time consuming. New trends in marketing as specified by World Trade Organisation (WTO) demand high quality graded products. Farmers are looking forward to having an appropriate agricultural produce-grading machine in order to alleviate the labour shortage, save time and improve graded product's quality. Grading of fruits is a very important operation as it fetches high price to the

grower and improves packaging, handling and brings an overall improvement in marketing system. The fruits are generally graded on basis of size and graded fruits are more welcome in export market. Grading could reduce handling losses during transportation. ■



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“SIGNIFICANT INROADS IN GREEN BUILDINGS”

Hiten Sethi,
CEO, Hiten Sethi &
Associates (HSA)
while highlighting India’s green building progress, trends, enormous challenges in the sector informs that India ranks number 2 after the US in terms of the number of green technology projects and built-up area in an email interaction with **Cooling India.**

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

In order to have a sustainable and holistic development, there is a need for balance and harmony between the economic, social and environmental needs of the country. There is a need to strike a balance between development and environment protection. India is walking a sustainable development path and has emphasised on green building development to maintain the climatic balance.

The concept of green building is prevailing in India for approximately 1,000 years, and is a way of life. The havelis that were built hundreds of years ago had thick walls,

jharokas and jaali windows that cooled the air along with water bodies in the central courtyard. Green architecture has been the part of our civilisation that started getting lost in the 1920s. Like most other Indian concepts that have caught on in the West, to be later aped by India, green architecture too is seeing a similar trajectory.

In the last few years, green building construction has made significant inroads in India and today it has emerged as one of the world's top destinations for green buildings ranging from residential complexes, exhibition centres, data centres, hospitals, educational institutions to laboratories, IT parks, airports, government buildings, corporate offices etc.) and implemented a number of rating systems LEED-India, GRIHA, IGBC etc which open up a wide range of opportunities in construction, architecture and engineering design, building materials and equipment manufacture.

With a mere beginning of 20000 square feet in 2003, India's green building footprint has grown manifold to date and according to the CII study and statistics which estimated that the market of green building construction is set to grow substantially in the years to come.

What trends do you see in the green building industry? What are you most excited about?

Increased competition among green building rating systems, the rise of net-zero buildings and a sharper focus on existing structures are among the trends that will drive sustainability through 2020.

I identify few megatrends that I believe will shape green building technologies, markets, government rules, and certification systems through 2020 and beyond.

Globally, green building will likely continue its worldwide growth, especially, in most countries of Europe and North America, as well as in fast-growing countries in the Asia-Pacific region, South America, and the Middle East. Each year, more government agencies, universities, property developers, and corporate real estate managers incorporate green design ideas and measures into their buildings and facilities. There is nothing on the horizon that will stop this megatrend.

It is worth noting that trends revolve around energy, water conservation and use of green building materials energy efficiency, zero-net-energy, cloud-based (and data-driven) energy management, energy performance disclosure, and solar power. These are largely impelled by two practical considerations: first, for most buildings, energy is the largest uncontrollable operating cost; second, the growing understanding of a connection between building energy use and global climate change means that corporate social responsibility and government action will result in rising

demand for building energy efficiency. The use of green building materials and products represents one important strategy in the design of a building. Using green building materials and products promotes conservation of non-renewable resources and helps in reducing the environmental impacts associated with the installation, reuse, recycling, and disposal etc. of the building materials. Most importantly energy efficient products and systems used in construction of sustainable building reduce maintenance and operating costs to large extent and it is noted that green buildings generally use 50 per cent—75 per cent less energy than conventional construction.

How would you achieve the goal of energy efficiency during the planning of buildings?

Energy is the single largest operating expense and accounts for more than USD 100 billion in expenses for commercial buildings every year in India. Major emphasis in green building is given on saving energy costs through proper selection of energy efficient products in lighting system, insulating system, heating ventilation & air conditioning, glazing and cladding etc.

Lighting is one of the important aspects in residential or commercial décor. About one-quarter of the electricity budget is spent on lighting. So, by specifying a high-quality energy efficient lighting system that utilises both natural and electric sources as well as lighting controls can provide a comfortable yet visually interesting environment for the occupants of a space.

Properly designed insulation system can mean big energy and cost savings for building owners. With a view to improve efficiency and thereby, enable conservation of energy, different segments of the industry and for different market applications, the best products are incorporated in the design stage line insulation boards, shield and reflectors to reduce solar heat gain, thus, saving on air conditioning costs, both capital and running costs, by suitably incorporating the same at the design stage.

Air conditioning happens to be a major requirement in the building industry, which contributes towards large energy consumption and its running costs. Keeping this in view, energy efficient designs should be applied through judicious use of insulation products for such a system. This would directly help in reducing costs and also environmental impact. Thus, selection of effective insulation materials, applied in the right manner, would contribute towards reducing costs in the working of Air Conditioning plants, help in containing ingress of moisture, which is detrimental to HVAC systems and Indoor Air Quality.

Glass cladding or facades optimise the use of natural light to illuminate the interior, thereby, not only making it more comfortable for occupants but also reducing the use of electricity or fuel-powered light. In tropical countries like India, a major requirement is air conditioning of the building. Proper usage of glass can ensure that the air conditioning loads and therefore, the air conditioning expenses can be reduced by controlling the heat coming into buildings. This is done by careful usage of glass with appropriate solar control so as to reduce the heating up of the building due to direct solar radiation.

In cold countries or parts of India where winter temperatures are low, there is a requirement for heating the interiors. One can reduce the heating loads (and the heating expenses) by reducing the heat loss from the inside to the outside. This is done by using heat insulating glass which reflects the far off infra-red radiation or thermal radiation which is the means by which the heat loss happens from inside to outside.

The glass is gaining wide acceptance due to the increasing regulation. ECBC (Energy Conservation Building Code) specifics use of energy efficient glass combinations to maximise daylight and minimise cooling loads.

What are the sustainable design considerations adopted during the construction of green buildings?

For sustainable design of the project we must stress on green construction practices such as preserving the top soil for landscaping during excavation, maintaining water and energy efficiency during construction, use environment friendly material for construction procured from areas within the 500 km radius of the site, such as fly-ash building blocks, other recyclable materials.

Committed to 100 per cent green compliance, the design must offer complete recycling of grey water for landscaping and flushing purposes, rainwater harvesting system and install metering devices to measure treated grey water consumption for flushing, landscape water consumption and hot water consumption.

What are the challenges faced during the planning of green building? How do you overcome the same?

There is not repudiating to the fact that sustainable building is still in its embryonic stage in the country, but according to numbers, India is one of the leading countries when it comes to green building developments. In actual fact, India ranks number 2 after the US in terms of the number of green technology projects and built-up area.

The initial investments of constructing a green building can be moderately high as compared to the conventional ones; the enduring benefits make sustainable building an enormously viable long-term investment decision for both consumers and developers. In India, GRIHA and IGBC are the leading bodies who define the green buildings' standards.

Few barriers preventing the wider adoption of green building technologies are:

Limited Awareness

A very large segment of Indian users is unaware of green buildings and its enduring benefits even today. Users who know little about green buildings perceive it to be an expensive and financially unachievable option. Inadequate Government's Policies & Procedures Irrespective of the fact that India is setting ambitious targets for green building agenda, sadly most of it is not complemented with proper government rules and regulations to spur growth. There is an inadequacy of proper government rules and regulations to enforce large-scale implementation of green buildings norms.

Extra Clearances and Approvals

Builders and developers have to go through a very tedious process when it comes to approvals, adding to that burden is the list of approvals for green building compliances, this can be one potential reason deterring rapid adoption of green buildings.

Deficient Incentives to Encourage Adoption

Currently, there are very few incentives plans available to encourage green building adoption in India. Also, the ones which exist are not uniform as they vary across different states and cities, depending largely on the diverse governing bodies. In most of the cases, green building incentives are in the form of additional FAR, which is followed by a rebate on the property tax and other similar schemes.

Expensive Equipment and Products

The equipment and products used in the construction of green buildings are too expensive when compared to the conventional ones. Many developers and builders are concerned that adopting green features into their buildings will involve high upfront costs.

Lack of Skilled Manpower and Subject Matter Experts

One of the biggest factors holding back green building adoption in India is lack of skilled experts and manpower. From policymakers to architects, engineers to contractors and workers, none of the groups possess adequate knowledge and skills needed for green buildings construction

Even though green building practices is gaining increasing acceptance in the construction industry as a viable solution for meeting the growing demand for environmentally friendly or healthy buildings. However, the uptake of green building technologies is not as apparent as it should have been.

What kind of innovations would you suggest to make green buildings more sustainable and energy efficient?

It is important to ensure all new construction for commercial or residential or mixed-use buildings as defined by the ECBC to be ECBC compliant.

Target 50 per cent greening of rooftops and public spaces in all urban areas to prevent urban heat island effect; in the first phase, important cities (3–4) may be taken for greening.

There is a need to take retrofit measures to make the existing building stock energy efficient and water wise to overcome the various environmental challenges posed by the sector. Turning heat into light that could make solar panels 80 per cent efficient, pairing geothermal plus rooftop solar for a truly renewable home.

New stock to be built on the principles of green buildings to accrue social, environmental, and economic benefits. Alternate building materials which perform equal or better than the conventional ones to bring in environmental sustainability.

A strategy and implementation plan at the national level on promotion of green materials and replacement of high embodied materials with low embodied materials—a must for India given the high construction rate.

Exclusive substantial financial allocation for R&D on green buildings and new materials, revitalising or strengthening all the buildings centers and facilitating establishment of new institutes as centres of excellence; regional presence of such centres of excellence in all regions of the country; incentivising the R&D and innovative initiatives.

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?

Greening of the building sector offers great economic and environmental opportunities and enormous challenges. EE measures undertaken at a slow rate and integration of various essential green measures is currently missing at the national and sub-national policy levels.

There is a need for integrating green measures such as storm water management, wastewater management, rainwater harvesting, low impact development strategies, use of appropriate construction materials and technologies, along with intensive measures targeting energy efficiency and renewable integration both for thermal applications and generation of electricity should be the vision as part of green growth strategy. ■

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Drying is a widespread established concept mostly used in the food industry, typically employed to convert a surplus crop into a shelf stable commodity. This article introduces recent progress made in various drying techniques, both benefits and drawbacks, and highlight several technologies with high industrial applicability.

DEHUMIDIFICATION IN F&B INDUSTRY

Use of dehumidification in dehydration is among the oldest and most prevalent processes used for food preservation. Foods are typically dried to achieve shelf stability and therefore, moisture is removed to the point where the water activity of the product is sufficiently low to ensure that the product is microbiologically and enzymatically stable. In order to ensure stability while in storage, the water activity is usually required to be lower than 0.7. In this state, the product undergoes limited deterioration during storage which allows the product to be made available outside of the normal harvest times without necessitating expensive continuous refrigerated or frozen storage as shown in figure 1. There are other benefits to dehydrated goods, where as dried products may be incorporated more easily into manufactured food products. Common examples of this include their incorporation into baked products, breakfast cereals, or ready to eat snack mixes. Moisture removal

is also an effective method to lower transportation by reducing the weight of the product.

There are however, some drawbacks to drying food products. Drying alters the characteristics of food products, where in general, dried fruit suffers from several faults including loss of juiciness and lignified tissue, both of which result in a harder or chewier product. Other typical quality loss attributes include case hardening, wherein the outer layers of the product are overdried in the process of removing moisture from the less accessible inner core of the product along with product shrinkage are among the issues associated with convective air drying. Additionally, changes can be noted in terms of loss of flavours and aroma volatiles, deterioration of colour and texture, and an overall decrease in nutritional value, effects that are largely attributed to products' exposure to high temperatures for long periods of time in the presence of air. These effects are, therefore, exacerbated by



Fig. 1. Preservation of foods in dehumidified environment of super market.

the oldest and the most widely used dehydration method in the food industry, convective air drying. While air drying has proliferated because of its simple operation, relatively low construction costs, ability to burn biomaterials to provide the necessary thermal energy, and well characterised operating principles, convective air drying has also been shown to be hugely energy inefficient and destructive to product quality.

There is an ongoing push from increasingly health aware consumers for higher quality dried products that maintain more characteristics of the fresh product. With that in mind, the key to improving the quality of dried products is to limit changes to the aforementioned quality characteristics during processing. In addition to quality concerns, the main interest from the industrial perspective should be from the perspective of reducing energy consumption and associated long term savings.

Different techniques of dehumidification

Microwave heating in foods

Microwaves are members of the electromagnetic spectrum in the frequency range of 300MHz to 300GHz. Frequencies reserved for microwave heating applications include the 915MHz, 2450MHz, and 5800MHz bands, where 2450MHz is the most commonly used for food production, and exclusively so in consumer-based microwave ovens. Microwaves heat foods differently than conventional heating methods, where in conventional thermal processes, energy is transferred to the material through convection, conduction, and radiative heat transfers. Conversely, microwaves cause the material to heat internally according to the dielectric properties of the target material, causing an effect known as volumetric heating.

More specifically, heat production within the food product is the result of the following two mechanisms: first by molecular friction due to the rapid movement of molecules with permanent dipole moments in response to the changing direction of microwaves, which takes place 2.45 billion times per second in the case of the 2450MHz band. Secondly, the charge drift of ionic species under the action of the microwaves leads to collisions between ions and increasingly disordered kinetic energy throughout

the sample and subsequent heat generation. Non-polar molecules that are asymmetrically charged may behave as dipoles in an electric field, but their responses to microwave energy are typically an order of magnitude less than that of water.

Microwave vacuum drying

The application of vacuum during microwave drying has been considered for many years to be a good solution for alleviating physical damage caused during microwave drying such as scorching, off-color production and uneven heat distribution. Because of the presence of a vacuum, during microwave-vacuum (MWV) dehydration the continuous application of microwave energy can cause massive fluxes of vapour towards the surface early in the process, and cause damaging temperature spikes later in the process. Moreover, it has been shown, at least on a bench top scale, that continuous application of microwave energy does not accelerate the rate of water removal once a critical moisture content has been reached and it been shown that there is no energy or quality advantage of continuous over pulsed application of microwave energy. As a result, the magnetron duty cycle is typically altered during these experiments in order to limit power application to the samples.

Solar drying

Open sun drying is a traditional method used widely after harvesting. Although its operating cost is quite low comparing with those of other drying methods, sun drying requires long drying time depending on the climate conditions. For example, a practice for cocoa production after fermentation in Brazil requires sun drying on wooden floor platforms with movable roofs for 1-12 days. Sun drying crops on concrete floor is preferred as this floor type provides better hygiene and shorter drying time; since concrete floor is better heated by the sun, it helps dry the crops faster. Natural ventilation drying, heated ventilation drying and stirred ventilation drying are also common methods that can be used to reduce the grain moisture content after harvesting.

Super heated steam drying

Superheated steam drying (SSD) involves the use of superheated steam in a direct (convective) dryer in place of hot air, combustion, or flue gases as the drying medium to supply heat for drying and to carry off the evaporated moisture. Apart from its advantages in terms of the ability to produce a dried product with higher porosity, better colour and more nutrition, SSD has also proved to be more effective than hot air drying in terms of microbial inactivation.

Heat pump drying

Heat pump drying (HPD) is a rapidly emerging technology, which can be used to dry spices within a controllable drying environment, specifically, the temperature and humidity. Heat pumps transfer heat from a source of heat to a destination called a heat sink and one of the important factors to be noted here is that it uses comparatively a small amount of external power to accomplish this task. Heat pumps have been designed in such a way that the thermal energy moves in the opposite direction of spontaneous heat flow by absorbing heat from a cold space and releasing it to a warmer one. Maintaining and controlling the correct levels of

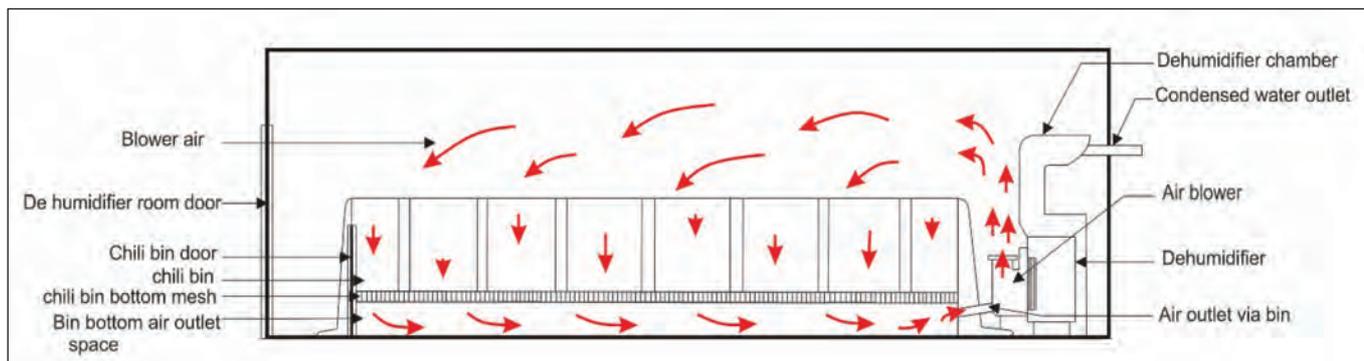


Fig. 2. Working principle of heat pump drying.

moisture content throughout the processing is the key factor in achieving the expected quality and it can be achieved using HPD system as it uses dehumidified air as shown in figure 2 for drying at relatively low temperature while preserving the volatile compounds. In addition, environmental concerns are minimal and economic viability is in an acceptable range. It is, therefore, HPD can be considered as an alternative method for drying chilli owing to its specific characters. However, designing and evaluating of HPD system in the chili processing industry is yet not well developed and it is, therefore, the study was conducted with the main objective of evaluating the compatibility of HPD system for mass drying of chili to be used in industry by analysing the specific moisture extraction rate (SMER).

Desiccant based dehumidifier drying

Desiccant dehumidifier dryer consists of a desiccant dehumidifier and drying chamber as shown in figure 3. The drying chamber is connected to dehumidifier by flexible pipes. The drying chamber



Fig. 3. Desiccant based food dryer.

made up of plywood and consists of five trays arranged one over the other with sliding rollers, plenum chamber, air inlet and chimney. Low humidity is maintained during drying ranges from 17-20 per cent and the drying temperature of 45C were selected for drying, keeping in view the product quality as well as time required for drying. For comparison of drying time and quality of dried product, samples were also dried in tray dryer at same drying air temperature. Desiccant food drying system can be used for drying various agricultural products, efficiently and economically without compromising with environmental conditions. The regeneration temperature and air flow rate of the dehumidifier was controlled to maintain constant optimal temperature (45C) and uniform drying rates within the drying chamber.

Conclusion

With an awareness of the dehumidification capabilities available for the food and beverage industry, many of the lessons learned in food processing facilities can be applied in the greenhouse industry. The most important aspect concerning optimisation of the greenhouse climate is with high humidity that can damage plant growth. In extreme conditions, excessive greenhouse RH can give rise to water droplets forming on the leaves, which can incubate and spread fungi, while the excessive heat will shrivel many types of fruits and hinder growth. In other industrial greenhouse projects, the conditions outside a greenhouse can impact the natural ventilation process negatively. To assure perfect conditions for plant growth, refrigeration-based dehumidification systems targeted for high temperatures and high moisture levels help sustain the best growing conditions. As with beef and poultry applications, a chilled water-pre-cooling coil is mounted directly at the dehumidifier inlet. This design allows for removal of much of the initial heat and moisture prior to entering the dehumidifier where the moisture is reduced even further. ■



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ISHRAE's ARCHITECTONICS provides platform for Architects & MEP Professionals

ARCHITECTONICS is a flagship program launched by ISHRAE Mumbai Chapter amongst its various other programs to address the need for a common platform for effective communications between architects and MEP professionals on July 19th in Mumbai.

Key dignitaries present at the inaugural were Mihir Sanghavi, President, ISHRAE Mumbai Chapter; Pradeep Bakshi, Managing Director & CEO, Voltas; Amod Dixit, President, ASHRAE Mumbai Chapter; R N Joshi, President Elect, ISHRAE Mumbai Chapter; Hiten Sethi, Principal Architect, Hiten Sethi Architects; Dr Clayton Miller, Assistant Professor Department of Building, National University of Singapore; Sandeep Shikre, Principal Architect, SSA Architects; Vivek Bhole, Principal Architect, Neo Modern Architects among other industry players.

It is a program for the architects, by the architects to create and understand the synergy with MEP professionals, which would create an unique interaction with the industry as a whole. It is a novel attempt to get all the stakeholders on common platform like end clients, builders, architects, MEP consultants, MEP contractors, system manufacturers and service providers.

ARCHITECTONICS brought together over 250 delegates from the industry and decision makers from the industry like architects and interior designers, structural, MEP, landscaping, transportation, environmental etc, to improve the performance and lifecycle of buildings.

The highlight of the program would also be discussions on contemporary topics like NETZERO Building Case Study, Campus Planning and Design, Connecting Human with Nature, Biophilia Approach, MEP in Architecture, and Case Study of JIO World Centre

Voltas, has taken the lead and has come forward to be a partner at ARCHITECTONICS.

ISHRAE is an association of 28000 members of HVACR engineers across India with the presence in 41 cities. It also has 10,000 student members. The main goal of ISHRAE is disseminating the knowledge of HVACR through training and courses. Other such events are ISHRAE Certified Professional courses in HVACR industry.

Mihir Sanghavi, President, ISHRAE Mumbai Chapter, informs "ARCHITECTONICS is an initiative of ISHRAE Mumbai chapter to create an effective way of communication between architects and MEP experts to meet the industry expectations. We thank M/s Voltas Ltd for supporting this movement. We have fantastic

bouquet of subject matter experts who will share their experience and knowledge through paper presentations, case studies and interactive sessions."

Vikram Murthy, National President, ISHRAE HQ, says, "ARCHITECTONICS is a path breaking program by ISHRAE Mumbai Chapter to integrate the elements of form and function of buildings and occupied habitats by combining multiple design elements to create spaces that please the occupants and enhance the environment. The architect and engineer fraternity are the stakeholders who will deliberate the advantages and the paths of this integrated approach. ISHRAE is a leader in catalysing and driving sustainable development through such multilateral forums."

Pradeep Bakshi, Managing Director & CEO, Voltas says, "At Voltas, we have always ensured that our MEP solutions seamlessly fit the architect's vision and the project's infrastructure. As a customer centric organisation, we are committed to offer innovative, state-of-the-art cooling and engineering expertise. We are delighted to be associated with the ISHRAE Mumbai Chapter in their first ever architect focused event ARCHITECTONICS. We look forward to engaging further with the fraternity to deliver best in class-built infrastructure solutions."

Amod Dikshit, Incoming President, ASHRAE Mumbai Chapter, "ARCHITECTONICS came as an idea to blend Architecture and MEP services cohesively. There has always been a gap between these disciplines and complaints from architects, MEP engineers and clients about these gaps. As ASHRAE, we thought of bridging this gap on a common platform and what better than getting both the fraternities on a common platform like ARCHITECTONICS, which brings architecture and technology together."

Hiten Sethi, CEO, Hiten Sethi and Associates, states, "With the recent success of ISHRAE Mumbai Chapter's National event Symposia, the importance of sustainability in architecture and construction industry again became the centre of discussion. Emphasis was on the environmental and social impacts of buildings by utilising design methods, materials, energy and development spaces that can be positive contributors to the neighbourhood. As architects, it becomes our prime responsibility to act on different levels with allied engineering professionals like structural, MEP, landscape, transportation, environmental, etc., to improve performances and life-cycle of the buildings. With this strong interface and collaboration, we can again emphasize on Right to Live - Healthy and Happy." ■



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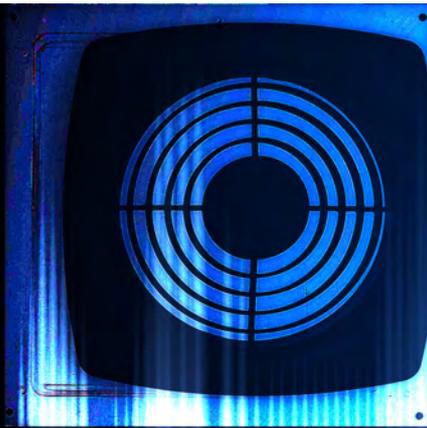
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Impact of Low Frequency Noise in HVAC Systems

This article is based on a case study the author had to resolve problem at TELCO - ERC, Pune during year 1975-76. The article discusses that annoyance by low frequency noise presents a real problem and solutions to overcome these noises.

Low frequency sounds can be harmful. Human beings are normally able to detect sounds in the range of 20-20,000 Hz and it is well known that sounds within this range can damage the hearing. The volunteers were exposed to a frequency of 30 Hz for 90 seconds.

Infrasound, sometimes referred to as low-frequency sound, is sound that is lower in frequency than 20 Hz or cycles per second, the 'normal' limit of human hearing. The ear is the primary organ for sensing

infrasound, but at higher intensities it is possible to feel infrasound vibrations in various parts of the body.

At TELCO ERC, new building had come up and the office was shifted in that building. In those days, air conditioning was not common. At ERC on the top portion of the side wall (near to roof) exhaust fans were mounted for efficient ventilation and it was really very effective. But the problem was noticed that, after shifting in new building the staff was suffering from severe

headache. The company being very conscious about the health of the staff started investigating the issue.

After careful study, no problem was found. The management was requested to shift the staff to old premises for few days for observation. For a week it was observed that none of the staff has any head-ache. I asked to shift some 10-20 people again to new premises. Surprisingly it was noticed that again they started getting head-ache. Those people were sent back to old premises. Through the study of sound engineering, it was suspected the low frequency noise. But in India no instrument was available to measure LF intensity. The management was requested to procure an instrument for GMBH. The measurements were taken with various combination. It was noticed that as soon as the exhaust fans were turned ON, the low frequency noise was of about 13 to 17 db at around 6 to 7 Hz. The entire mounting panel holding about 22 fans was having vibration.

I requested them to modify the mounting of the fans with bushing pads and provide cross ribs to the panels. Again, when readings were taken, the LF noise was totally eliminated.

The main problem is non-availability of proper instrument to measure LF noise level. This LF being below 20 Hz. It is not audible to human ear can not be noticed in normal manner.

They produced a series of audible noises and low-frequency sound, which made staff sick. Even if one can't see it, hear it or feel it, sound waves can still make one sick or kill.

Low frequency noise, the frequency range from about 10Hz to 200Hz, has been recognised as a special environmental noise problem, particularly, to people who are sensitive to low frequency of below 20 Hz which is non-audible. The staff can have a large number of laboratory measurements of annoyance by low frequency noise, each with different spectra and levels, making comparisons difficult, but the main conclusions are that annoyance of low frequencies increases rapidly with level. Additionally, the A-weighted level underestimates the

effects of low frequency noises. There is always possibility of learned aversion to low frequency noise, leading to annoyance and stress associated with constant headache similar to migraine severe throbbing pain or a pulsing sensation, usually on just one side of the head. In particular, problems of the hum often remain unresolved. An approximate estimate is that about 2.5 per cent of the population may have a low frequency threshold which is at least 12dB more sensitive than the average threshold, corresponding to nearly 1,000,000 persons in the 50-59-year-old age group in the EU-15 countries.

Following methods will significantly block the waves and reduce the overall impact in a room.

- Use Bass Traps (Low-Frequency Sound Absorber)
- Install Sound Blocking Curtains.
- Add an Extra layer of a wall using Green Glue.
- Add Acoustic Panels (Drywall alternative)
- Add a Thick Carpet.
- Use proper mounting method for fans or FCU or Cassettes or ducting etc.

Infrasonic sound can have very unusual non-auditory effects on the body. Sound and vibration control are becoming more important in HVAC. Sound and vibration are very closely related. The relationship between the two has to do with the frequency at which a vibration or pulsation occurs. The lowest he deals with are centred around 63 Hz (cycles per second) and go up to 8,000 Hz. The lower frequencies, have been more difficult to deal with than those at the upper end.

It's one of the biggest challenges in HVAC industry, to make products that don't have low-frequency sound. Sound attenuators can't attenuate 60 to 125-Hz sound.

Fan Designs

In the design of fans, two things are considered for noise and vibration:

- Low-frequency vibration.
- Most of the energy a fan creates has a

tone at the blade pass frequency. (Blade pass frequency equals fan rpm multiplied by number of blades in the rotor divided by 60.)

Vane axial fans have lots of blades in there, they rotate at a high rpm and create 500-Hz tones. A lower-frequency fan would be a centrifugal fan, with fewer blades, slower rpm, and creating a lot of lower-frequency energy.

Noise Solutions

One of the first solutions is to break the transmission path of the sound or vibration problem. (Typical transmission paths have already been pointed out.) Economical solutions may include:

- Vibration isolators applied right to the fan.
- Sound attenuators applied within the duct themselves, very close to the fan.
- Sound barriers, typically fiberglass that changes vibration into heat and drywall, which prevents sound from going through. When there is duct vibration to be stopped, drywall may be attached right to the sheet metal duct, as long as there is little risk of duct condensation.
- Changes to equipment (i.e., replacing equipment, put in a new fan, changing fan rpm to get off of a bad frequency).

New fan technology can also help reduce noise and vibration during the design phase. Mixed-flow fans (for instance, the Greenheck Model QE1) offer an alternative to conventional vane axial and tubular-centrifugal inline fans. Centrifugal fans (Model QEP plenum fans) also offer high-efficiency/low-noise wheel designs,

In the HVAC industry, most sound or noise is generated via rotating equipment and air and fluid movement through ducts and pipes. This movement creates vibration, sound, or noise.

Vibration in its simplest form can be considered an oscillation or repetitive motion of an object around an equilibrium position. In the HVAC industry, sound is not generated without some form of vibration from equipment.

Therefore, the best way to reduce sound is to limit the vibration produced by

mechanical equipment. Examples are rotating shafts or gears, thermal processes such as combustion, or fluid dynamic means such as airflow through a duct or fan interactions with air.

Understanding vibration and sound

Control of HVAC system sound and vibration are of equal importance, but measurement of vibration is often not necessary to determine sources or transmission paths of unwanted sound or noise. Because vibration is the source of noise from HVAC systems, management of those conditions is imperative to a quiet design. System design that neglects to properly address vibration may result in malfunctioning components, noise, and, in some cases, catastrophic failure.

There are two facets of vibration management: isolation and damping. Isolation is the prevention of vibration from entering the system and dissipating it by changing kinetic energy of vibration into a different form of energy, such as heat.

Vibration isolation systems for mechanical components require some amount of damping. Damping dissipates mechanical energy from the system and attenuates vibrations more quickly. Without damping, these systems may vibrate for some time before coming to rest. The fluid in automotive shock absorbers is a kind of damper, as is the inherent damping in elastomeric (rubber) equipment mounts described below. This energy is converted to heat in the shock absorber or rubber

mounts. There are also pads made of neoprene or cork used in equipment mounting that can be identified as damping devices.

A- and C-weighted sound pressure

A-weighted sound pressure (measured in decibels; dBA) has been used for 60 years as a single-number measure of the relative loudness of noise, specifically for outdoor environmental noise standards. It is popular because it is a single number that most sound meters include. A-weighted is corrected to more closely resemble the hearing characteristics of the human ear. The C-weighted curve (dBC), which is more sensitive to low-frequency sound, contributes less to the overall sound level than dBA. The human ear has a relatively poor sensitivity to low-frequency sound in the 20- to 30-dBA range.

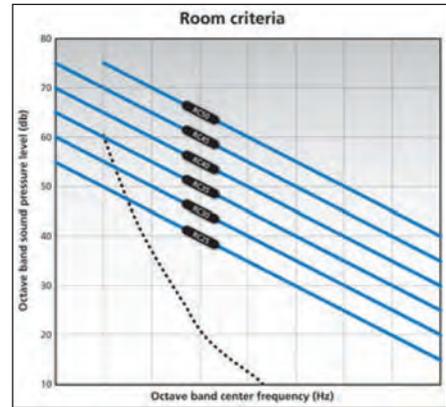
When attenuating sound for an outdoor installation of an air-cooled chiller, the manufacturer-supplied decibel rating would be compared to design decibel level at the design distance from the source. If the design level is exceeded, attenuation will be required. Acoustic screen walls or manufacturer-supplied attenuation enclosures can be added, or relocating the chiller far may be the answer.

Sound pressure and sound power

The sounds are caused by sound pressure. It is due to fluctuation in atmospheric pressure that acts on the human eardrum.

Sound pressure is dependent on the surroundings, therefore, making it difficult to measure sound levels of the equipment, or sound power.

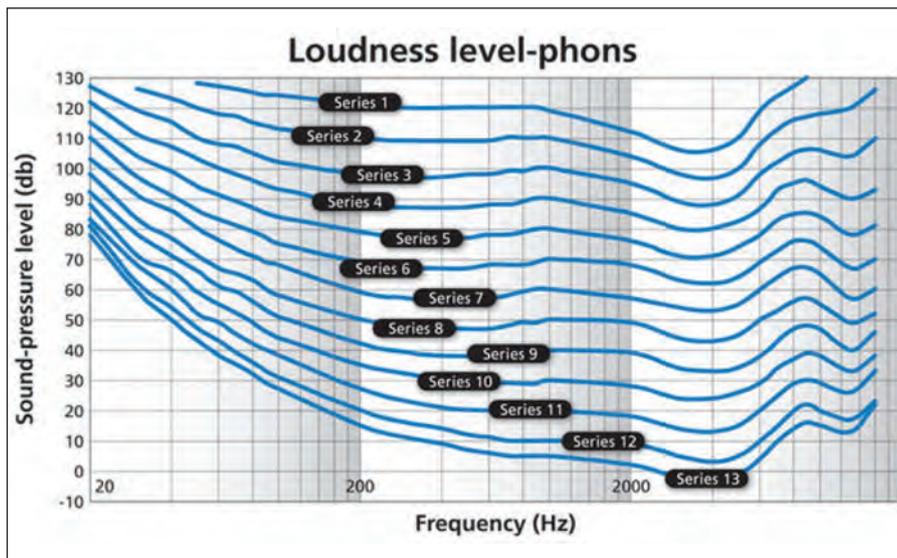
The sound power and sound pressure relationship can be described with an example. Consider a 5-hp fan motor. A 5-hp motor is a definable measure that can



be used to compare one motor against another. This is the equivalent of sound power. However, it is not possible to know whether a 5-hp fan is sufficient to provide cooling or ventilation unless the temperature of the space is known. The temperature of the space is equivalent of sound pressure. If the fan is providing ventilation or cooling for a 2,000 square feet building, it will most likely be large enough to provide a comfortable temperature. If the fan with the 5-hp motor is used in a 130,000 square feet space, it is unlikely to provide comfort to the occupants. In each situation, the same size fan (sound power) provides very different results (sound pressure level).

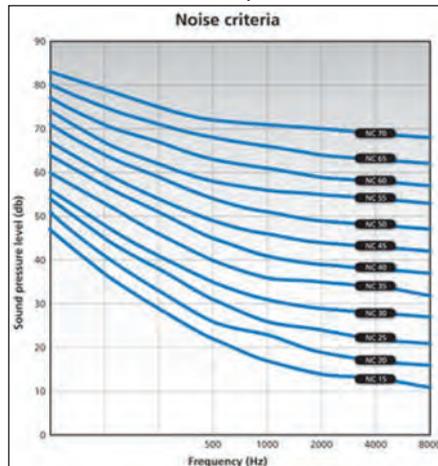
Room criteria (RC)

ASHRAE's favoured method for determining sound levels is by room criterion, or RC, curves. The RC curve system was developed to overcome the shortcomings of the noise criteria (NC) system. The RC system adds the 16.5 and 31 Hz bands to deal with low-frequency sound and the 800-Hz octave band is dropped from the NC curves. The RC curve accounts for acoustically produced vibration in light building construction. In this article, we will address noise with the RC method. (see Figure 2).



Noise criteria (NC)

Noise criteria, or NC, curves are the most common standard in the United States for rating indoor noise from HVAC systems. NC curves were developed to take into account human response to sound



pressure levels at different octave bands. NC curves are based on the 63 to 8,000 Hz octave-band values. The criteria curves define the limits of the octave band that must not be exceeded to meet occupant acceptance in a space. One issue with the NC method is that it does not evaluate low-frequency sounds below 63 Hz, which can be the most troublesome and most difficult to attenuate.

Basic acoustical design techniques

Based on the 2007 ASHRAE Handbook—HVAC Applications, when selecting fans, pumps, and other related mechanical equipment and when designing air-distribution systems to minimise sounds transmitted from system components to occupied spaces, engineers should consider the following:

- Design the air-distribution system to minimise flow resistance and turbulence. High flow resistance increases required fan pressure, which results in high staff noise being generated by the fan, especially, at low frequencies. Turbulence also increases flow noise generated by duct fittings and dampers, especially, at low frequencies.
- Select a fan to operate as near as possible to its rated peak efficiency when handling the required airflow and

static pressure. Also, select a fan that generates the lowest possible noise at required design conditions. Using an oversized or undersized fan that does not operate at or near rated peak efficiency can substantially increase noise levels.

- Design duct connections at both the fan inlet and outlet for uniform and straight airflow. Both turbulence (at fan inlet and outlet) and flow separation at the fan blades can significantly increase fan-generated noise. Also, turning vanes near fan outlets can also increase turbulence and noise, especially if airflow is not sufficiently uniform.
- Select duct silencers that do not significantly increase the required fan total static pressure. Selecting silencers with static-pressure losses of 0.35 in of water or less can minimise regenerated noise from silencer airflow.
- Place fan-powered mixing boxes associated with variable-volume air-distribution systems away from noise-sensitive areas.
- Minimise flow-generated noise by elbows or duct branch take-offs whenever possible by locating them at least 4 to 5 duct diameters from each other. For high-velocity systems, it may be necessary to increase this distance to up to 10 duct diameters in critical noise areas. Using flow straighteners or honeycomb grids, often called egg crates, in the necks of short-length take-offs that lead directly to grilles, registers, and diffusers is preferred to using volume extractors that protrude into the main duct airflow.
- Keep airflow velocity in ducts serving sound-sensitive spaces as low as possible by increasing the duct size to minimize turbulence and flow-generated noise.
- Duct transitions should not exceed an included expansion angle of 15 degree, or the resulting flow separation may produce rumble noise.
- Use turning vanes in large 90-degree rectangular elbows and branch take-offs. This provides a smoother directional transition, thus, reducing turbulence.

- Place grilles, diffusers, and registers into occupied spaces as far as possible from elbows and branch take-offs.
- Minimise use of volume dampers near grilles, diffusers, and registers in acoustically critical situations.
- Use barriers near outdoor equipment when noise associated with the equipment will disturb adjacent properties. In normal practice, barriers typically produce no more than 15 dB of sound attenuation in the medium frequency range. To be effective, the noise barriers must at least block the direct line of sight between the source and receiver.
- Vibration-isolate all reciprocating and rotating equipment connected to a structure. Also, it is usually necessary to isolate mechanical equipment in a basement, directly below a tenant space. It may be necessary to use flexible piping connections and flexible electrical conduit connections for pipes and ducts connected to the equipment.
- Vibration-isolate ducts and pipes using spring and or neoprene hangers for at least the first 50 feet from vibration-isolated equipment.

The World Health Organisation (WHO) recognises the special place of low frequency noise as an environmental problem. Its publication on Community Noise (Berglund et al., 2000) makes a number of references to low frequency noise, some of which are as follows:

- It should be noted that low frequency noise, for example, from ventilation systems can disturb rest and sleep even at low sound levels.
- For noise with a large proportion of low frequency sounds a still lower guideline (than 30dBA) is recommended.
- When prominent low frequency components are present, noise measures based on A-weighting are inappropriate.
- Since A-weighting underestimates the sound pressure level of noise with low frequency components, a better assessment of health effects would be to use C-weighting.
- It should be noted that a large

proportion of low frequency components in a noise may increase considerably the adverse effects on health.

- The evidence on low frequency noise is sufficiently strong to warrant immediate concern.

Level variations

Holmberg et al (1997) investigated noise in workplaces, using the (dBC - dBA) difference as an indicator. Low frequency noise exposure was found in a group of 35 out of a total of 337 persons. Measurements of temporal variation of the levels of low frequency noise at the workplaces, averaged over 0.5, 1.0 or 2.0 seconds, was correlated with subjective annoyance. Significant correlation was found between the irregularity of the noise levels and annoyance.

Low frequency noise annoyance and stress

Stresses may be grouped into three broad types: cataclysmic stress, personal stress and background stress. Cataclysmic and personal stresses are evident occurrences, which are met with sympathy and support, whilst their impacts normally reduce with time. Background stresses are persistent events, which may become routine

elements of life. Constant low frequency noise has been classified as a background stressor (Benton, 1997; Benton and Leventhall, 1994). Whilst it is acceptable, under the effects of cataclysmic and personal stress to withdraw from coping with normal daily demands, this is not permitted for low level background stresses. Inadequate reserves of coping ability then lead to the development of stress symptoms. In this way, chronic psychophysiological damage may result from long-term exposure to low-level low frequency noise.

Changes in behaviour also follow from long term exposure to low frequency noise. Those exposed may adopt protective strategies, such as sleeping in their garage if the noise is less disturbing there. Or they may sleep elsewhere, returning to their own homes only during the day. Others tense into the noise and, over time, may undergo character changes, particularly in relation to social orientation, consistent with their failure

to recruit support and agreement from the regulatory authority that they do have a genuine noise problem. Their families, and the investigating officer, may also become part of their problem. The claim that their “lives have been ruined” by the noise is not an exaggeration, although their reaction to the noise might have been modifiable at an earlier stage.

Conclusion

Regulatory authorities must accept that annoyance by low frequency noise presents a real problem which is not addressed by the commonly used assessment methods. In particular, the A-weighted level is very inadequate, as are the NR and NC criterion curves. Assessment methods specific to low frequency noise are emerging, but a limitation of existing methods is that they do not give full assessment of fluctuations. It is possible that application of noise quality concepts, in particular fluctuation and roughness (Zwicker and Fastl, 1999), may be a way forward. ■



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Forthcoming Events At A Glance

Foodpro 2019

Venue: Chennai Trade Centre, Chennai

Date: 23rd to 25th August 2019

Website: www.ciifoodpro.in

Dairy Tech India 2019

Venue: Bangalore International Exhibition Centre, Bangalore

Date: 30th August to 1st September 2019

Website: www.dairytech.in

ISK-SODEX Istanbul

Venue: TÜYAP Fair Convention and Congress Centre

Date: 2nd to 5th October 2019

Website: www.sodex.com.tr/en

Refcold India

Venue: Hitex Exhibition Centre, Hyderabad, Telangana

Date: 21st to 23rd November 2019

Website: www.refcoldindia.com

India Cold Chain Show 2019

Venue: Bombay Exhibition Centre, Mumbai

Date: 4th to 6th December 2019

Website: www.indiacoldchainshow.com

Achieving Sustainability in Distribution & Logistics Centre



Gandhi Automations manufactures loading bay solutions like dock levelers, dock shelters, sectional overhead doors, thus ensuring loading bays work at an optimal speed.

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Sustainability

The right doors and docking solutions at loading bays can cut unnecessary emissions. At large loading bays, insulated dock levelers and insulated overhead sectional doors can reduce unnecessary loss of energy, both when the loading bay is closed and also during loading and unloading. Fast-acting overhead sectional doors can also make a difference to the amount of energy lost. By reducing the amount of time, the door is open, they limit the amount of time available for temperature exchange and for energy to escape.

At smaller loading bays, or in parcel distribution centres, van cushion shelters have been shown to reduce energy loss by up to 50 per cent. When the van is docked, a tight seal is created between the van and the loading bay, which means temperature transfer is minimised, thus, reducing energy loss and maintaining a steady indoor environment.

Safety

There are a variety of steps that one can take to enhance safety at loading bays. Traffic light systems mean trucks only maneuver when safe to do so, and all personnel know the status of the docking procedure so making sure that they stay out of harm's way.

Restraint systems, ranging from wheel chocks to hydraulic restraint systems, firmly secure trucks in place during loading and unloading to prevent premature drive off and the risk of accidental vehicle creep.

Integrated docking systems mean that overhead sectional doors can only ever be open when a truck is safely docked, removing any risk of staff or stock falling off the loading bay.

Speed

Ensuring loading bays work at an optimal speed is easy with fast acting doors. Fast overhead sectional doors mean loading is never held up by slow moving entrances. Products such as restraint systems prevent accidents occurring, which in turn limits the risk of slowing business down with unplanned downtime.

And in addition, having a standard loading procedure that staff can follow whenever a truck arrives will help the user ensuring faster and more efficient processes every time.

Gandhi Automations manufactures loading bay solutions like dock levelers, dock shelters, sectional overhead doors. Dock equipment are designed and factory-made in state-of-the-art manufacturing facility. Its dock equipment meet international safety standards like EN1398 for dock levelers and product is CE marked.

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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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