

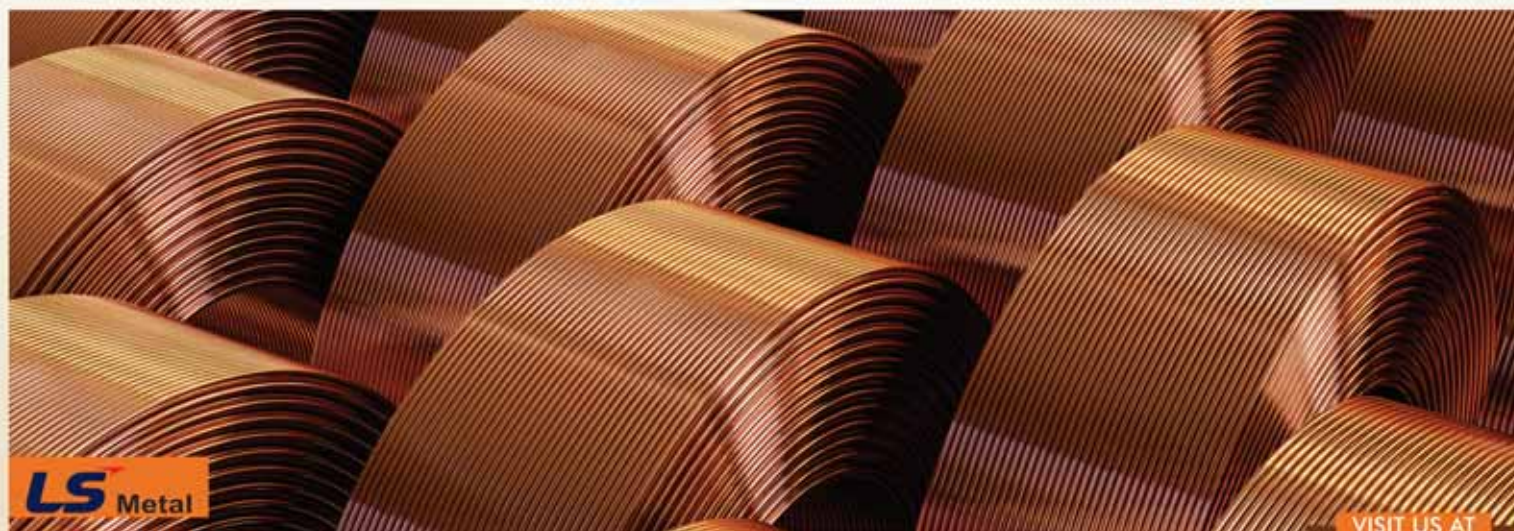
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# Publisher's Letter

Hello and welcome once again to *Cooling India*.

The HVAC industry in India has gone through many ups and downs in the recent years. While the prolonged sluggishness in the real estate sector especially in the commercial buildings space has contributed to the slowdown, increase in industrial activities is driving the demand. Reports suggest that the Indian HVAC market is forecast to reach \$3.97 billion by 2019 on account of changing lifestyle, increasing per capita income, and rising expenditure by consumers on comfort solutions. By 2020, the market is expected to exceed a value of over US\$6.3 billion.

ACREX India 2019, South Asia's largest HVAC&R exhibition to be held during 28th February – 2nd March in Mumbai, will showcase the Indian industry's preparedness to ride the growth.

To sum up the spirit of this HVAC&R extravaganza, Cooling India brings to you this exclusive issue on market trends, technological innovations, product update etc. Many companies from around the world gather here to give a sneak peek at what will be on show. The issue also discusses on what's in store for HVAC&R industry in the years to come. Hope you'll enjoy reading this issue as always.

Further, HVAC systems play a critical role in heating, cooling and ventilating any industrial facility. According to latest market research report, the global industrial HVAC market to grow at a CAGR of around 5 per cent during 2018-22 driven by the increasing demand for energy-efficient HVAC systems like chillers, boilers, cooling towers, AHUs, fan coil units and control systems.

On this note, coming March, Cooling India is coming out with an exclusive issue on industrial HVAC wherein we will feature an in-depth analysis of market size, growth forecast, and market trends for this industry. The issue is expected to cover product and technology innovations across chillers, ventilation, cooling tower, insulation, air-treatment, filtration, IAQ, BMS, ducting, plumbing, compressors, AHUs, ATUs, and sensing and measurements. We invite your participation in this special issue.

Please write to me at [pravita@charypublications.in](mailto:pravita@charypublications.in).

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## ICA Showcases Role of Small Diameter Copper Tube for Energy Efficiency

**E**mphasising on the advantages of smaller diameter, copper tube development in India, International Copper Association India (ICA India) organised a special seminar in Gurugram. The seminar was hosted with an aim to showcase how smaller-diameter tubes can be used to increase the rate of heat transmission through coils in numerous applications, thereby, improving the energy efficiency.

Gracing the event in large numbers were professionals from the R&D team of room air conditioners and coil manufacturers from across the country. Sanjeev Ranjan, Managing Director, ICA India welcomed the dignitaries through his special address. The panel at the seminar included Frank Gao, ICA China, Ajay Sharma, Spirotech Heat Exchangers, Dr Wu, Shanghai Jiao Tong University, Hong Qingchi, Hailiang, Anand Sharma, Burr Oak Tools, Harshal Upadhyay, Zamil Air Conditioners, and Avinash Khemka, ICA India. Speaking at the seminar, Sanjeev Ranjan, Managing Director, ICA India said, "Smaller Diameter Copper Tube Heat Exchangers are used to make refrigeration equipment, heat pumps and air conditioners that are a great energy efficient alternative. They have a key role to play in the design of ACR products and is one of the best alternatives to use with green refrigerants. Microgroove is one piece of the sustainability puzzle for cooling and refrigeration and is suitable for use with many eco-friendly refrigerants."

The use of 5mm Copper Heat Exchangers in condensers reduces cost, creates higher energy efficiency, and comes with high durability and demands low investments. This advanced heat transfer efficiency, therefore, increases the overall energy efficiency of the system. The use of smaller tubes also improves the air-flow outside the tubes because of the concentrated form factor. ■

## Thermax to Manufacture Chillers at Sri City

**T**hermax Limited inaugurated its new manufacturing facility in Sri City, Andhra Pradesh. The company's latest state-of-the-art production unit, deploying high levels of digitisation, will manufacture a wide range of vapour absorption machines comprising chillers, heat pumps and heaters in its first phase.

With an investment of Rs 166 crore (23 Mn USD) in Phase I, the unit has a capacity to produce 400 machines per year. "We have come up with a world-class facility that is aligned to our vision of 'Smart Thermax' and a significant step in diversifying our operations to leverage the infrastructural advantages of strategic locations such as Sri City. We have invested in digitisation and automation to facilitate zero-defect processes that will ensure superior quality products to our customers," said M S Unnikrishnan, MD and CEO, Thermax.

"While this new plant will help us serve



our existing and potential customers in the southern region better; it will also be an important manufacturing hub for Thermax's global operations that will augment our export capabilities. With the increasing demand for green and energy efficient solutions globally, we see our vapour absorption products manufactured in this plant as an ideal fit towards sustainability", said Meher Pudumjee, Chairperson, Thermax.

All manufacturing processes are designed to create a safe and healthy working environment, and comply with the stringent green building norms. This is the ninth manufacturing plant of Thermax in India, out of the fifteen hubs spread across India, China, Germany, Denmark, Indonesia and Poland. ■

## Atlas Copco Unveils New Variant of VSD Compressors

**A**tlas Copco launches the new range of Variable Speed Drive (VSD) compressors at a customer meet 'Seeing is Believing' in Mumbai. Atlas Copco is the first compressor company to unveil the world-famous energy saving Variable Speed Drive compressors in India. The new compressors have been introduced under three categories - Industrial Air Compressor, Medical Gas Solutions and Vacuum Pumps Solutions. Furthermore, the company showcases its commitment to manufacturing under the government's 'Make in India' initiative with the newly launched Industrial Air Compressor and Medical Gas Solutions product ranges.

Conrad Latham, General Manager, Atlas Copco Compressor Technique in India, said, "Manufacturing in India has seen strong growth in many industrial segments during 2018. We are always striving to enhance customer experience

and increase productivity through innovation and design. True to our commitment to 'Make in India', we continue to push the boundaries of excellence with our latest range of compressor products."

The company supplies compressed air solutions across industries such as general engineering, automotive, manufacturing, textile, pharmaceuticals, power, food, automobile, iron and steel.

Industrial Air Compressor: Reduces the energy costs and makes the manufacturing process more efficient. Medical Gas Solutions: Atlas Copco's GA-MED compressors bring outstanding performance, flexible operation and high productivity, while minimizing the total cost of ownership. Vacuum Pumps Solutions: The revolutionary oil-sealed GHS VSD+ series screw vacuum pumps save up to 50 per cent energy compared to the conventional vacuum technologies. ■





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## AIRAH Launches Online Flammable Refrigerant Safety Guide

**A**IRAH has released an online, updated version of its Flammable Refrigerants Safety Guide. The resource – developed by independent organisations and stakeholders with support from the Department of the Environment and Energy – can help refrigeration technicians, apprentices and other stakeholders understand the range of skills and knowledge required to work safely with flammable refrigerants.

AIRAH CEO Tony Gleeson, M AIRAH, says that the HFC phase-down, which officially began in Australia on January 2018, has seen a switch to flammable low-global-warming-potential (low-GWP) synthetic and natural refrigerants. In turn, industry professionals must be fully aware of equipment that uses them, and the risks associated. “Many HVACR professionals are accustomed to working with the non-flammable refrigerants,” Gleeson says. “We need to ensure that, as the use of alternative refrigerants picks up, our industry is properly equipped to work safely, efficiently and professionally with any refrigerant they encounter. And that’s where the Flammable Refrigerants Safety Guide has a crucial role to play.”

The guide was originally published in 2013 in hard copy form. Over the past five years more than 700 people have received training at free seminars around Australia. Yet, AIRAH also recognised the need to explore more innovative ways of delivering the information. “The face-to-face delivery model had its limits, so rather than them coming to us, we’re taking it to them,” says AIRAH’s Phil Wilkinson, F AIRAH. “The new online format allows people to access the resource whenever they have time. We’ve broken the material down into ‘smoko-sized’ chunks of around 20 minutes, and users can leave it and pick it back up to make it as flexible as possible.” It has been updated to refer to standards AS/NZS ISO 817 and AS/NZS 5149 series. ■

## India to Host Sustainable Development Symposium

**T**he Asia-Pacific Sustainable Development Symposium has extended its calls for abstracts. Supported by the United Nations’ One Planet Network and the Inter-University Sustainable Development Research Programme, the Symposium committee is seeking ideas, real-world experiences and case studies. These topics can relate to education for sustainability; built environment sustainability; circularity in the built environment; and smart and sustainable built environments, including resilient and liveable cities.

“The Symposium brings focus on sustainability in the built environment,” says Symposium Chair Dr Usha Iyer-Raniga, associate professor at RMIT University. “As there are so many disciplines that shape the built environment, such as engineering, architecture, project management, construction and the like, an integrated approach is critical.”

While the focus will be on India, the

committee welcomes abstract submissions from across the globe. “This Symposium in India brings experiences, case studies and practices in different contexts together so we may learn from each other,” says Iyer-Raniga. She also highlights the urgent need to achieve a low-carbon future. “The time is right to engage in meaningful discussions on how we may collectively achieve the targets set by the Paris Agreement, Sustainable Development Goals and the new Urban Agenda,” she says, pointing to the increased population growth and rapid urbanisation of the Asia-Pacific region. “Nearly three-quarters of the world population is expected to live in the Asia-Pacific region by 2050, and we need practical steps to decarbonise the built environment.” The Sustainable Development Symposium is scheduled to take place at the Madhav Institute of Technology & Science in Gwalior, India from December 19-21, 2019. ■

## Carrier Introduces Ultra-Low NOx Gas Furnace

**C**arrier introduces its ultra-low nitrogen oxides (NOx) gas furnace in its non-condensing 80 per cent efficiency models. Two models – a 60,000 and an 80,000 BTU/h furnace – have been developed to meet California’s South Coast Air Quality Management District (SCAQMD) and San Joaquin Valley Air Pollution Control District (SJVAPCD) Ultra Low NOx Rule 1111 and Rule 4905, respectively, which require NOx emissions of less than 14 nanograms per joule. These new models will cut emissions by approximately 65 per cent from the older low NOx standard.

“Carrier has invested significantly over the past several years in this product to meet these new emissions requirements and is proud to serve this unique segment demand,” said Todd Nolte, Director,

product marketing, Carrier Residential. “The deadline to meet this requirement draws closer each day, and we’re pleased to introduce our first products to what we expect to be a comprehensive product portfolio.” Home owners aren’t required to install an ultra-low NOx furnace until October 2019. After that date, all replacement and new furnaces within the included districts require the ultra-low NOx designation. The fees range from USD 225 to USD 400 depending on the system type, BTU range and when the furnace is installed. The mitigation fees are scheduled to be phased out in October 2019. To meet the state’s ambitious emissions reductions goals, Ultra Low NOx furnaces must reduce emissions from the state’s current standard 40 nanograms per joule to 14 nanograms per joule. ■







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**Mr. V.P.Vargheese (Managing Director, Surakhsha Transport Systems India (P) Ltd)**

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**Mr. Dushan (Owner, Iceman Technologies Pvt Ltd)**

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## AIRAH and IOR Strengthen Ties

Two of the world's leading HVACR member organisations have put pen to paper on a Memorandum of Understanding (MoU). The Australian Institute of Refrigeration, Air Conditioning and Heating (AIRAH) and Institute of Refrigeration (IOR) formalised the agreement on January 14 at the ASHRAE Winter Conference in Atlanta, Georgia.

The MoU is aimed at "furthering a more effective and beneficial exchange of knowledge and ideas in the HVACR industry". In practical terms, it will provide the members of AIRAH and IOR access to each other's technical resources, foster

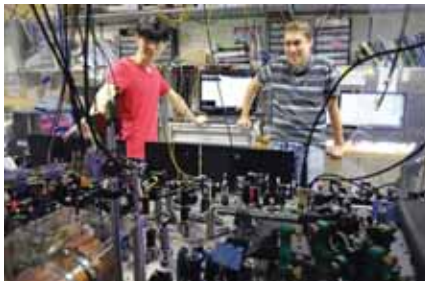


global collaboration on research projects, and provide shared training opportunities. The two organisations have also agreed to give full support to International Refrigeration Day, slated for June 26. The day will see refrigeration-themed celebrations taking place across the globe including in the UK and Australia to raise the profile of the industry.

AIRAH President Ian Harwood, F AIRAH say the MoU is a perfect move for both organisations and specifically supports AIRAH's strategic aims. "We are always looking to highlight the importance of the R in AIRAH," says Harwood. "Our agreement with the Institute of Refrigeration will help us achieve that."

"Our organisations have a long and proud history in their respective countries, with the IOR founded in 1899 and AIRAH in 1920," says Glass. "A century later, the challenges we face are more intrinsically linked than ever, especially with the HFC phase-down driving major change all over the world, and the growing focus on sustainability – a focus that we share." ■

## Researchers Develop Quantum Fridge



Researchers in Singapore have built a refrigerator that's just three atoms big. This quantum fridge won't keep drinks cold, but it's cool proof of physics operating at the smallest scales.

Researchers have built tiny heat engines before, but quantum fridges existed only as proposals until the team at the Centre for Quantum Technologies at the National University of Singapore chilled with their atoms. The device is an absorption refrigerator. It works without moving parts, using heat to drive a cooling process. The first absorption refrigerators, introduced in the 1850s, cycled the evaporation and absorption of a liquid, with cooling happening during the evaporation stage. They were widely used to make ice and chill food into the 20th Century. Albert Einstein even held a patent on an improved design.

Today's fridges and air conditioners more often use a compressor, but absorption refrigerators still have their uses -- science experiments included.

"Our device is the first implementation of the absorption refrigeration cycle on the nanoscale," says Stefan Nimmrichter, co-author of a paper published in Nature Communications.

To create an absorption fridge with just three atoms took exquisite control. "As an experimental scientist, it's a pure joy to be able to manipulate individual atoms," says Gleb Maslennikov, the paper's first author. First, the researchers caught and held three atoms of the element Ytterbium in a metal chamber from which they'd removed all the air. They also pulled one electron off each atom to leave them with a positive charge. The charged atoms -- called ions -- can then be held in place with electric fields. Meanwhile, the researchers nudge and zap the ions with lasers to bring them into their lowest energy state of motion. The result is that the ions are suspended almost perfectly still, strung out in a line.

Another laser zap then injects some heat, making the ions wiggle about. The ions interact with each other because of their like charges. The result is three patterns of wiggle -- squishing and stretching along the line, like a slinky, rocking like a seesaw pivoting about the central atom, and zig-zagging out from the line like a waving skipping rope.

The energy in each wiggling mode is quantised with the energy carried by a number of 'phonons'. ■

## France Adopts HFC Tax

France has adopted an HFC tax that will enter into force in 2021. A component of the country's 2019 Finance Bill, the measure uses a 40 per cent income tax discount to encourage companies to make the transition away from HFCs. The measure will also support the adoption of HFC alternatives from now until December 31, 2022. The tax means companies can deduct from their taxable profit an amount equal to 40 per cent of the original value of all HFC-free refrigeration and air conditioning equipment.

"The implementation of a tax on hydrofluorocarbons in 2021 is a real breakthrough on a key theme," says MP Matthieu Orphelin, one of the early and strongest advocates of the HFC tax in the French Parliament. "It responds to the commitment of the government taken in the July 2017 Climate Plan to limit the use of HFCs, which are powerful greenhouse gases with a global warming potential more than 15,000 times greater than carbon dioxide – and are at the origin of just over 5 per cent of France's greenhouse gas emissions." ■



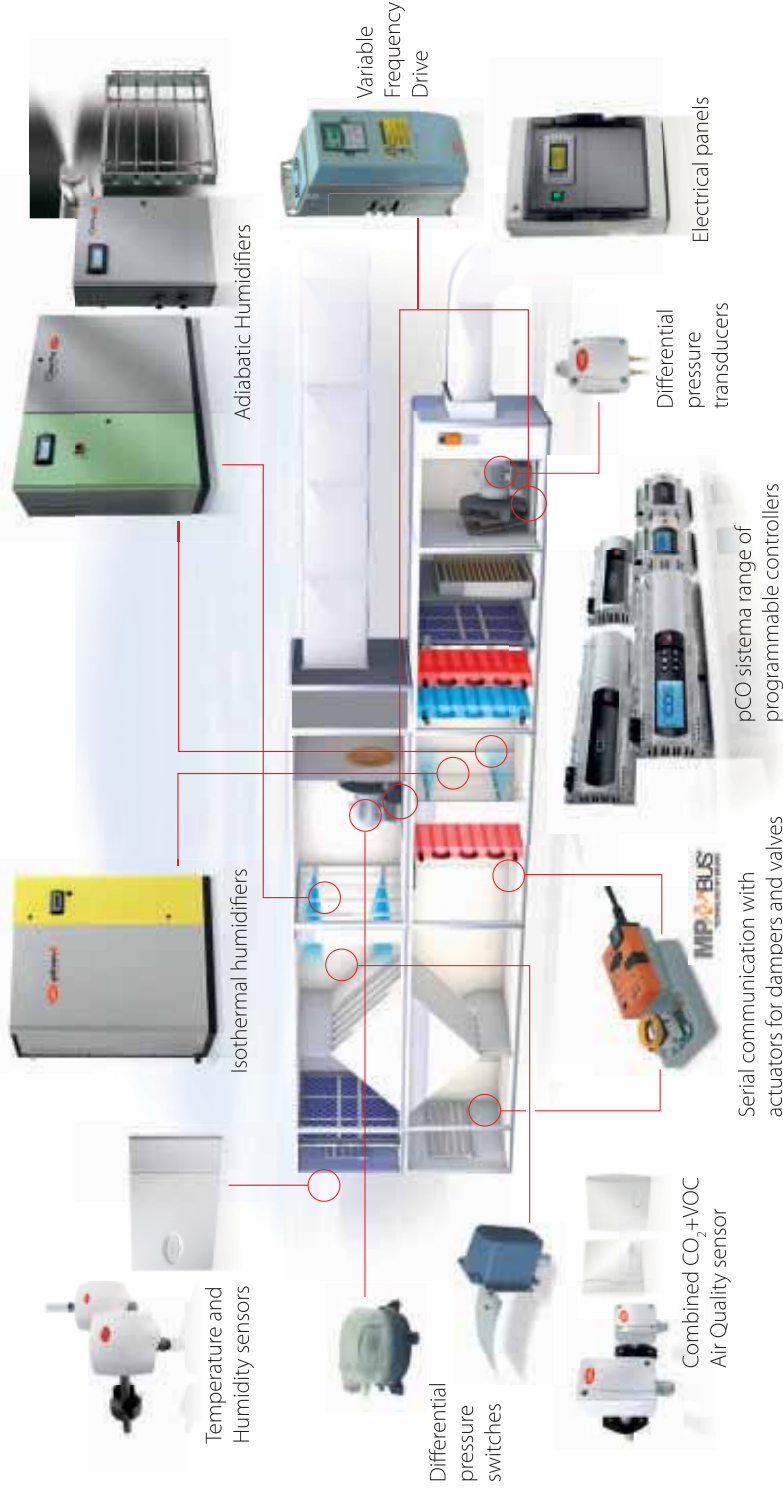
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## Three-fold Increase in Projects with Natural Refrigerants

December is the time to take stock, and CAREL can look back at positive results in terms of energy saving and the use of solutions with natural refrigerants. The number of CO2 projects with DC inverter technology has tripled since 2017, with the purchase of natural refrigerants instead of traditional gases making for a total saving of EUR 1 million. The increase in high-efficiency solutions with natural refrigerants also translates into significant energy savings. It is estimated that the systems sold during 2018 saved almost 3000 MWh of energy, with almost 1500 tonnes less CO2 equivalent released into the environment.

In addition to this, there was also a reduction in polluting gas emissions due to refrigerant leaks from low GWP solutions. In fact, we estimate that our 2018 projects cut environmental emissions by 2500 tons of CO2 equivalent compared to R404/A solutions of equal capacity.

This represents a net and tangible saving of a total of 4000 tons of CO2 equivalent, that is, the equivalent of no cars driving through central London for 20 days\*!

In the face of a further increase in global warming, CAREL is contributing to the use of natural refrigerants by developing solutions that simplify their use and increase the efficiency of the system. "Solutions with natural refrigerants represent the present and no longer the future", says Matteo Dal Corso, Application Specialist - Retail Solutions. "Now that the technologies we have developed in recent years are available it is time to focus on innovative features and services, possible thanks to very advanced devices, already installed and ready". ■

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## Trane Launches New Fifth Generation Genyue5+ Full DC Inverter VRF System

Trane announced the launch of Genyue5+, full DC Inverter VRF system for India and SAARC markets. The advanced 5th generation inverter is an ideal choice across sectors such as retail, healthcare, hospitality, commercial, educational institutions etc.

With the launch of all new Genyue, the company has expanded its Commercial Unitary portfolio not only effectively to address the growing needs of our customers but also to focus on furthering energy efficiency and savings as envisaged in the Government of India's National Cooling Action Plan.

"Genyue has been designed keeping in mind our customer need for better efficiency in their operations and lower energy consumption while improving capacity, ensuring reliability and delivering ease of operations. The advanced system will provide 26 per cent better efficiency with its compact design saving up to 30 per cent more space in the customer premises." said Sanjeev Seth, Country Leader, HVAC & Transport, India & SAARC Markets, Ingersoll Rand. "We are committed to introducing pioneering technology and products that enhance customer experience and help our customers achieve their sustainability goals in the long run." ■

The all new inverter system has been designed to provide best-in-class efficiency, high reliability, convenient operations and enhanced comfort. It also boosts significant performance and energy



savings through precise temperature control for a stable and comfortable environment. The advanced DC technology helps make the compressor run more smoothly with lesser noise and more efficiency. It also has wide operating range that is applicable for different regions with different climates. The performance of the series is upgraded substantially to improve the system's self-adaptive adjusting capacity. The product has been tested rigorously to stringent quality standards to ensure a safe, comfortable and efficient HVAC system.

Genyue5+ is easy to control with its GEN Network Control, the advanced 15" Touch screen controller that is suitable for energy management and third-party building management system. ■

## Indian Govt Approves MoC between India and Japan in Food Processing Industry

The Union Cabinet, chaired by the Prime Minister Narendra Modi has given its approval to the Memorandum of Cooperation (MoC) between India and Japan in the field of food processing sector.



Bilateral cooperation in the field of food processing between India and Japan will be mutually beneficial to the food processing sector in both countries. It will promote understanding of the best

practices in food processing in the two countries and will help in improving the food processing sector as well as improved market access, leading to equity and inclusiveness. The MoC will lead to betterment of the food processing

sector in the country by introducing innovative techniques and processes. It will help in increasing food processing in the country by getting access to best practices and better markets. ■





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### Giandomenico Lombello Appointed Carel Group Managing Director

**C**AREL Board of Directors appointed Giandomenico Lombello, currently Group Sales and Marketing Director as the new Managing Director, replacing Francesco Nalini, who will continue to maintain his role as CAREL's CEO. The Managing Director will report directly to the CEO to whom he is hierarchically and functionally subordinate, and will play a general role in the direction, management and coordination of corporate operational process activities and functions. The appointment aims at strengthening the administrative structure of the Group at guaranteeing lasting support for the management of the business and strong protection for operational processes in a period of high growth for CAREL.



Giandomenico Lombello

'It is a great honour for me to accept this new role and to assist Francesco Nalini in the transition to the near future', Lombello commented. "I hope to meet the expectations of the Board of Directors and to interpret this role in the best possible way. My goals are very clear, and concern investors, customers and all CAREL employees."

Giandomenico Lombello graduated in Electronic Engineering from the University of Padua and, after four years' experience in the biomedical sector, joined Carel in 1988 where he held various positions within the Group taking on posts of increasing responsibility reaching lastly Sales and Marketing Director in 2008, a position he currently holds. ■

### Frost Appointed as Vice President of Modine

**H**VAC equipment manufacturer Modine has appointed Timothy Frost as Vice President of its CIS Americas Coils and Coolers business. Prior to joining Modine, Frost spent over 23 years with RobertShaw (formerly Burner Systems International), where he served in a variety of leadership roles, most recently as executive vice president – commercial business unit.



Timothy Frost

In this new role, Timothy Frost will have full P&L responsibility for the Americas Coils and Coolers business Modine Coils. ■

including delivery of the annual operating plan, coordination of all production operations, material planning, distribution, sales, marketing, engineering or product development, finance, quality assurance and customer service.

He will also be responsible for developing and executing on the growth strategies across the Americas. Modine's CIS division was formed following the acquisition of Luvata Heat Transfer Solutions in 2016 and its subsequent merger with ■

### Sharp is BCIA Vice-President

**T**erry Sharp of NDA Consulting is the new vice-president of the Building Controls Industry Association (BCIA). Terry Sharp has worked in the controls industry for over 35 years with experience at UK and European leadership level for Johnson Controls, as sales and marketing director for Sontay and product marketing manager for Satchwell Control Systems.



Terry Sharp

He is currently an associate at NDA Consulting, the specialist BEMS and energy consultancy

practice. BCIA president Jon Belfield said of Sharps's appointment: "Having worked alongside him with the BCIA for a while now and having known him as a long-time industry colleague, I know that his strong leadership skills and his hands-on approach will bring us huge benefits as we continue our work."

The Building Controls Industry Association (BCIA) has around 93 members accounting for 80 per cent of the UK controls market. ■

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## Schneider Electric Gets Global Award for Contribution to Circular Economy

**S**chneider Electric, a leader in digital transformation of energy management and automation, has won The Circulares 2019 award in the Multinational category. The Circulares, an initiative of the World Economic Forum and the Forum of Young Global Leaders, run in collaboration with Accenture Strategy, is the world's premier circular economy award program. It recognises private and public organisations, as well as individuals, who make a significant contribution to the circular economy. 40,000 tonnes of primary resources avoided being consumed and 30 million tonnes of CO<sub>2</sub> saved in 2018 thanks to the circular economy Schneider Electric's approach to the circular economy is a concerted move away from the wasteful linear system of "extract, manufacture, dispose" (or "take, make and dispose") that is demonstrably damaging to the planet and climate. The Group's approach to circularity, which reflects the principles of the Ellen MacArthur Foundation, is to:

- Preserve and enhance natural capital;
- Minimise use of primary resources;
- Foster new systems including leasing, extending product life, repair and reuse and finally recycling of materials, if all other options are exhausted. The Circulares 2019 award recognises Schneider Electric's commitment to the circular economy everywhere and at all levels, as part of a universal approach that encompasses all of Schneider Electric's activities;
- Eco-design of products with minimum use of primary raw materials;



- Circular Value Propositions (connected objects, services, leasing, repair, take-back etc.);
- A circular supply chain (reverse logistics, repair centers, modernisation and reconditioning centers etc.);
- Corporate governance around four 'circular economy' indicators in the quarterly non-financial Schneider Sustainability Impact barometer, which impacts remuneration of thousands of Schneider Electric managers. All new products are eco-designed, which means they are created, to be easily repaired, upgraded and finally dismantled at end-of-life. Digital Product Environmental Profiles (PEP) give customers straightforward information on a product's carbon footprint, environmental impact, as well as detailed end-of-life instructions that maximise products' circularity after their "first life". In 2019, Schneider Electric will make a strong effort to increase the use of recycled plastics in its products. ■

## Jacinta Caden Wins ACR Woman of the Year

**J**acinta Caden has been adjudged as the ACR Woman of the Year at the National ACR & Heat Pump Awards 2019 at the Midland Hotel in Manchester. She is working as Spiral Freezers Operations Manager at Integral UK Ltd.

Jacinta entered the refrigeration and air conditioning industry as an apprentice with a contractor in Dublin in 2003. She spent close to 10 years as a technical sales engineer with Dean & Wood and, following a spell as area manager for Tecnaïr, joined the Specialist Industrial Refrigeration Division of Integral, initially as business development manager and, since November last year, as spiral freezers operations manager. She retains a huge enthusiasm for refrigeration in all its forms. She said, "I am always intrigued



and sometimes surprised about where I see refrigeration utilised and it makes me proud to be part of an industry that will never die, an industry that everyone needs."

2018 proved to be quite a year for Jacinta, as she was elected to the council of the respected Women's Engineering Society, a charity and professional network of women engineers, scientists and technologists who offer inspiration, support and professional development. Then, in November, she was elected to the Institute of Refrigeration Board of Trustees.

She is also a member of the steering committee of the Women in RACHP network and is a vocal supporter of efforts to attract more women engineers into the industry. ■

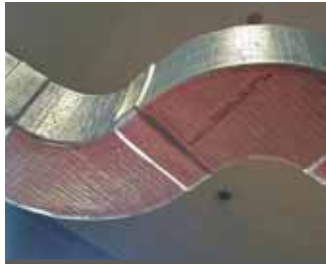
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## Natural Refrigerants Market worth USD 1,419.19 mn by 2020

The growth is on account of the enforcement of stringent environmental legislations that call upon a ban on environmentally harmful HCFC and HFC refrigerants and promote the application of natural refrigerants as alternatives.

**A**ccording to Marketsandmarkets report on natural refrigerants, the natural refrigerants market is projected to reach USD 1,419.19 million by 2020 at a CAGR of 11.5 per cent between 2015 and 2020. Europe is the largest market for natural refrigerants followed by Asia-Pacific. Europe has also been estimated to account for the highest growth between 2015 and 2020. The growth is on account of the enforcement of stringent environmental legislations that call upon a ban on environmentally harmful HCFC and HFC refrigerants and promote the application of natural refrigerants as alternatives.

### Ammonia to continue being the most widely used natural refrigerant

Ammonia (R-717) accounted for 60 per cent of the market share for natural refrigerants in 2014. The refrigerant is extensively used for industrial refrigeration operations due to its high co-efficient of performance (COP), comparatively lower leakage rate, low-cost, zero ozone depletion potential (ODP), and global warming potential (GWP). Ammonia is toxic at high concentrations which restricts its application in smaller refrigeration systems. The industry has come up with cascade systems where ammonia is used with carbon dioxide (CO<sub>2</sub>) as the secondary refrigerant to overcome the restraint and increase energy efficiency of the overall system.

### Commercial refrigeration to be the fastest-growing application in the natural refrigerants market

Natural refrigerants, mainly carbon dioxide (CO<sub>2</sub>) (R-744) and hydrocarbons (R-290, R-1270, and R-600a) are witnessing a high rate of adoption by major superstore and food retail chains in the European and North American regions. Natural refrigerants are used in cold display cabinets, stand-alone refrigerators, and for refrigeration during transportation. ■



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# Frozen Food Market worth USD 282.5 bn by 2023

The development of retail channels in the form of supermarkets, hypermarkets, and convenience stores has driven the growth of the frozen food market.

According to Marketsandmarkets report, the frozen food market is estimated to account for about USD 219.9 billion in 2018 and is projected to reach a value of nearly USD 282.5 billion by 2023, growing at a CAGR of 5.1 per cent from 2018. The retail food industry has witnessed significant growth over the past few years, globally. The development of retail channels in the form of supermarkets, hypermarkets, and convenience stores has driven the growth of the frozen food market. These large food chains form an important growing outlet for frozen food products, owing to the latest trend of on-the-go consumption. The rising per capita income and increasing number of working women, globally, have further accelerated the market growth.

On the basis of product, the convenience food and ready meals segment is estimated to dominate the frozen food market in 2018. This is due to the increasing consumer preference toward convenience foods,

which indirectly favors the increasing demand for frozen products, as they require less time and efforts. The processed food market is driven by the greater need for convenience due to the busy lifestyles of consumers. This, in turn, increases the demand for frozen products. Increasing disposable income is also one such factor that had a huge influence on the growth of the frozen food market, as it increases the buying power of the consumers.

**The frozen food market is witnessing strong growth due to the developments in the retail landscape.**

The development of retail channels in the form of supermarkets, hypermarkets, and convenience stores has driven the growth of the frozen food market. These large food chains form a significant growing outlet for frozen food products, owing to the latest trend of on-the-go consumption. With this, the supermarkets are also able to capture their share in the frozen bakery food market, as a result of the increasing demand for exotic vegetables and fruits and in-house bakers. This trend is driving the frozen food market, especially, the frozen bread market.

**Europe is estimated to dominate the frozen food market in 2018.**

Europe is estimated to account for the largest market share in the frozen food market in 2018. The region is projected to offer huge growth potential to the frozen food market. The market in Germany is estimated to be the major contributor to the growth in the region. The European market is driven by the robust growth of the food industry, which has supported the ready-to-eat snack food industry to gain acceleration in this market. ■







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## Use of solar energy in dairy value chain can reduce operational cost:

### RK Singh

**T**he entire dairy value chain – from village level milk pooling points to product delivery – is energy intensive. Extensive use of solar energy in dairy value chain can significantly reduce operational cost and ensure usage of clean energy, said Raj Kumar Singh, Minister of Power and New & Renewable Energy while inaugurating the NDDB's workshop titled "Solar – A Green Energy Alternate to Augment Dairy Farmers' Income" in New Delhi.

The minister said that NDDB with its mandate of promoting cooperative strategy has played a pivotal role in creating a PAN India network of dairy cooperatives.

He further mentioned that the dairy network now has around 1.65 lakh village level dairy cooperatives, 218 district/regional/taluka unions and 24 State Dairy Federations/Apex Milk Unions. Around 15 million milk producers are affiliated to this network. As on March 2018, the network maintains 72 MLPD of processing capacity, 18 MLPD of chilling capacity and 38 MLPD

of village level bulk milk cooling capacity. The minister stressed on the need of creating an enabling policy framework to further propagate usage of solar energy utilising the dairy cooperative network for the benefits of farmers.

He conveyed that the government is promoting solar pumps to ensure usage of clean energy and at the same time reduce the agricultural subsidy burden. Grid connected solar pumps is an alternative which while ensuring water for free to farmers will help them earn additional income through selling surplus energy.

The workshop highlighted solar energy as income source for dairy farmers. DISCOMs shared their initiatives and promoted the concept of solar as a remunerative crop. IIT, STFI, GIZ, National Institute of Solar Energy (NISE), Rajasthan Electronics and Instrumentation Limited (REIL) and Energy Efficiency Services Limited (EESL) shared their experiences in application of solar in dairy value chain especially the Concentrated Solar Thermal

(CST), industrial heating, bulk cooling and milk collection systems.

Dilip Rath, Chairman, NDDB said, "NDDB has started application of Concentrated Solar Thermal technology in dairy processing plants to partly address the need of thermal energy in dairy cooperatives. CST can reduce the annual heat demand of the processing plant from 5 to 15 per cent. With the help of capital subsidy support from MNRE and UNDP, NDDB have completed 15 CST installations in processing plants of dairy cooperatives across four states of Maharashtra, Punjab, Gujarat and Karnataka. The total installed collector area at these locations is around 8,000 sq.m. of aperture area."

With successful experimentation of installing grid connected solar PV systems with storage (if required) in village level dairy cooperatives or milk collection centres, NDDB has started propagation of solar energy run village cooperatives across the country. Support under National Dairy Plan I was also provided to 125 such installations across 18 states and results have been encouraging. A uniform policy framework with suitable grant support can help solarise entire village level dairy operations, which would reduce energy cost and contribute significantly to environment protection.

The Prime Minister inaugurated NDDB-promoted Saur Urja Utpadak Sahakari Mandli Ltd at Mujkuva village near Anand in Gujarat on 30 September 2018. 11 farmers have surrendered their access to the state subsidised electricity and opted for solar energy and supplying surplus energy to grid.



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# ACREX India 2019

## THE CURTAIN RAISER

A sneak peek into the upcoming mega event of HVACR sector.

– Supriya A Oundhakar, Associate Editor

**H**eating, Ventilation, Air Conditioning and Refrigeration (HVACR) sector has gained prominence due to the Indian government's thrust on the development of infrastructure. HVACR industry has been witnessing remarkable growth due to burgeoning urbanisation, rising disposable income of people, development of modern urban transportation like metro rails, commercial as well as residential realty sector etc.

According to Techsci report, the HVAC market in India is expected to reach USD 3.97 billion by 2019. Moreover, with anticipated growth in FDI (Foreign Direct Investment), several international players are expected to enter and start operations in the Indian retail market. The Indian HVAC market is projected to surpass USD 7.7 billion by 2022, on account of rising need for energy efficient HVAC systems, and growing replacement demand for HVAC systems.

The stock of room ACs has skyrocketed from four million units in 2014 to approximately 30 million in 2017, with 2017 AC sales at around 5.5 million units. Room AC sales are projected to continue their rapid rise, with an installed stock of between 55 and 124 million units by 2030, informs Avinash Khemka, Chief Manager HVAC, International Copper Association India.

ACREX India 2019, India's biggest event on HVACR, brings together the entire gamut of HVACR industry in order to tap this growth opportunity and raise the industry's concerns. This amalgamation provides a platform to network and interact with like-minded professionals and decision makers, engaging in thought-provoking discussions. ACREX India 2019 will showcase latest products, technology, solutions, and offerings across various segments in components and services, ventilation, air-conditioning, clean rooms, indoor air quality (IAQ) and building automation for national as well as international audience.

"We continue our patronage to this event. What gives a fillip to our participation is that it is going to happen in Mumbai from February 28 to March 2. We are very excited to be part of this mega event," states B Venkatesh, Global Head, Absorption Cooling Business, Thermax Limited.

With rapid developments taking place in India, especially, in the western region, in terms of infrastructural developments, we are hopeful that our participation in this exhibition will serve as a medium for us to reach out to this market, create brand awareness, and yield better results in time to come, informs Dinesh Semwal, Managing Director, Ensavior Technologies.

Being a key event for Sekesui Foam International, Rajesh Baliga, National Sales and Marketing Manager informs, "We do showcase our product to a large HVACR segment through this event regularly. This year the event being held in Mumbai is also a special event as the Western region is a key region for our organisation."

The 20<sup>th</sup> edition of ACREX India 2019, the flagship event of the ISHRAE (Indian Society of Heating, Refrigerating and Air Conditioning Engineers) and co-organised by NürnbergMesse India will witness a string of workshops and technical seminars, enhancing knowledge of the visitors.

It provides Gandhi Automations an ideal platform for the exchange of ideas among professionals and the opportunity to highlight the latest products, trends and innovations in the industry. Special focus is on products and services for energy efficiency and saving, states Kartik Gandhi, Director, Gandhi Automations.

ACREX India 2019 programs will highlight energy efficiency, healthy buildings, indoor air quality, refrigerants, IoT apart from engaging sessions from International Associations - USGBC, REHVA, CEEW, AAR, IAQA and ASHRAE.

Here's a sneak preview of the advanced technologies and products to be displayed at ACREX India 2019.

## Embraco to Present Fullmotion Inverter Technology

Embraco is a global player in the refrigeration company that promotes quality of life through innovative cooling solutions that promotes quality of life through innovative cooling solutions. Embraco is participating in ACREX India 2019 and its focus would be on promoting its new products focusing on food retail, food services and merchandisers to connect with the value that the company is providing to the end user.

Embraco will display the new generation of inverter technology (Fullmotion), such as FMFD, the most efficient compressors for commercial segment available in its capacity range, and as FMX, a compact product that provides more internal space in small refrigerators and allows natural refrigerant R600a (isobutane) usage.

The Fullmotion technology present in markets all over the world, brings more convenience to the consumer through the variable speed technology, the ideal temperature for food and beverage are quickly attained, providing more fresher food.

The Indian Government has been encouraging the refrigeration industry to develop even more sustainable



FMF line-up

solutions, and we are aligned with this objective, as we have implemented natural refrigerant usage for the past 25 years. The solutions that Embraco has been offering to this market meet the increasing demand of the government and the Indian population for solutions capable of providing a better quality of life. In this sense, we believe that natural refrigerants are the most compliant way to fulfill population and customer's interests, informs Guilherme Almeida, Marketing and Strategic Planning Director, Embraco.

In addition to the new launches, Embraco is still one of the leaders of R134a market, delivering reliable and robust solution focused in India, including wide-voltage range compressors.

## Ensavor to display Electrolytic Scale Remover

Ensavor Technologies provides comprehensive engineering solutions in design, engineering, sales, marketing, operation and maintenance of various product and systems for building services industry pertaining to the field of HVAC.

Ensavor will showcase its latest products and services, meet and interact with like-minded professionals and engage in thought-provoking discussions that are of utmost relevance for the industry in the Indian context at ACREX India 2019 exhibition.

Ensavor will display a new product Electrolytic Scale Remover

that is an electrochemical cooling tower water treatment system that removes scale by electrolytic operation without adding chemicals (zero chemical), informs Dinesh Semwal, Managing Director, Ensavor Technologies.



Electrolytic Scale Remover

### Features of Electrolytic Scale Remover

- It generates oxidants in the water which mitigate corrosion and biofouling, control the growth of micro-organisms, and helps in reducing the scaling and spread of airborne bacteria.
- This is an online treatment system, which is a widely accepted product, designed for larger capacity cooling towers in centralised AC, general industries, power station, refinery etc.
- This system precipitates all scale forming ions such as magnesium and calcium that are susceptible to dropping out the liquid at high pH Viz., Silica, Ferrum, Manganese etc.
- This online electrolytic scale remover is a single system that produces strong oxidants and takes care of scale formation, algae formation, slime formation, waterborne bacterial growth, disinfection (prevent legionella), and creation of an alkaline pH environment to prevent corrosion.

## Thermax to Showcase COP Absorption Chiller Series



COP Steam driven Absorption Chiller

Pune-based Thermax offers vapour absorption cooling systems including an extensive range of chillers that use steam, hot water exhaust gases and other fuels. Thermax chillers are extensively used for process cooling and air conditioning.

According to B Venkatesh, Global Head, Absorption Cooling Business, Thermax Limited will be showcasing its latest high COP absorption chiller series along with other award-winning absorption chillers and heat recovery solutions. The company will also showcase its new state-of-the-art, digitised manufacturing facility in Sricity, AP, where the company has an automated manufacturing system fully controlled by the latest Manufacturing Execution System (MES). "This helps us to deliver chillers with a higher level of accuracy and leak tightness, improved aesthetics and reliability. We would like to communicate to our audience the operational benefits of using our innovative products, in addition to the environmental advantages," he further adds.

## Gandhi Automation Brings Prime Freeze & Prime Freeze Duo

Gandhi Automations has expertise in manufacturing as well as exporting, distributing and installing Entrance Automation Systems and Loading Bay Equipment.

According to Kartik Gandhi, Director, Gandhi Automations, ACREX India 2019 event provides Gandhi Automations an ideal platform for the exchange of ideas among professionals and the opportunity to highlight the latest products, trends and innovations in the industry. Special focus is on products and services for energy efficiency and saving.

Perhaps the most challenging door application, cold storage door openings present unique requirements as well as an opportunity for Reliable Door and Dock to demonstrate our expertise in this market.

At ACREX India 2019 exhibition, Gandhi Automations will showcase Prime Freeze and Prime Freeze Duo. "We have innovated the technology by creating High Speed Vertical doors that are self-repairable, fast, safe, reliable and a perfect solution where cold storage with negative temperatures to as low as  $-22^{\circ}\text{F}$  is required," informs Kartik Gandhi.

The products use heater system thus, helping to prevent heat loss, door leakage, wastage of electricity, leaving out of refrigerated air. The product offers solutions for wide openings that offer very good sealing properties. Further, it provides insulation, fast moving, and causes minimal loss of air as well as minimal breakdown. Dual curtain with a blower or dryer aids in isolating the freezer area from other area reducing convection partial opening and full opening available to minimise convection and energy losses through operation of Freezer Door suitable for both positive and negative temperature between  $+5^{\circ}\text{C}$  to  $-35^{\circ}\text{C}$ .



*Continued on page 30*



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## ICA India to Display Small Diameter Copper Tube Heat Exchanger

International Copper Association (ICA) India will be participating in the ACREX India 2019. According to Avinash Khemka, Chief Manager HVAC, International Copper Association India, Smaller Diameter Inner-Grooved Copper Tubes technology is expanding into all sizes of heat exchanger coils from small to very large. Not many years ago there were just a handful of smaller diameter copper tube applications but that is no longer the case. Smaller-diameter copper tubes can be found in a myriad of products with tube lengths ranging from a few inches to several meters; and capacities ranging from hundreds of watts to hundreds of kilowatts.

Smaller Diameter Copper Tube heat exchangers enable high efficiency to be realised in diverse and dissimilar products, from cold vending machines and cold display cases to clothes drying heat pumps and mobile refrigeration systems; and Smaller Diameter Copper Tubes are being used in large commercial and industrial systems, too.

Once the small diameter tubes are interlaced with aluminum fin plates and mechanically expanded, the



5mm Inner Groove Heat Exchanger

ruggedness of the round tube plate fin (RTPF) heat exchangers is remarkable. Such are highly valued for their corrosion resistance. Unlike systems made from aluminum, the high nobility of copper compared to aluminum results in the sacrificial corrosion of aluminum fins rather than the copper tubes. Consequently, there is scant chance of a leak even under harsh environmental conditions. That means Smaller Diameter Copper Tube designs are favoured in outdoor condensers and process cooling equipment, he adds.



Testo 440 Air Velocity IAQ measuring Instrument



Testo Smart Probes with App

## Testo to Promote Smart Measuring Solutions



Testo Air Capture Hood

Testo provides a range of accurate and effective digital measurement instruments. These are suitable for all important temperature, humidity, pressure and flow velocity measurements.

At ACREX India 2019, Testo's prime focus is to promote smart work with Testo's smart measuring solutions for the HVAC industry. Testo will display smart products such as Smart Probes, intuitive IAQ measuring instrument testo 160, testo 420 air capture hood etc. "Visitors will also get a feel of the real applications and solutions in our hi-tech experience zone," informs Vimal Chavda, Manager – HVACR, Testo India.

"We do have a new product in consideration right now. We also believe that it will be a revolutionary step in the smart measuring technology which will ease and improve the IAQ measurement techniques that we currently have. Probably the most versatile and intuitive product in the market for HVACR sector," he further adds.

*Continued on page 32*

# Reduce air-conditioning bills the sustainable way with pre-cooling of fresh air



The fresh air cooling load contributes around 30% of the total cooling load on centrally air-conditioned systems. Reduce the cooling load with **HMX Indirect Evaporative Cooling** – the best solution amongst all fresh-air handling technologies like energy recovery wheels (ERW), treated fresh air (TFA) units, and heat pipes.



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## Kahan Controls to introduce High Pressurised Misting System

Kahan Controls is introducing High Pressurised Misting System for air cooled condensers and chillers in Indian market with collaboration with Tecnocooling Italy.

According Virendra Kamdar, CEO, Kahan Controls, Tecnocooling manufactures complete range of high pressurised pump ranging from 1 LPM to 21 LPM along with specially designed open able and cleanable type anti-drip nozzle, high quality and heavy-duty high-pressure hose and various types of high-quality push-in fittings.

The system works on principle of Adiabatic Cooling Principle where by forcing water by means of high-pressure pump, through specially designed misting nozzles, one can create a fog of ultra-fine water droplets with an average size of less than 5-10 microns. These tiny drops



High Pressurised Misting System

quickly absorb the energy (heat) present in the environment and evaporate converting water to water vapour (gas). The energy (heat) used to change the water to gas is eliminated from the environment, hence, the air is cooled and at the same time humidity of air is increased. Kahan Controls can design complete project depends upon client requirement.

### Advantages of System

- Very high efficiency as compared to cooling pad system or any other evaporative cooling system.
- Very low installation cost and very easy to install as no ducting is required.
- Very low moving parts and very low energy consumption.
- Installation at retrofit jobs are very easy as compared to old traditional systems.
- Takes minimal space and no extra space required for fans or pads etc.

The system finds applications in outdoor cooling, industrial cooling, adiabatic cooling or humidification in AHU, misting system for air cooled condenser or air-cooled chillers, textile humidification, dust suppression, and air-cooled condensers.

## Vulkan Technologies to Showcase Service Lokring

Vulkan Technologies, 100 per cent subsidiary of Vulkan Lokring Germany, manufactures lokring - solder-free (or braze-free) tube connections used in refrigeration and air conditioning technology, supplying nearly 80 million lokrings per year.

According to Prashant Patel, Vice President, Vulkan Technologies, the company will be presenting Service Lokring, a unique product for joining tube without brazing at ACREX India 2019. It ensures leak proof joint with high quality in refrigeration and air-conditioning systems, geothermal, heat pumps, solar thermal systems,



Vulkan Lokring

refrigeration appliances and automotive ACs. Lokring is TUV Nord, UL approval, EN 16084, and EN 378-2 certified.

The advantages of lokring are

- No heat, no flame - clean and cold joint.
- No need to carry bulky gas cylinders, welder, fire extinguisher.
- No need for any fire approvals.
- Installation during business hours and public access possible.
- Light hand assembly tool.
- No harmful brazing fumes. Eliminates solder related quality problems
- Saves 40 per cent time of installation.

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Interested manufacturers and suppliers of 'smaller diameter inner grooved copper tubes heat exchanger' can get in touch with us.

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For more information, or to join a free webinar, visit [www.microgroove.net](http://www.microgroove.net)



Continued from page 32

**Concurrent Events**

ACREX India 2019 seminar, the concurrent event will focus on HVAC of Tomorrow, covering emerging technologies for energy efficient and healthy buildings in hot and humid climates, future refrigerants, radiant cooling in Indian buildings, indoor air quality in workplaces, liquid desiccant added air conditioning etc.

Industry experts' workshops on IAQ, Indoor Environmental Quality in Buildings, Ammonia Refrigeration, Internet of Things (IoT), Variable Refrigerant Flow System will

share their expertise and experiences for enlightening the industry.

ACREX Awards of Excellence will recognise products and services in categories such as innovation, green buildings, energy saving in refrigeration segment, green product, innovation in building automation, product with technology developed in India, and Indoor Air Quality.

ACREX Hall of Fame, a new industry benchmark instituted by ISHRAE, will honour the excellence in conservation of energy by commercial buildings in India.

The coveted recognition aims to recognise iconic projects in India which can be global benchmarks in energy efficiency and sustainability.

**Conclusion**

The ACREX India 2019, apart from being a launch pad for new products and technologies, will witness participation from more than 25 countries and bring the entire HVACR universe to Mumbai. The event will be a knowledge hub enlightening everyone—from manufacturers to end-users. ■

## Monitor and manage your facility from anywhere

**7**5F Facilisight is an intelligent building management system (IBMS), with web & mobile apps, that uses machine learning of real-time sensor and weather data to predictively and proactively manage indoor environment for optimal occupant experience and operational efficiencies. It also helps building owners and operators manage smarter, with remote monitoring and control of smart HVAC, lighting and energy management systems across all sites.

**View your entire portfolio**

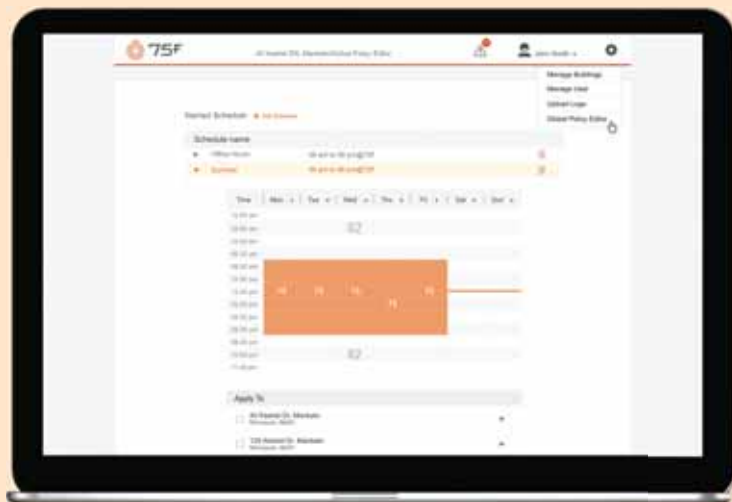
Get a portfolio-wide, colour-coded snapshot and dashboard across all buildings, with the ability to drill down to individual building, floor, zone and equipment levels in a few easy clicks to check status and monitor real time data, with 650 data points synched to the cloud every minute. Access quick summaries of each of your buildings on one screen, in real time.

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Gain multi-site visibility and insights on lighting and HVAC gas and electric energy consumption, intensity and costs with 75F Portfolio Energy Manager, part of the 75F Facilisight intelligent building management system. Facilisight helps compare sites and benchmark energy consumption, identify peak energy use spikes, and gain energy sub-metering insights to reduce utility bill. Unlike traditional Energy Management Systems (EMS), 75F building intelligence solutions can predictively and proactively reduce HVAC and Lighting energy by 30-50 per cent, while delivering optimal indoor environment comfort and air quality through smart sensing, controls and remote management.

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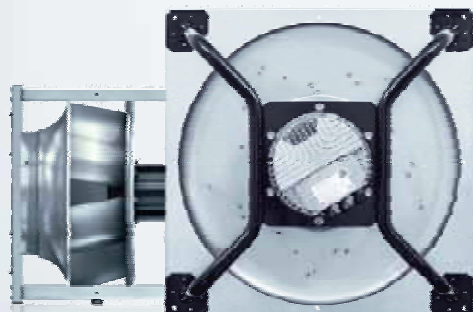
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# Mission Energy Efficient India on ISHRAE's Radar

Future for the HVACR industry is very bright with the market increasing at the CAGR of more than 10 per cent. With rapid urbanisation, the growth in the demand of AC&R equipment is on the rise, asserts **C Subramaniam, National President, ISHRAE (Indian Society of Heating Refrigerating and Air Conditioning Engineers)** in an interaction with **Cooling India**.

## What is the role of ISHRAE in Indian HVACR industry?

ISHRAE helps in advancement of the art and science in the field of HVACR. We help to educate members and other interested people. ISHRAE encourages scientific research. We give career guidance and financial assistance to students. In order to achieve these, we interact with the government bodies, academia, industry and individual professionals and create a platform where all the stakeholders can come, contribute and work for the growth of the industry.

## What is your take on current trends in the sector?

Today need for energy efficient drives market with requirement of buildings having more of automation systems, getting smart technologies incorporated into the design and operation of buildings.



**The program is coined as URJAVRAN and this has been very well received in the industry. Only by increasing awareness and reaching out to more and more end users and practitioners and making them a part of the design and operations team, we can achieve the objective of energy efficient India.**



Data analytics has also become an important area for achieving performance improvements in buildings.

**What kind of opportunities do you look forward for the sector with the government's roll out of 100 smart cities project and the government's emphasis on smart urban transportation (particularly, metro projects)?**

The demand for air conditioning and refrigeration will rise with the implementation of smart cities project. Demand for automation and controls for the HVACR systems in buildings will rise as it will witness a buoyancy in demand for smart monitoring, data collection and analytics that will drive this industry forward. Metro projects obviously increase the demand in this sector with a heavy thrust on ventilation systems; focus on safety is also going to be a lot of importance

**What are your suggestions for improving Indoor Air Quality (IAQ)?**

In commercial, industrial, institutional segments, a holistic building energy analysis has to be performed through certified engineering professionals who have capability in understanding the integrated impact of climate, materials, current trends in technologies, system analysis, right equipment selection, impact of environment, lifecycle cost analysis etc. If we really want to achieve energy efficiency to be the main driving force for buildings, performance of the HVACR systems in buildings need to be measured at regular intervals and these have to be part of the codes and standards; these have to be published and the tenants and owners are to be appraised in this aspect and they need to be part of the system. Going forward, I may even say that there has to be a penalty factor for not using energy efficient HVACR systems in buildings and the energy tariffs have to be linked to this.

With regard to Indoor Air Quality, awareness is increasing now amongst the end users. ISHRAE has brought out a standard on Indoor Environmental Quality which has been well received by the government. Further, we are working with BIS to make these

important standards reach out to all the stakeholders.

**As an association, how do you help the industry to achieve the objective of energy efficiency?**

We are carrying out regular technical programs across the country in almost more than forty locations and in the neighbouring countries – Sri Lanka, Bangladesh and Nepal that focus on the theme – 'Climate Change & Emerging Solutions'. This program is coined as URJAVRAN and this has been very well received in the industry. Only by increasing awareness and reaching out to more and more end users and practitioners and making them a part of the design and operations team, we can achieve the objective of energy efficient India. In addition to this, we carry out more than 1000 technical programs to spread this message in the industry. ISHRAE is also reaching out to more than 12000-member student community and conduct regular technical programs, webinars etc., since they are the future torch bearers of the nation. It is our responsibility to reach out to every nook and corner of the country in this regard.

**What measures do you expect from the government for growth of the HVACR sector?**

Government has to appreciate that air conditioning is no more considered as luxury and it is becoming a kind of necessity for a comfortable indoor environment today. In this regard, the government can give subsidy to promote use of energy efficient products that will ensure manufacturers to come out with good innovative products that will be really energy efficient.

**What do you envisage for future of the HVACR industry?**

Future for the HVACR industry is very bright with the market increasing at the CAGR of more than 10 per cent. With rapid urbanisation, the growth in the demand of AC&R equipment is on the rise. Various vertical segments like healthcare, hospitality, industry, commercial office space, residential are all on the growth trajectory. The future is energy efficient products and systems and also for systems that have minimal impact on the



environment. There are a lot of challenges in the areas of new refrigerants that have to replace the ones currently used and responsible for global warming etc. There are a lot of opportunities for research in this area and use of natural working fluids like Ammonia and Carbon Dioxide. Overall, the HVACR industry is poised for an interesting period of development and transition with the buzzword being energy efficiency, environmental impact and indoor air quality.

### Which sector will generate the future industry growth?

As mentioned earlier, the future growth is expected to come from the segments of healthcare, hospitality, commercial space, data centres, residential demand and industries as well. With the demand rising in these areas, there will be a chain reaction and the growth will come from all these areas.

### What objectives do you want to achieve in 2019?

Objective is to widen our reach in the industry and make every stakeholder aware of the responsibility that he or she has to work for the cause of the climate change. There has to be a sense of ownership and only then we all can move forward and achieve the goal of energy efficient India in the field of HVACR.

ISHRAE is also reaching out to the service professionals since they play a major role in ensuring the optimum way of operations of the HVACR systems in a building. In this regard, we have come out with specific technical programs to target various stakeholders.

Also, ISHRAE is organising sixth largest exhibition in this field of HVACR and allied services – ACREX India 2019 in Mumbai from February 29-March 2. The event will bring various manufacturers and service providers from India and abroad (almost 500) to exhibit the latest technologies and reach out to the stakeholders of the HVACR. We will be organising RefCold India 2019 that focuses on refrigeration and cold chain in Hyderabad during November 21-23.

### What is your outlook for the HVACR sector?

We have to be proud owners of the change for achieving energy efficient India. It is very important that every designer, installation, operating and service professional in this field has to commit for implementation of the best systems and products for the owners and end users. We should be responsible users of energy as HVACR system contributes to more than 50-60 per cent of energy consumption in buildings. Most energy efficient products or systems with least impact on the environment will lead us to a sustainable world. ■

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**C**old chain is an integral part of our lives today. However, till 1970, the term 'cold chain' was not even heard of. The only mode food preservation considered was bulk storage of potatoes. It was in the 70's that a new wave of multiproduct cold stores began in Maharashtra and that was followed by development in other important avenues in the food processing and freezing sector across the country. This was followed by a shift of outlook from 'cold storages' to 'cold chain' where the entire food chain from farm to retail was seen as an important aspect of food preservation. Now, cold chain has emerged as a major area of development and is recognised as 'Sunrise sector' in India.

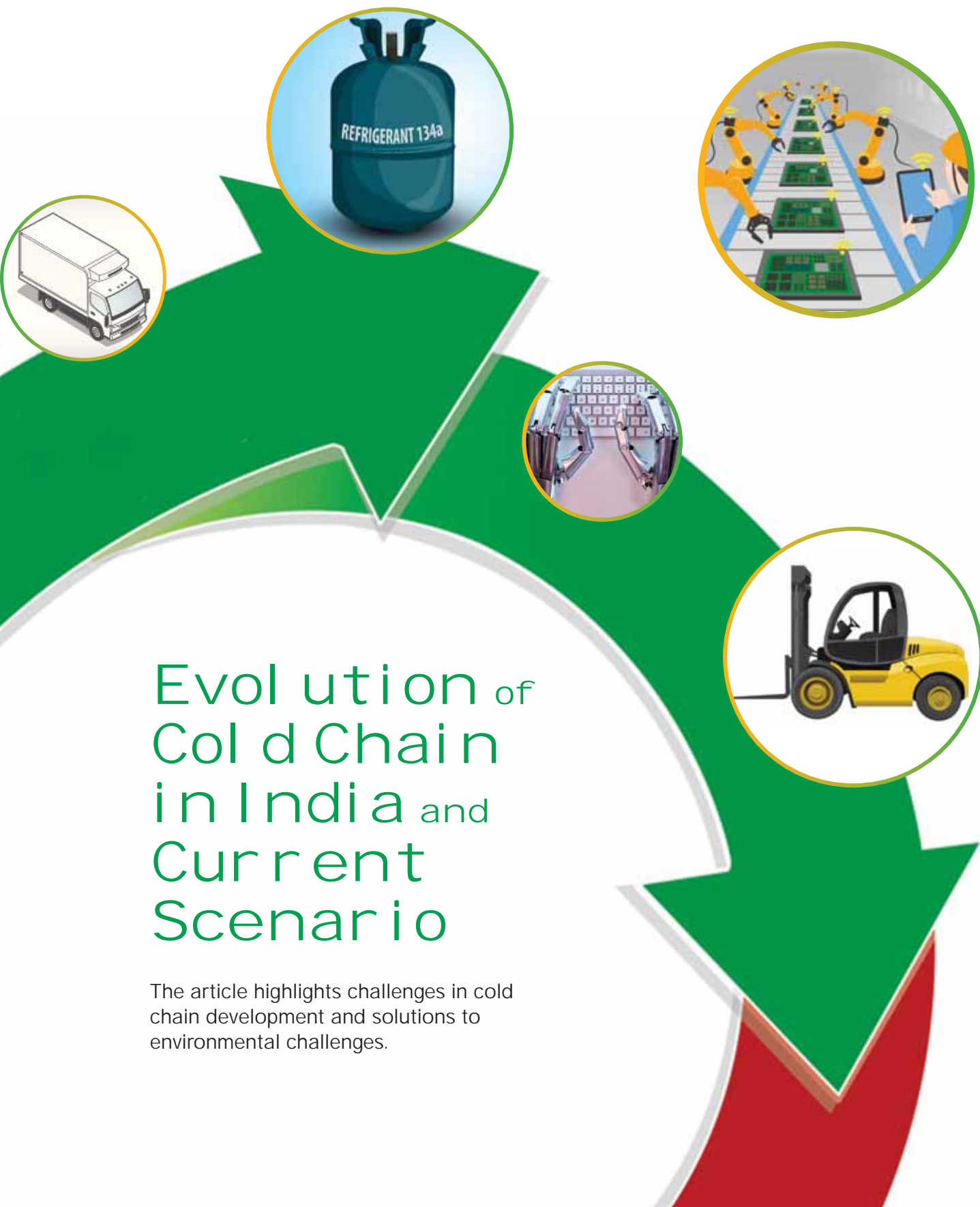
### Current Scenario in India

The recent trends in cold chain industry in India show that apart from multiproduct cold stores, there has been a wave of introduction of new types of cold chain facilities like Controlled Atmosphere (CA) stores, Pack houses with processing and pre-cooling facility and ripening units. There is also great potential for frozen food production in the country and distribution facilities for the refrigerated foods. Refrigerated transport is an important link in the cold chain and has a great scope for increase in numbers.

*The various types of cold chain facilities include:*

- Bulk cold storages for storing single commodity of large capacity with only few chambers. Bulk units are generally located near the producing centres and commonly store potatoes, chillies and raisins.
- Multi-purpose cold stores for storing multiple commodities - mix of positive temperature cold storages for storing fresh fruits and vegetables, pulses, spices, etc and negative temperature frozen stores for storing meat, fish, dairy products, processed fruits and vegetables, etc.
- Packhouse facility with pre-cooling for fresh fruits and vegetables which are required to be pre-treated, pre-cooled and cold stored as close to the source of production as possible. The facility consists a handling line which includes sorting, washing or cleaning, drying, grading, packing and palletisation of the produce. The products are then moved to the pre-cooling chamber and then to the staging cold store from where it is transferred to the reefer vans or containers. The facility is mainly used for exports and domestic organised market. Initially, the handling started as a manual process in a huge process hall with grading, sorting and packing of fruits and vegetables done on SS tables. Nowadays, automatic processing lines are used in most packhouses for round fruits and vegetables. As per





# Evolution of Cold Chain in India and Current Scenario

The article highlights challenges in cold chain development and solutions to environmental challenges.

current norms, the packhouses for export purposes are to be designed and constructed as per APEDA guidelines and approval.

- **Controlled Atmosphere (CA) stores:** These are special purpose cold stores mainly for storage of apples, pears, etc. The concept of CA is to control percentage of oxygen and CO<sub>2</sub> during the storage while maintaining the desired temperature and RH. The unit has number of small chambers as they are opened depending on the demand from the market. These projects are high value projects as they have special technology in gas tight construction and provision of continuous control of oxygen and CO<sub>2</sub> along with temperature and RH.
- **Ripening Units:** These are designed for scientific ripening of produce like bananas, mangoes, papayas, etc. This process involves maintenance of temperature, RH, supply and control of ethylene levels, CO<sub>2</sub> levels, etc.
- **Frozen food production units with processing, freezing, packing and storage facilities.** It was MAFCO, a government-owned subsidiary, who had a pioneering role in establishing multiproduct cold stores and frozen food facilities for fruits and vegetables, meat, poultry and milk products. They popularised frozen food varieties such as frozen peas, corn, mixed vegetables, okra, mango pulp, mango slices and dices, etc. This concept was later followed by other private players and this process is still on even in the current scenario. Apart from the above the normal frozen food varieties, they also came up with Ready-To-Eat (RTE) products like frozen parathas, samosas, etc

Frozen food plants incorporate the processing line which has facilities like cleaning, washing, blanching or pasteurisation, followed by the freezing, packing in bulk containers and storage in frozen food chambers. There are various types of freezers used by the industry and they include plate freezers, air blast freezers, IQF in



PEB with Insulated Panels

line and spiral type freezers used depending on the type of the produce.

- **Food Distribution Centres (DCs)** are designed to provide a variety of services including handling fresh, frozen and even non-refrigerated foods, both in the veg and non-veg category. The DC has the facilities for handling processing, freezing and storage of a large variety of items to cater to the food chains, large hotels, institutional canteens, etc. It also deals with the logistics aspects taking care of the last mile delivery of the good.
- **Refrigerated Transport:** This is an integral part of the cold chain which includes reefers for positive temperatures as well as for negative temperatures for frozen foods. Variety of transport vehicles are available in various sizes depending on the long-haul service or last mile delivery. Electric driven vehicles have also now been introduced in smaller capacity range.
- **Food malls, retail food stores, etc** are now a common place for consumers buy fresh and frozen produce where use of walk-in chillers and small cold rooms is increasing.

Based on NCCD's report on 'All India Cold-chain Infrastructure Capacity Assessment of Status & Gap', as per recorded data (31.03.2014), and the information collected thereafter, the country has created nearly 33 MMTs of cold storage space. The additional requirement as per the report is just about 10 per cent of the existing capacity. The other areas where there is a potential for further development are as follows:

- **Packhouses:** Existing infrastructure is approx. 500 nos. Estimated requirement is 70,000 nos. Hence the estimated gap is 69,500 nos.
- **Reefer vehicles:** Existing vehicles - 10,000 nos. Estimated requirement, 61,800 nos. Hence the estimated gap is 51,800 nos.
- **Ripening chambers:** Existing - 900 nos. Estimated requirement - 9,100 nos. Hence, the estimated gap is 8,200 nos.

It is also a matter of experience that some of the existing cold stores are non-functional and a large number of others are based on old and outdated technology. These certainly have to be upgraded with the modern technology and this itself is a huge business opportunity.

As far as the frozen food sector is concerned, the current processing capacity is estimated at 5-6 per cent of the production. This shows that there is a huge opportunity for growth in this sector. It has been observed that a number of players are planning setup units for frozen food production with the attractive financial incentives from MoFPI and other national bodies.

## Growth of Cold Chain

Owing to the rising need of the infrastructure and to reduce wastage, according to a market research report, the cold chain industry in India is forecast to grow at a CAGR of 19 per cent during the period of 2017-2022. The drivers for growth of the industry include:

- Changing demographics, lifestyle patterns and food consumption patterns in urban areas with nuclear

*Continued on page 44*



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Continued from page 42

family setup leading to increasing demand for processed, chilled, frozen food and beverages

- Rising need for the cold chain facilities to reduce the cold chain infrastructure gap as stated above
- Increasing government initiatives and financial support
- Increasing private sector investments of both domestic and foreign players
- Increasing demand for packaged, canned, frozen or ready-to-eat products
- Increasing interest in Indian food market and investments from international players like food chains and logistic players.

## Challenges in Cold Chain Development

On one hand, there is huge potential for cold chain industry in India. But these growth prospects come with some basic challenges at facility setup level as well as environment level:

### Facility Setup Concerns:

- o High initial cost of cold chain projects with rising cost of land
- o Land availability at suitable locations
- o Insufficient market surveys
- o Lack of adequate and reliable power supply
- o Non-availability of adequate water with proper quality
- o Lack of proper road infrastructure
- o Lack of proper reefer transport
- o Lack of skilled personal.

### Environment and Energy Concerns:

- o Global warming through refrigerant usage
- o High electrical energy usage

- o Water requirement in plenty
- o Refrigerant leakage
- o Damaged or spoilt produce disposal.

However, efforts are going on to find solutions to these issues with support from government and technical advisory bodies.

## Solutions to Environmental Challenges

### Natural Refrigerants

Gone are the days for refrigerants causing ozone depletion. Even the refrigerants introduced later e.g. HFCs have come on the phase down list due to their high Global Warming Potential (GWP). The newer systems would now have either natural refrigerants such as Ammonia, CO<sub>2</sub> and Hydro Carbons having zero ODP and GWP, or those synthetic ones which have very low GWP.

### Safety Issues and Standards

Safety standards are being updated to reflect increasing interest in flammable or mildly flammable refrigerants. Flammability or toxicity requirements have been covered by ASHRAE safety standards 15 and 34 and their international equivalents (ISO 5149, ISO 817). IIR standards are available for Ammonia for international application. Other organisations adopt ASHRAE technical requirements into codes and regulation. For cold chain projects in India, National Horticulture Board has published five standards for cold storages and other related projects which later have been transformed into MIDH standards.

## Newer Technology in Cold Chain Project Construction

Keeping the above-mentioned challenges

and solutions on radar, the technology for construction and operation of cold chain projects has undergone a lot of change over the past few years. These include advances in all aspects of cold chain management from construction to material handling equipment. Listing below the major advances in these fields:

- In construction of cold chain facilities, PEB structures are now replacing conventional construction practices. Pre-engineered steel buildings (PEBs) are those which are fully fabricated in the factory after designing, shipped to site in CKD (completely knocked down) condition. All components are assembled and erected at site with nut-bolts, thereby, reducing the time of completion. Use of eco-friendly materials in construction is increasing.
- Docks used for loading and unloading of products are now more scientifically designed to facilitate easier movement of materials and also ensure safety in operation.
- Insulated panels technology has largely replaced the old and conventional insulation practice. Sandwich insulation panels ensure highly thermal insulation properties and high structural strength and are being used for cold stores as well as process halls.
- Manual or mechanised insulated doors for cold rooms and docks ensure least energy loss and effective temperature control.
- Use of eco-friendly refrigerants is now being promoted and practiced to take care of the environmental challenges.
- Refrigeration machinery and systems are now designed with high energy efficiency for optimal use of power; thus, reducing operational costs and ensuring minimal water consumption. Apart from Ammonia and other low GWP refrigerants, CO<sub>2</sub> is making in-roads in this field as primary refrigerant as well as secondary refrigerant (brine). As a latest development, Low Charge Ammonia systems are being developed and employed in the cold chain sector and



Distribution centre with insulated panel construction and docking facilities

Continued on page 46



# INDIA'S LARGEST EVENT ON REFRIGERATION & COLD CHAIN INDUSTRY



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the latest is addition of Ammonia DX systems which have much smaller refrigerant charge and can have fully automatic operation like the HFC plants.

- Cold chain operations are getting more and more automated with state-of-the-art control systems. Capacity controls are used with compressors for energy savings.
- Energy efficient equipment are being used in electrical systems. These include IE2 or IE3 electric motors, LED lighting, alarm systems, PLC systems, APFC panels and Solar PV panels.
- Use of renewable energy like solar, wind and other sources are finding their place in cold chain field. Innovative products like solar roofs, energy generating systems with use of biogas and cow-dung cakes, etc are being introduced in markets. The use of solar PV is getting popular, especially where net-metering is available.
- In material handling and storage systems, various modern storage systems are being implemented like racks for manual loading and unloading operation, racks with reach trucks, fork lifts, BOPTs, etc
- IT and automation has started making way into the industry as the scale of cold chain facilities increasing and more and more bigger companies and multinationals are making an entry into this industry. Software for e-tendering, cold storage management, cold logistics management, IoT sensors and tracking in reefer transport, mobile

monitoring of remote operations, etc are becoming increasing popular.

- In the fire safety domain, there is increasing awareness about provision of dry and wet firefighting systems which have to be installed as per local norms.

## Government Initiatives

In order to promote technically sound, energy efficient and sustainable cold chain, the government has established National Centre for Cold Chain Development (NCCD) under Ministry of Agriculture. The other related institutions are:

- Mission for Integrated Development of Horticulture (MIDH) ([www.midh.gov.in](http://www.midh.gov.in))
- National Horticulture Board (NHB) ([www.nhb.gov.in](http://www.nhb.gov.in))
- National Horticulture Mission (NHM) ([www.nhm.nic.in](http://www.nhm.nic.in))
- Ministry of Food Processing Industry (MOFPI) ([www.mofpi.nic.in](http://www.mofpi.nic.in))
- Agriculture and Processed food

products Export Development Authority (APEDA) ([www.apeda.gov.in](http://www.apeda.gov.in))

- RKVY and other state and central level bodies

Further to increase investments and promote entrepreneurship and growth in this sector, the government provides good financial incentives through the above-mentioned bodies. They ensure that financial schemes are relevant to the need of the industry and promote growth in the right direction. The schemes also take into consideration the varied geography of the country and are spread across various states in the country.

Technical support is available from various organisations like ISHRAE, ASHRAE, NCCD, NHB, GCCA, IJAR and some other institutions. These organisations help promote cold chain in the country, provide standards for installation, safety and other aspects of cold chain, organise cold chain events which help increase business and fuel growth on state, national and international level.

## Green Cold Chain - The need of the hour

To address the environmental challenges and energy concerns of the cold chain industry, the concept of green cold chain was introduced by the author in 2008. This concept has been presented and promoted at various forums in India, Germany, Colombia, USA, Dubai, Thailand. etc.

A green cold chain concept encompasses the following main features:

- Environment friendly locations, layouts



Modern Cold Chain Facility following Green Design Concepts

and building structures

- ▶▶ Building structures with high thermal efficiency
- ▶▶ Highly efficient refrigeration and electrical systems
- ▶▶ Water saving and other related features
- ▶▶ Use of renewable energy in the best possible manner.

Realising the need for developing sustainable technology in the refrigeration and cold chain sector, ASHRAE, The American Society of Heating, Refrigerating and Air-Conditioning Engineers - an international organisation, has also recently published 'ASHRAE Guide for Sustainable Refrigerated Facilities and Refrigeration Systems'. The author was a part of the Project Monitoring Committee (PMS) for this first of its kind publication of ASHRAE. In addition, his own work in promoting green technology has been acknowledged by including his work in the list of references.

### Conclusion

An overview of the refrigeration and cold chain industry in India over the past 50 years shows that the industry has undergone significant transformation in terms of industrial applications, technology, geographical spread, standards and practices followed and support from government as well as technical organisations. Energy saving and Green Cold Chain concepts are also being seriously looked at by owners, private players and entrepreneurs.

However, it must be realised that for a country which is No. 1 in terms of milk production and No. 2 in terms of F&V production, the overall food processing, storage and cold transport capacity cannot be considered adequate and there is a good potential for development of modern and energy efficient cold chain facilities.

The concept of green cold chain needs to be promoted, rating system for evaluation of the projects needs to be formulated and special incentives need to be considered for green cold chain projects.

To support the government's goal of doubling farmer's income, cold chain will play as a key enabler by improving post-harvest management, reducing food waste, maintaining food quality and hence helping in increase sales and market rates of food products.

One can, certainly, hope that a scientifically developed, technology sound and environment friendly and energy efficient cold chain will transform into a value chain which will offer value for the producers, processors, cold store owners, transporters, distributors, retailers and finally the consumers.

(The author acknowledges contribution of Ms. Aditi Surange, Technology Expert at ACR PCPL in putting together this article)

**Arvind Surange,**  
Fellow ASHRAE,  
PP ISHRAE  
CMD, ACR Project  
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# POISED FOR AGGRESSIVE GROWTH

The future growth will come from Variable Refrigerant Flow (VRF) for commercial air-conditioning, informs Ajit Panicker, President, Refrigeration and Air-Conditioning Trades Association (RATA) in an interaction with Cooling India.

## How does RATA help HVACR industry to raise its concern?

Refrigeration and Air-Conditioning Trades Association (RATA) is a 70-year-old association focused on the techno commercial aspects of the business and is an association of the micro small medium sized enterprises in field of HVACR. The Association brings together people from the entire industry and gives them a central forum to help them accomplish





their common goal of making progress and achieving success. It is a forum for an organisation in the field of HVACR to come together and collaborate on how to grow the market and help each other scale up their businesses.

### **What are the growth drivers of the commercial refrigeration sector?**

The focus of the government on a seamless flow of farm produce from the farm to the fork will ensure the growth of the industry. This would also help farmers to get better value for their produce.



### **According to you, where will future industry growth come from?**

We expect it from Variable Refrigerant Flow for commercial air conditioning. Residential sector will also escalate the growth of air-conditioning.

### **What are the trends in the sector?**

The Variable Refrigerant Flow (VRF) segment is the fastest segment in the air conditioning growth story, while the residential segment will grow aggressively for air conditioning year-on-year for the next decade. Internet of Thing (IoT) devices will help to manage the refrigeration industry effectively. They would help in energy efficiency and trouble shooting.

### **What are your expectations from the government for the growth of the HVACR sector?**

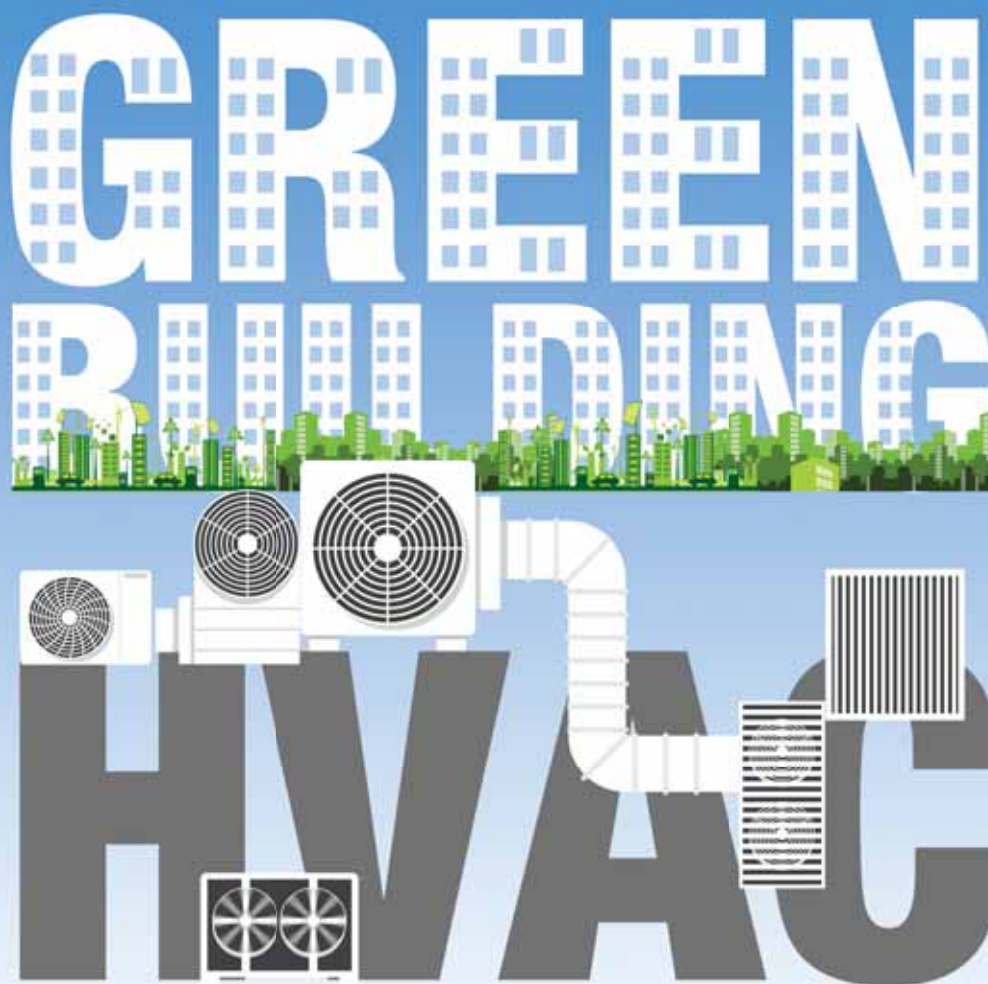
We expect the government to reduce GST from the current 28 per cent to 18 per cent. Further, availability of uninterrupted power supply in tier 2 and tier 3 cities will help to grow the industry.

### **How does the future look like for HVACR industry?**

The HVACR industry is poised for aggressive growth in the next two decades. The air conditioning industry is expected to grow eight times from the current 2018 baselines while the refrigeration industry is still at an early stage. It will evolve rapidly with the continued focus it receives from the government.

### **What are your suggestions to the Indian HVACR sector?**

The MSMEs need to organise themselves to tap the huge growth opportunity by accepting digital transformation of their business practices especially in customer data and human resource management. This will help to bring in the desired efficiency and profitability to their current operations. ■



An in-depth analysis on designing of a HVAC system in green buildings.

**H**eating, ventilating, and air-conditioning (HVAC) systems have an important role to play in green buildings since many of the green building factors are directly or indirectly affected by the performance of the HVAC systems. HVAC accounts for nearly 50-60 per cent of the energy used in commercial buildings in India. The HVAC system for green building shall be designed to reduce energy consumption while maintaining the interior conditions at a comfortable level to keep occupant's health and productivity. HVAC system design should not only meet the standard on energy front but beat the standard codes like Energy Conservation Building Codes (ECBC), India and American

Society of Heating, and Refrigerating and Air Conditioning Engineers (ASHRAE) standards to achieve higher level of green building rating.

Consequently, any commercial building has the potential to realise significant savings by improving its control of HVAC operations and improving the efficiency of the system it uses. An integrated and holistic design process beginning at a project's inception is required to optimise the HVAC design, HVAC commissioning and operation for green buildings.

#### Designing for Energy Efficiency: Through Building Simulation

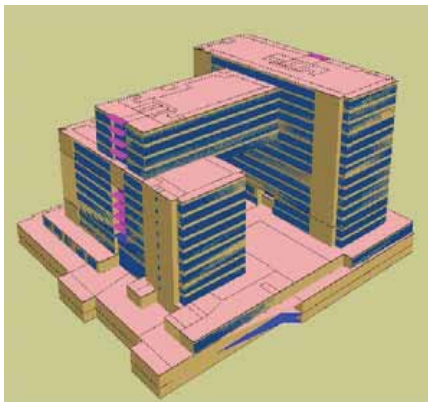
The systems in air-conditioned buildings

are so dynamic and interactive that it becomes very difficult to analyse the benefit of an Energy Conservation Measure with respect to other using the traditional method of calculations using various formulae. For example: any reduction in lighting load not only reduces the lighting consumption but also reduces the heat load and hence provides energy savings in HVAC. As we look for a glass with higher light transmittance, the solar co-efficient of the glass also relatively increases consequently leading to higher thermal load.

That's where energy simulation comes in as a Design Assistance tool. There are various simulation software available in the market today – Visual DOE, EQuest, Energy Plus, IES etc, to name a few.

### Energy Efficient Design Measures to reduce Heat Load and increase energy efficiency of the Building

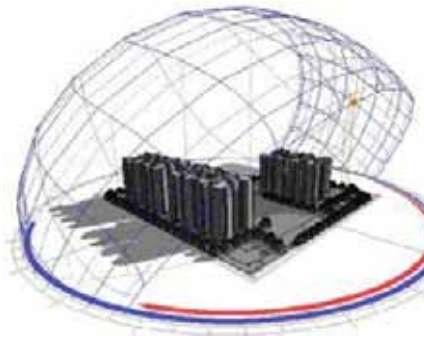
**Solar passive techniques:** Incorporation of solar passive techniques in a building design helps to minimise load on conventional systems such as heating, cooling, ventilation and light. There are



considerable opportunities for significant energy savings through efficient, integrated design, especially at the building envelope. An integrated and efficient building envelope with appropriate window, glazing design, insulated walls and roof can not only reduce the energy and operating costs of a facility, but can also reduce the size and cost of the HVAC system.

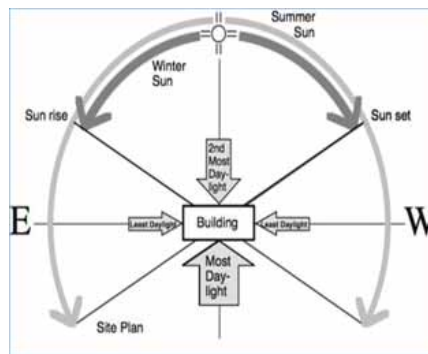
**Building orientation:** Building orientation has a major effect on solar gain. Proper orientation can significantly reduce the cooling load and improve energy efficiency.

In tropical climate like India long facades of buildings oriented towards North-South are preferred. East and West receive maximum solar radiation during summer.



In predominantly cold regions, also North-South long facades are advisable, as South orientation receives maximum intensity of solar radiation in winter months.

**Proper Shading:** All the elements of a building are vulnerable to heat gains. Proper shading is therefore a very important aspect in solar passive building design. It is observed using software simulations that, shading of roof, walls and windows have considerable potential in reducing the cooling energy consumption.



**Window Wall Ratio:** Window Wall Ratio is the ratio of vertical fenestration area to gross exterior wall area. Gross exterior



wall area is measured horizontally from the exterior surface; it is measured vertically from the top of the floor to the bottom of the roof. The cooling energy demand increases with increase in window wall ratio. The optimum WWR recommended is 20-30 per cent with daylight integration

**Building Envelope:** Building Envelope consists of roof, fenestration, glazing and the exterior walls. A thermally insulated



building envelope involves using materials that reduce heat transfer by conduction, radiation and convection. It helps cut down the heat load in the building, downsizing the air conditioning equipment required to cool the spaces and hence, results in lowering of the capital costs for the project. Thermal performance of fenestration, wall and roof assembly depends on Solar Heat Gain Coefficient (SHGC) and that of glazing depends on the solar energy transmittance through the glazing (measured by U-value). Lower the SHGC and U values, better are the thermal insulating properties of the wall, roof, fenestration and glass.

### Energy Efficient HVAC Systems & Equipment

Following strategies can be adopted in the HVAC system to meet green buildings requirements:

#### Selection of Chiller

All the major HVAC equipment like Chillers and Packaged AC units are procured based





on their energy performance rating to beat the energy rating specified in ECBC and ASHRAE Standards.

#### **Variable Speed Drives for Pumps, Fans and Compressors**

Pump and fan capacities can be reduced and energy saved by using variable speed drives to control their speed. Reductions in both peak and off-peak energy costs can be obtained by using variable speed drives on pumps, fans and compressors that operate at varying loads. They pay off better if the systems they are applied to operate at part load for relatively long hours. Variable speed pumping can dramatically increase energy savings, particularly, when it is combined with demand-based pressure reset controls. Variable speed drives on pumps/fans provide a soft start, extending equipment life. Variable speed systems are quieter than constant speed systems

**Dedicated Outdoor Air Systems:** A DOAS uses a separate air handler to condition the outdoor air before delivering it directly to the occupied spaces. While a DOAS can

be applied in any design, it is the most beneficial in a facility with multiple spaces with differing ventilation needs. It reduces a building's energy use when compared to mixed air systems that requires over ventilation of some spaces. It allows the designer to decouple the latent load from the sensible load, hence providing more accurate space humidity control.

**Supply Air System Control:** Using Variable Air Volume boxes and dedicated individual control for 50 per cent of the occupied people or all closed cabins in the occupied area will become mandatory to ensure human comfort and energy saving benefit.

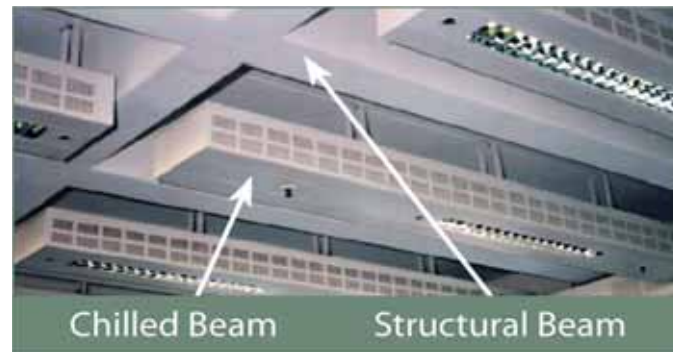
**Demand Control Ventilation:** In order to maintain the IAQ of the occupied area, it is required to install a fresh air system which controls, measures, monitors continuously the flow of fresh air (Outdoor air) supplied to the occupied area. CO<sub>2</sub> sensor can be used to measure or control the per person ventilation rate and, in turn, allow the designer to introduce a ventilation demand control strategy.

Apart from these standard measures

following new and innovative technologies in HVAC could be used to enhance energy efficiency in green buildings.

**Air to Air Heat Recovery System:** A heat exchange enthalpy wheels can be used in comfort application, where energy in the exhaust stream would otherwise be wasted. Energy recovery is most economical when there are large temperature differences between the airstreams, the source of supply is close to the exhaust, and they are both relatively constant throughout the year. With a total energy wheel, the humidification costs may be reduced in cold weather and dehumidification costs may be lowered in warm weather.

**Chilled Beams:** Chilled beams do not require a secondary fan so they are inherently more energy efficient than fan coil units, their main air terminal device rivals. On top of this, chilled beams use higher chilled water flow temperatures than fan coil units (around 14°C), which means there is a significant part of the year when chillers do not need to be



working and free cooling is available. The net result of the above, the chilled beam systems always lower energy consumption and operating costs.

#### Thermal Storage System for Cooling:

Consider a thermal storage system when designing your chiller plant. With a thermal storage system, the idea is to run chiller equipment off-peak and store cooled water or ice, then draw on this cooling during the peak times of the day. These systems take one of three forms: chilled water, ice or a salt-water hybrid of both—called a eutectic system. Specifying which system is based on the availability of space for storage media, cooling load profile, rate schedule and current equipment.

**Gas Fired Chillers:** Chilled water systems that use fuel types other than electricity can help offset high electricity prices, whether those high prices are caused by consumption or demand charges. Absorption chillers use thermal energy (rather than electricity) to produce chilled water. This type of system can be thought of when natural gas prices are significantly



lower than electric prices. The other option is to go for gas based captive power engine to produce electricity and the waste heat from the gas engine can be used to generate chilled water through heat recovery VAM chillers.

#### Control cooling tower fans by sensing ambient wet bulb temperature

Control cooling tower fans by sensing

ambient wet bulb (wb) temperature. Adjust the set point for an approach of about 2-degree F (controller will measure outside wb and adjust set point to 2-degree F warmer).

#### Commissioning and O&M

Commissioning is arguably the most critical aspect of the sustainable



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development cycle as it ensures that a building is handed over to operate safely, efficiently and in accordance with how the owner intended. Commissioning has come to be recognised as the most important process needed for design, construction and operation and maintenance of HVAC system to realise owners true project intent and establish energy saving and sustainable operation and management of the building system.

The commissioning process define commissioning as: "A quality-focused process for enhancing the delivery of a project. The process focuses upon verifying and documenting that all of the commissioned systems and assemblies are planned, designed, installed, tested, operated and maintained to meet the owner's project requirements."

Commissioning ensures building quality by using design review and on-site verification to help maximise energy efficiency, environmental health, and occupant comfort. The process improves indoor air quality by ensuring building components work correctly and that plans are implemented efficiently and effectively. Commissioning also confirms that maintenance plans, O&M manuals, and training procedures are correct and in-place for maintenance staff to follow. It is also a mandatory requirement to hire Commissioning Authority for achieving Green Certification for your project

Building Control or Automation systems play an important role in the operation of a building and determine whether many of the green design aspects included in the original plan function as intended. Control systems are at the core of building performance. Control system has artificial intelligence built in. Key lies in 'Managing the Building Automation System'.



Operations and Maintenance plays very critical role in ensuring energy efficiency in the building. It is recognised as an important tool for achieving operational excellence for a facility. It has significant implications on cost, reliability of systems, safety, good ambience in work space. Asset value is enhanced. Good documentation, manpower training, eye for details, housekeeping, routine audits are important to sustain best management practices on operations and maintenance of Facility.

HVAC engineers can play a crucial role in environmental design by being the technical/analytical resource for the team, and by encouraging the development of more rigorous assessment tools that are appropriate, practical and friendly, and defensible. To make a difference for the green design goal, they should push architects to design better envelopes, encourage HVAC decisions be based on life-cycle costing, insert their influence earlier in the process and support the proper commissioning of buildings. They should also try to educate building owners

or developers the value of a green or sustainable design so that the green process can be carried out successfully.

Green building approach enables building owners and managers to reduce energy consumption, improve the work environment, and reduce the environmental impacts of building operations. If the building can reduce operating costs, increase occupant productivity, and decrease health complaints, as well as be environmentally responsible, it is a green building. If green means happier tenants and healthier occupancy rates, more building owners would want to incorporate these technologies to gain a powerful market advantage. HVAC and building designers are responsible for bringing this into reality and contributing to the green revolution. ■

**Abhijit Pisal,**  
Business Head,  
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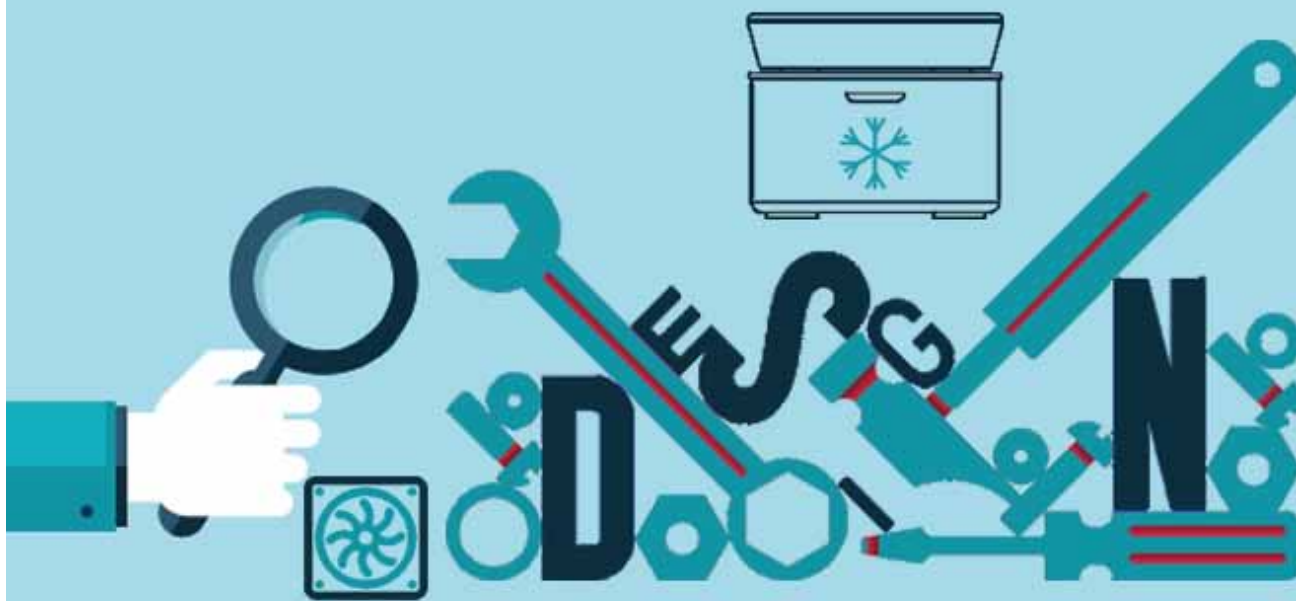
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# CHALLENGING PROBLEMS & Easy Solutions IN REFRIGERATION



Internationally acclaimed HVACR expert Ramesh Paranjpey narrates his own experience in terms of dealing with the common problems that baffle almost everyone in the refrigeration domain.

If you are involved in manufacturing and designing of field engineered process plants and air conditioning systems for more than 5 decades, you are bound to come across many situations, which appear to be baffling even to the most experienced engineers.

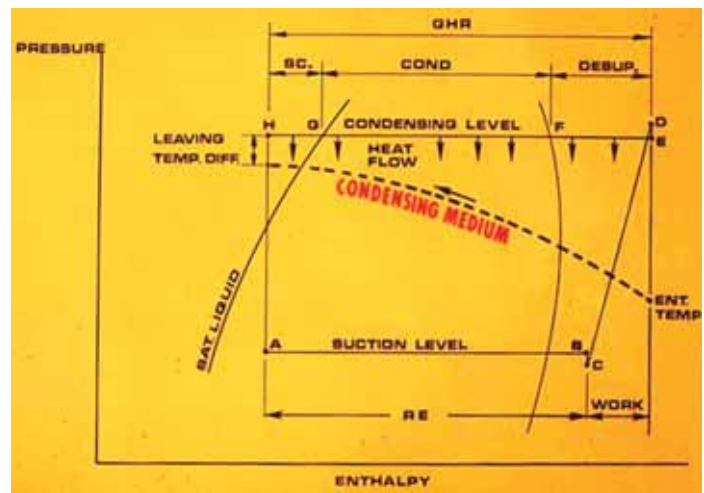
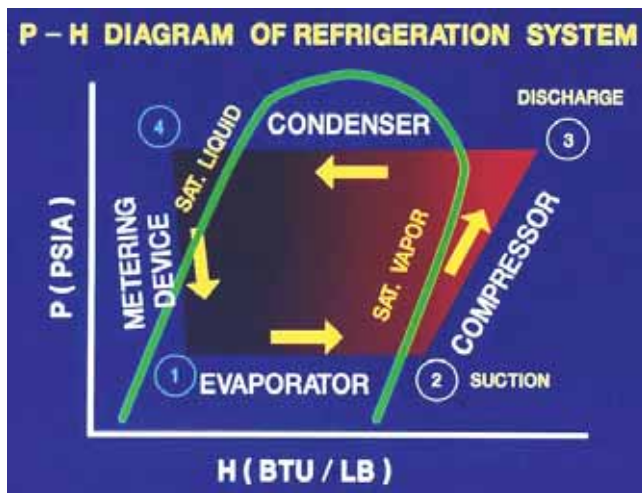
Many times, once the solution becomes evident, it appears to be too simple, but till such time many manhours are spent and expenses incurred before you meet someone who has either already gone through similar problem, or is able to tell confidently with logical explanation,

what needs to be done.

More than 99 per cent problems can be solved with systematic analytical approach, using step-by-step elimination process, to arrive at correct diagnosis and then to eliminate root cause, rather than working on symptomatic short-term solutions.

The remaining 1 per cent problems, for which any amount of theory or practice does not lead to solution, could be due to various reasons, not likely to be imagined, but can be broadly categorised in one of the following heads:

- Equipment designing and manufacturing related issues
- System engineering and component design errors
- Lack of communication or clarity between supplier and buyer
- Over confidence, or insistence by consultant or buyer
- Not adapting technology to suit local conditions
- Lack of proper knowledge in installation and piping practices
- Lack of understanding on proper working of system components



- Ignorance of relevant clauses from applicable codes or standards.

Some of the common problems that baffle almost everyone in the domain are narrated here:

### Equipment Designing & Manufacturing Related Issues

Normally if the manufacturer strictly follows drawings, specifications and methods given by his principals or collaborators, chances of errors are few and even if they occur, they can be easily identified and rectified.

A reputed manufacturer of reciprocating compressor supplied these compressors for various applications ranging from low temperature to comfort applications.

After installing more than 1,000 of these compressors for such varied applications, the designer/installer started facing typical problem of suction valve plate chattering and breaking, only on applications involving comfort air-conditioning applications using R-22 refrigerant. The same compressors working on ammonia installations did not face this problem, and they could not identify the reason for such premature failures. After exploring all possible avenues such as checking and rechecking drawings, inspecting components thoroughly, it was finally decided to approach the manufacturer's principals in Holland, expecting a usual answer to recheck all over again, the areas they had already covered.

To their surprise, the manufacturer

immediately got a response stating that the collaborators had also encountered similar problem and asked to increase the tolerance between stroke limiter diameter and the valve ring by few microns. Once this was carried out, the problem got resolved.

Now the interesting point is how increasing this tolerance helps in solving problem with R-22 comfort air conditioning applications?

On subsequent interaction with the collaborators, it was revealed that at higher suction pressures, the density of R-22 being very high, and due to uneven pressure exerted by small coil springs the inner rim of valve plate was hammering against stroke limiter diameter, leading to failure. As soon as the suction pressure reduced, the problem used to disappear as the gas density reduces and the valve plate rests firmly in the recess provided since the suction pressure is higher than the cylinder pressure. On pistons upward stroke as the cylinder pressure rises over suction pressure, the springs force the valve plate on to its seat.

R-22 vapour density at 40-degree F is 1.524 lb/cu.ft, whereas for ammonia it is only 0.2523 lb./cu.ft at the same temperature. Subsequently, manufacturer changed the design and instead of many small springs, replaced with two much stronger sinusoidal springs.

This problem was beyond the imagination of the engineers and could only be resolved with such assistance. The important point is the property of

refrigerant inducing this problem and had nothing to do with manufacturing accuracies.

### System Engineering Component Design

The condenser heat rejection is higher than the evaporator load. For air-conditioning application, it is nearly 1.2 to 1.25 times as a thumb rule. It is however always a good practice to actually calculate the same. Normally the safety factor is taken into account and actual operating conditions, which as a rule are always less than design load conditions, especially in comfort air conditioning applications. The problem of missing this aspect of correctly sizing the condenser may remain unexposed, however, on low temperature, process plants, not taking in to account heat of compression for condenser heat rejection can lead to serious problems.

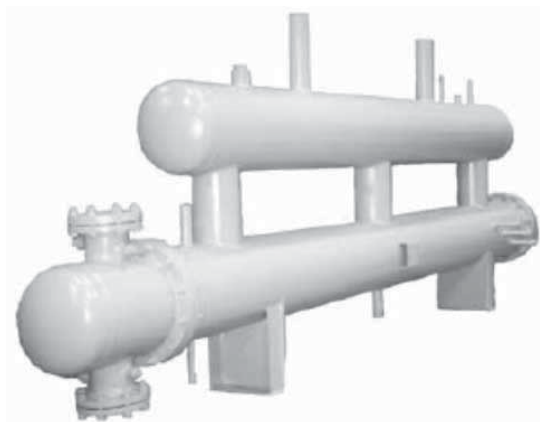
In one of the major installations using eight (-) 25-degree C brine chilling packages, the system designer had selected condensers suitable for evaporator load. As the compressors employed were uni-built two-stage design, they had to start with one cylinder of high stage getting loaded first, till such time the temperature dropped to such an extent, when low stage cylinder could be switched on.

Due to obvious error, in selecting condenser, to cater for correct heat rejection, the plant could never be started and run continuously without tripping on high pressure cut out.





Kettle Type heat exchanger



Heat exchanger with surge Drum

There was no place also in the plant room to install additional condensers for each package or to replace existing condensers with bigger size. Thus, the project commissioning faced severe problems and the contract finally ended with litigations, leading to huge losses for both client as well as suppliers besides bad publicity.

On a similar smaller plant, using one package, the problem could be resolved by supplying one additional condenser. So that two condensers shared initial cool down load, till temperatures dropped to reasonable level.

To highlight this issue, if we look at the typical ratings of two-stage compressors, KC 21 compressor with R-22 refrigerant, when starts initially from ambient conditions with one high pressure cylinder operating, has a capacity of 45 tonnes at (+) 40-degree C or (+) 10-degree C, whereas when it operates as two stage compressors with (+) 40-degree C or (-) 30-degree C conditions, it has a capacity of 18 tonnes.

One can appreciate, if a condenser is designed for 18 tonnes heat rejection, how one can start and operate the plant automatically, without tripping on high pressure, unless one manually throttles the suction?

Similar precaution needs to be taken while selecting the electric motor of adequate capacity to take care of initial starting and cool down load conditions as well, for a low temperature application.

A selection of brine tank capacity also needs careful consideration, if one is not

able to load compressor to full capacity at start-up, then to cool the stored quantity of brine in the tank from ambient temperature could take a very long-time which customer would not be willing to accept.

### Lack of proper communication

A chemical plant operating with Ethylene Glycol brine at (-) 20-degree C brine was installed in Mumbai, using ammonia-flooded chillers.

Similar plants were earlier executed and were working well. The sequence of events in this particular instance was as under.

The project commissioning was delayed due to certain reasons and the completion of refrigeration plant and the main chemical plant were ready for start-up simultaneously. There was no time available to test the refrigeration plant in advance and keep it ready before chemical plant could be started. The German engineers, responsible for process design were present and our most experienced erection crew was also at hand. The engineers were quiet confident that the plant would work well without any hitch. When the plant trials commenced, the charging of gas in the refrigeration unit was done simultaneously. Within short span, instead of expecting smooth operation resulting in brine temperature drop, liquid refrigerant started coming to compressor, and the suction pressure was not dropping. The commissioning crew did normal checks such as brine pump operation, all line valves in open position, liquid level controller functioning etc.

Everything appeared to be normal. The German chemical engineers thought that, the chiller design is faulty and adequate area has not been provided. The site engineers were of the opinion that the liquid level controller was not at the correct height and needs to be lowered. As there was no consensus, an urgent call came to me at 4 PM to rush to site immediately as all the engineers were waiting at the plant.

Immediately, everyone cornered me and started telling me their analysis and theory as to what is wrong with the system design. I requested them to restart the plant, and as expected, liquid started coming to compressor within short time, without expected reduction in brine temperature. I then tried to throttle the suction valve manually, to prevent liquid stroke, but the plant had to be stopped. I could not understand, why this is happening, when all other parameters looked normal, and I had confidence in my design of heat exchangers as well as in piping layout. It was evident that not much heat transfer in chiller is taking place.

Then the user was requested for the design specifications. The supply and charging of Ethylene Glycol brine was part of client's responsibility. The recommended specifications, called for brine of 45 per cent concentration. The user was asked about the source of procurement of brine. On searching the records, it was found that it was a reputed supplier and therefore the question of quality of brine was beyond suspicion. The scrutiny of the order further revealed that he had placed order for 45 per cent concentration of brine as a

requirement. Anticipating something wrong, I asked about the person who has prepared the brine mixture and ensured required concentration. To my surprise, client replied that there was no question of preparing brine concentration at their end and they had charged the system with the supply as received from the manufacturer, assuming that the manufacturer has taken care of necessary concentration as specified in the order.

In short, client had charged 100 per cent Ethylene Glycol solution, in the system directly from the drums received from supplier.

Refrigeration designers do not need further explanation as to why the plant was misbehaving. With 100 per cent concentration, obviously with high viscosity, there was hardly any heat transfer taking place. The viscosity of Ethylene Glycol at (-) 5-degree F is 18.00 cSt, with 45 per cent concentration, whereas it increases dramatically 180 cSt (to 10 times) if the solution concentration is 100 per cent. Similarly, the thermal conductivity reduces from 0.26 to 0.18 when solution concentration increases from 45 per cent to 100 per cent, (44 per cent reduction). Also, the specific heat of the mixture drops from 0.72 to 0.52 (38 per cent reduction).

I then requested to restart plant and started filling water in the tanks with the hoses and simultaneously removing excess quantity. As the pure Glycol started getting diluted with water, the brine temperature started dropping and finally at 4 O'clock in the morning we got desired results when right concentration was achieved, without any liquid coming to the compressor.

It can be thus seen, that this problem was due to taking certain things for granted leading to unexpected situations. Clarity on requirements, what is expected from each agency and dialogue with all concerned people could have avoided such situation.

### Over Confidence of Consultants

ASHRAE Refrigeration handbook chapter on refrigeration for chemical industry summarises this beautifully.

Chemical engineers expect refrigeration as any other utility, like steam or air and feel that refrigeration will be available in the similar manner when the tap or the valve is opened. They, very rarely, are willing to share process side data and designs.

Refrigeration engineers know that their systems work in conjunction with chemical processes and knowledge on either side is essential for trouble-free design and operation of entire plant.

At one of the plants designed by a leading consulting firm from USA, the author's company was associated to provide refrigeration. The plant was supposed to manufacture CFC refrigerants and therefore used R-22 for refrigeration plant as well. The battery limit conditions specified quantity of R-22 refrigerant in the liquid form to be made available at a particular pressure and temperature. This liquid refrigerant was then used in various process heat exchangers using refrigerant on the shell side and fluid on the tube side the heat exchangers were located at considerable height on third floor, where as the refrigeration plant was in the basement. In order to protect compressors, there was a big size knock out drum (accumulator).

When the plant was commissioned, it was found that the liquid was getting filled up in the drum and then subsequently entering the compressor suction header. In short accumulator was only delaying liquid stroke. Obviously, the system fault existed.

The consultants and the client were reluctant to take us in confidence and show the process side stating that it is confidential information. However, on urging them finally the client took us to the plant. All the liquid level controllers were checked for proper operation. These were pneumatically operated instruments with control valve and all related controls and indicators or alarms like high or low level etc. The entire process was monitored from remote location from the central control room.

It was obvious that as the liquid was boiling, the suction drag force due to powerful compressor suction was picking

the liquid droplets to suction against gravity force. Once the droplets entered suction, they had to travel only in the direction towards compressor suction and could not come back.

The process heat exchangers were kettle type design, regularly used by chemical engineers and not the flooded design similar to what refrigeration engineer normally provides.

Normally a flooded cooler with liquid level controlled at 75 per cent to 80 per cent height is provided. In addition, a surge drum on top of the cooler is provided, so that in case the liquid droplets are dragged upwards, due to reduction in velocity to approximately 100 to 150 fpm, the heavy liquid droplets fall back in the vessel instead continuing its journey towards compressor.

After three days of discussions, although consultants were reluctant, and client had no other alternative suggestions coming forward from consultants, they agreed to modify process heat exchangers as per the recommendations.

The plant was shut down for 5 weeks and all process heat exchangers were modified and provided with surge drum on top to effectively separate vapour and liquid. After the plant was recommissioned, everything worked well.

Finally, consultants agreed that they should have taken us in confidence earlier, which could have avoided such costly repairs and wastage of client's valuable time.

### Understanding Relevant Codes & Standards

The author's company was associated with India's largest petrochemical plant at Baroda. The total plant capacity was 2,200 tonnes, using ammonia refrigeration and the temperatures up to (-) 27.5-degree C. The project being executed under the consultancy of the largest public sector consultancy engineers and was under strict requirements of all relevant international codes and practices.

The material requirements were also to international standards and in those days (1975), it was difficult to get raw material

to required codes, hence client supplied the material.

The heat exchangers were designed to TEMA-B standard and construction was as per ASME SEC VIII Div. 1. The drawings of each heat exchanger were routed through various groups of consultancy engineers, such as thermal and, process design, maintenance group, strength checking and to ensure that the design strictly meets the code requirements. After many interactions and incorporating requirements of various groups, the drawings were finally approved and the fabrication of heat exchangers was carried out under the strict supervision of inspecting engineers. The heat exchangers were huge, compared to normal refrigeration condensers or chillers which one is used to. And the sizes were 38-inch diameter by 20-foot long using 670 tubes of 1.25-inch diameter and weighing 18 tonnes each.

After the heat exchangers were manufactured and were stamped by inspection engineers, arrangements for organising dispatch were made.

Suddenly, we received a fax from the chief engineer of the consulting firm that all the low temperature vessels and heat exchangers stand rejected, since we have not carried out impact test on raw material before using it for fabrication and vessels are likely to fail in operation.

As per ASME code for use on low temperature applications, it is mandatory to carry out this test. This requirement had also escaped the attention of their inspecting engineers. However, the consultants squarely put the blame on the suppliers.

This communication was bolt from the blue, and all our efforts stretching over two years came to naught, leading to huge financial loss to the company if we had to start all over again.

In desperation, ASME committee in USA was approached to find whether any concessions to such requirements is available for refrigeration duty, since we had never done such testing earlier in any of our low temperature plants and all of them were working well for long periods

without any damage.

To our great relief we received the letter stating that as per UCS-66(c)(1), no impact test is required on any material for use at temperatures of (-) 20-degree F or (-) 28.9-degree C and above, if the pressures and temperatures do not occur simultaneously.

The code states that materials subject to temperatures, below (-) 20-degree F, except as under shall be impact tested as required by Para UG-84 of Section VIII Div 1 of the ASME Boiler and Pressure Vessel Code, and will have Charpy impact value at the operating temperature of not less than 15 ft lb. using keyhole notch.

### Exception

Carbon, low alloy and high alloy steels (but not austenitic ductile iron) may be used at low temperatures not lower than (-) 50-degree F or (-) 46-degree C without impact testing if the operating pressure will not be more than 25 per cent of the maximum design pressure at ambient temperature

The reason being, in refrigeration applications pressures and temperatures do not occur simultaneously, unlike chemical process heat exchangers. In other words when the vessel is operating at low temperature, the corresponding pressure is very less, and since the vessel has been designed for much higher pressures, it is always safe for operation at low temperatures.

The ASME volumes are large and to read and master all the information is not a regular requirement of refrigeration engineers, but we should learn such clauses, which are relevant to our industry, to avoid any such happenings. The consultants and chemical engineers are experts in heat exchanger designs, but are also not aware many times of special requirements of refrigeration industry.

The importance of understanding each other's requirements has been highlighted nicely in ASHRAE Refrigeration volume as stated earlier.

It is therefore essential that both the parties are fully aware of required codes and practices, to avoid such

misunderstandings.

If we would have accepted consultant's rejection, one can imagine what would have been the outcome.

### Technology adaptation to suit local conditions

Our company's strength was in designing refrigeration plants for low temperature applications.

One of the early plants involved selection of two-stage ammonia compressors for a brine chilling plant-supplying brine at (-) 28-degree C to process. The installation was in Mumbai for one of the pesticides company using German Technology. The chief engineer was also German posted by the principals.

The plant was commissioned and worked well. All handing over formalities were completed to everyone's satisfaction.

After a period of one week we received a call from user, indicating that there is abnormal wear out on cylinder liners. We promptly deputed our service staff and, on their suggestion, replaced a batch of 12 liners for one compressor. We, then started investigating why such premature wear out are taking place.

There was no liquid carry over and thereby affecting lubrication. We also checked cylinder alignments to confirm that the axis for each cylinder was true as per drawing, and hence possibility of wear out due to incorrect manufacturing or fabrication did not exist.

Having completed this study, we thought that probably, the particular batch of liners might be defective and not having material composition as per specifications.

After replacing the cylinder liners and supplying correct liners after thorough inspection, we were reasonably sure that the problem would disappear.

This did not happen and we again got call after few days indicating the repetition of the same phenomena.

The German chief engineer thought our liner material is not correct and we either change the material or do some hard chrome plating or change the design of piston rings etc.

He also suggested that we should seek



assistance from our sister concerns who had immense experience in manufacturing reciprocating machines, particularly diesel engines.

We did not want to take such route since in all other installations the compressors were working well without such premature liner wear out.

Meanwhile we continued replacing liners at regular intervals, costing enormous expenses to company.

The compressors were built as per collaborators design and client insisted that we call their expert since they also knew our collaborators well, as they were using similar compressors in Germany.

Accordingly, we requisitioned services of our principal's expert, and when we took him to site, everyone was eagerly awaiting to find out what is his diagnosis and remedial suggestions. We took him around the plant along with German chief engineer.

We then assembled in the conference room to eagerly hear from him. He indicated to client that he has found the solution but would convey the same next day after he holds the discussions with our team.

On reaching Pune he informed us that the problem was not serious and suggested that we change currently used oil Zerice R 44 (43/44 cSt at 40-degree C) with a higher viscosity grade oil and confidently said that the problem would be resolved. When we told him that we are using oil as per collaborators recommendations, he then clarified that the recommendations are basically for European countries with cold or moderate climatic conditions. In India for higher ambient conditions, the chart needs to be modified. Normally it would be alright for any other application but with Ammonia refrigerant and with two-stage application for such extreme low temperature use, the compressor

discharge temperatures are high and affect lubricating properties of oil adversely. It is therefore suggested that thicker grade oil should be used.

When we carried out this change, the problem of liner wear out disappeared. We then changed our oil recommendation chart incorporating Indian Oil Servofriz-68 or Seetul 68 from high pressure which has a viscosity of 68 cSt at 40-degree C for all users resulting in improved performance for all installations and reduced maintenance costs.

The lesson to be learned is many technologies need to incorporate requirements to suit local conditions instead blindly following foreign technologies.

### Proper understanding of working of component

We were manufacturing flake ice machines using ammonia as well as R-22 refrigerants. The icemaker used flooded design, in which low temperature refrigerant was filling up the double walled cavity in the cylinder. The water sprayed on the inner wall was getting converted into ice.

The fabrication of icemaker drum was subcontracted and machining process was in house operation. The liquid refrigerant to ice maker is fed with the normal arrangement of hand expansion valve and solenoid valve combination controlling liquid level in a vessel, connected to icemaker with the liquid and gas equalising connections.

We installed one such icemaker in a chemical or dyestuff plant in Mumbai. No sooner the ice plant was started, we observed that the liquid is directly filling the surge vessel and entering the compressor without producing ice.

We then carried normal checks, such as operation of float switch, ensuring all

equalising valves are open etc. Our site engineer thought the liquid level is too high and we then lowered the drum and reduced the height, without any success. We then opened the system to find whether any plastic cap is blocking the liquid flow to the icemaker drum. Many times, erection staff forgets to remove plastic caps and join the piping in a hurry. When the system is put on vacuum, the caps may get sucked in the line and thus blocking flow path. On this installation we did not find any such problem.

Finally, when no solution was in sight, we decided to bring the icemaker to factory and decide to cut open the cylinder to find what is blocking the refrigerant flow.

To our horror, we found that the fabricator had provided a complete round strengthening ring above the refrigerant liquid inlet connection, instead providing just the four small joining pieces to hold the cylinder inner and outer wall. This resulted in liquid not entering the icemaker at all, but was directly going to surge vessel and finally entering the compressor.

When we asked the fabricator, who incidentally was not our regular supplier, why he had done so, he indicated that since he was doing the job for first time, he wanted to do a good job and thus thought of strengthening the design further by providing complete support instead of few small ribs. If he had known the application and the operation of icemaker the situation would not have arisen.

The best intentions, without knowledge of system operation, could thus lead to puzzling problems. ■

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This article discusses the economical methods for cold storage based on renewable energy sources for the agro produce, which will help the farmer to hold it till good price can be fetched in the market.

## RENEWABLE ENERGY BASED MOBILE COLD STORAGE FOR AGRO PRODUCTS

Farmers suicide in our country especially in Maharashtra has become a burning issue since last two decades. Waiver of loans, compensation by government, free electricity etc. are not at all solutions for these problems. Crop planning, proper storage till the product reaches market at appropriate time and value addition of agro produce mostly using renewable energy is the only solution.

In this article we shall discuss about the economical methods for cold storage



based on renewable energy sources for the agro produce, which will help the farmer to hold it till good price can be fetched in the market.

In India alone, 10 million tonnes of cold storage capacity is required to prevent the over 30 per cent wastage of fruits and vegetables and other perishables. The main challenging task is transporting the produce to the far away located cold storage unit which involves substantial expenses for a short duration.

Considering the above challenges, adoption of renewable energy based mobile cold storage can be useful. Being a mobile unit, the system can be shifted to any site of any farm for cooling and storage of produce immediately after harvest. Further, it operates 100 per cent on renewable energy i.e. solar PV + battery storage + ice banking with or without solar thermal or biomass based methanisation or gasification.

A mobile cold storage does not depend on grid supply or back-up DG set and other infrastructure leading to huge cost saving at initial stage as well as in regular operations. As a result, it is best suitable for energy starved areas.

With a wide range of temperature control, it makes ideally adaptable for storing fruits, vegetables, flowers and other perishable agricultural produce.

If the fresh fruits and vegetables are stored at the temperature below their optimum low requirement, develop chilling injury and therefore, loose the marketability. The fruits stored at low temperature exhibit more shelf life than those stored at ambient temperature.

Mature green fruits may be stored at 10-degree C – 14-degree C for 30 days and ripe tomatoes at 4.5-degree C for 10 days under 85-90 per cent relative humidity. Fresh unshelled peas may be kept for two weeks at 32-degree F at relative humidity of 85-90 per cent. Peas can also be stored in crushed ice for about 2-3 weeks.

### Storage mix

- Apples or pears with celery, cabbage, carrots, potatoes or onions.
- Celery with onions or carrots.
- Citrus with strongly scented vegetables.
- Pears/apples with potatoes as former acquire unpleasant taste.
- Green pepper will taint pineapples.
- Onions, nuts, citrus, potatoes should be stored separately.

### Construction of mobile cold storage unit

Insulation 60 mm thick PUF panel shall be provided for insulating the cold room walls and ceiling and flooring. For strengthening the insulation, chicken wire mesh is provided with it. The entire system is mounted on a trolley similar to used with tractor which is having dimensions as shown in the drawing.

R 404A refrigerant is used for the cooling unit. Room temperature of 2-degree C to 8-degree C should be maintained inside the chamber. The ambient temperature will be 40-degree C. The total refrigerant capacity will be 60,000 BTU/hr for 20 MT capacity cool chamber.

The storage life of fruits and vegetables even at low temperatures in general varies between 2 to 4 weeks excepting for a few commodities like apples, oranges, potatoes, cabbage etc. In case of cold room, long-term storage is not envisaged and duration of storage is likely to be 1 to 4 weeks.

Cold storage is the widely practiced method for bulk handling of the perishables between production and marketing processing. It is one of the methods of preserving perishable commodities in fresh and wholesome state for a longer period by controlling temperature and humidity within the storage system. Maintaining adequately low temperature is critical, as otherwise it will cause chilling injury to the produce. Also, relative humidity of the storeroom should be kept as high as 80-90 per cent for most of the perishables, below (or) above which has detrimental effect on the keeping quality of the produce. Most fruits and vegetables have a very limited life after harvest if held at normal harvesting temperatures. Post-harvest cooling rapidly removes field heat, allowing longer storage periods.

#### *Proper post-harvest cooling can:*

- Reduce respiratory activity and degradation by enzymes.
- Reduce internal water loss and wilting.
- Slow or inhibit the growth of decay-producing microorganisms.
- Reduce the production of the natural ripening agent, ethylene.

In addition to helping maintain quality, post-harvest cooling also provides marketing flexibility by allowing the grower to sell produce at the most appropriate time. Having cooling and storage facilities makes it unnecessary to market the produce immediately after harvest. This can be an advantage to growers who supply restaurants and grocery stores or to small growers who want to assemble truckload lots for shipment. Post-harvest cooling is essential to deliver produce of the highest possible quality to the consumer.

Cold storage can be combined with storage in an environment with added of carbon dioxide, sulphur dioxide, etc. according to the nature of product to be preserved. The cold storage of dried or dehydrated vegetables in order to maintain vitamin C, storage temperature can be varied with storage time and can be at 0-10-degree C for a storage time of more than one year, with a relative humidity of 80-95 per cent. The cold storage of perishables has advanced noticeably in recent years, leading to better maintenance of organoleptic qualities, reduced spoilage, and longer shelf lives. These advances have resulted from joint action by physiologists to determine the requirements of fruit and vegetables, and by refrigerating specialists to design and run refrigerating machines accordingly.

Cold chain management in India has been accelerated in last decades to reduce post-harvest losses. However, most of the tropical and sub-tropical agricultural as well as horticultural produce goes in waste due to its perishable nature and improper cold chain management on-farm. Thus, apart from the large cold storage chambers for long-term storage, refrigeration system also required for on-farm or in production catchment for agricultural crops during short-term storage.



## Basic Design 20MT Cold Room

Room dimension ft	30 L x 8.5 W x 11 H
Room temperature	+ 4°C (+ 2°C)
Humidity	85 - 90% RH
Ambience temperature	43° C
Material to be stored	Fresh vegetables and fruits
Product quantity	20 MT
Product Incoming Rate	33% (6600 kg per day)
Product Entry Temperature	28-38° C
Pull down time	24 hrs / Batch
Insulation	60mm PUF with 0.5mm COATED CRCA Sheet as external finish and internal finish
Floor	60mm thick PUF slab over kota and PCC
Hinge door	34"x 78" – 2 Nos.
Refrigeration unit capacity	60000 Btu/hr @ 4°C Room temperature and 43°C Ambient temperatures
No of units	24000 Btu / hr x 2 nos. + 18000 Btu x 1 no.
Refrigerant	R404A
Compressor	48 VDC compressor
Density	181 kg/m <sup>3</sup>
Running compressor	14 - 18 hrs

## Calculation Results

Ambient losses	57400 watt/24 hrs
Infiltration due to use	23700 watt/24 hrs
Motor load	10800 watts/24 hrs
Product load	44800 watt/24 hrs
Personal load	1013 watt/24 hrs
Lighting load	750 watt/24 hrs
Refrigeration capacity	224580 watt/24 hrs
Refrigeration power for unit	12600 watt

Perishable foods include fruits and vegetables, foods purchased from chill cabinets, freshly cooked food stored to be used later. It is usually stored in the refrigerator. Some fresh fruits and vegetables, however, will store quite well out of the refrigerator as long as they are stored in a cool place.

Good sound curds can be stored in cold storage for about a month at 30-degree F with 85-90 per cent relative humidity.

The low-pressure liquid refrigerant then allows passing through refrigerated space whereby the heat of hot air of refrigerated space starts evaporating the liquid refrigerant hence,

heat in the atmosphere decrease and cooling is produced. Blowers circulates the chilled air to stored fruits and vegetables.

A general rule for vegetables is that cool-season crops should be stored at cooler temperatures (32 to 35-degree F), and warm-season crops should be stored at warmer temperatures (45 to 55-degree F). There are exceptions to this rule, though.

Cooling can be defined as the decrease of temperature of a substance or medium below temperature of its environment. Refrigeration is a process of lowering the temperature and maintaining it in a given space for the purpose of chilling foods, preserving certain substances, or providing an atmosphere conducive to bodily comfort. Storing perishable foods, pharmaceuticals, or other items under refrigeration is commonly known as cold storage. Such refrigeration checks both bacterial growth and adverse chemical reactions that occur in the normal atmosphere.

The most important factor in cold storage is ambient temperature. As a rule, the temperature in cold storage is higher than 2-degree C, which is the freezing point temperature of stored fruit and vegetable. Stored product must not be freezing in the cold storage reported that there is heat transfer in many places of cooling system and that the heat transfer widely takes place during the process.

The purpose of the calculation of cooling load is important choosing system components such as compressor, condenser etc. correctly and economically determination of all inputs of cooling load would not be possible, for this reason there may be some deviations in the cooling load and the focus point must be minimizing the deviation.

It is explained that the ambient temperature of cold storage, the situation of stored product before entering to the cold store, the daily working hours and the determination of which product will be stored are important for calculation of the cooling.

There is no method of defining cold store capacity that satisfies the requirements of everyone concerned with cold storage. Storage capacity based on the weight of produce that can be stored will depend on the storage density of the products and the method of storage.

Therefore, unless only one product is stored under closely defined conditions, this definition is obviously unsuitable. It is generally agreed that it is more appropriate to define storage capacity in terms of the store volume but there are a number of ways in expressing this value.

Gross volume is the volume of the refrigerated space whereas net volume is the volume that can potentially be used for storage and is the gross volume less the volume required for coolers, structural requirements, doorways and other permanent features of the store.

Effective volume is the store space that can actually be utilised for storage and it takes into account the requirements for passageways, stacking equipment etc.

Gross volume and net volume can easily be defined by devising a simple set of rules for making these calculations. These

store volumes, however, can only give a rough estimate of storage capacity and their main use may be before statistical purposes. The effective volume can only be calculated for each particular case and to achieve any degree of accuracy, a drawing of the store layout would be required together with full details of the storage conditions. Store operators should therefore use general statements of store capacity with care and when placing an order they would give full details of the products and the storage operation to enable the supplier to provide a store to suit the operating requirements with the maximum utilisation of the gross storage volume.

### Costs are generally divided into three parts:

- Initial costs
- Annual fixed charges
- Operating costs.

#### Initial costs

- Cold storage built on a trolley with can hauled by any tractor
- Service charges for water, mobility to the site.
- Freezer plant
- Delivery charges
- Installation charges
- Design and consultation charges
- Refrigerant and oil charges.

#### Annual fixed costs

- Depreciation
- Interest
- Insurance
- Taxes
- Capital maintenance.

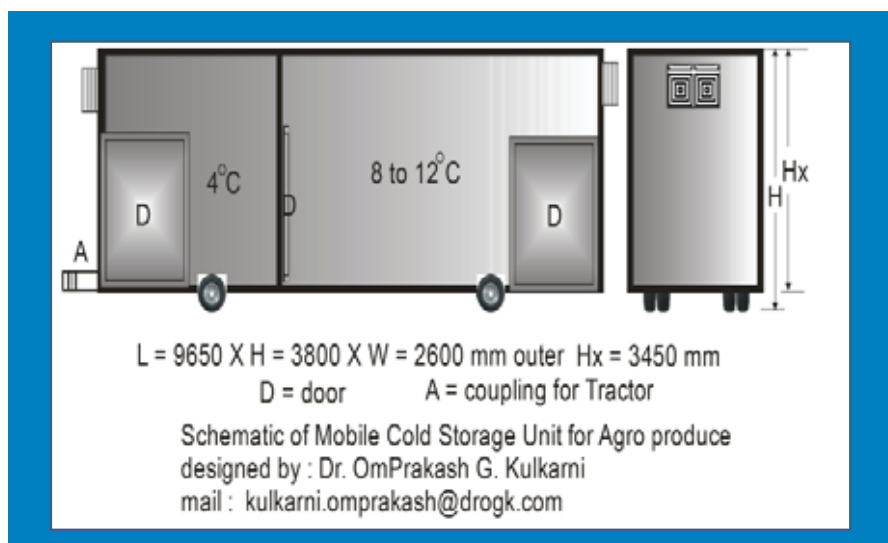
#### Operating costs

- Maintenance - refrigeration plant, building, handling
- Fuel - heating, electrical generator
- Water - condensers, washing, glazing, general refrigerant
- Oil
- Labour - freezer operation, handling, supervision, office
- EMI costs
- Social dues.

### Factors to be observed

#### Care and Cleanliness

Close attention to care and cleanliness will



minimise loss of quality, and the risk of introducing food poisoning micro-organisms.

Good handling practice should begin on board fishing vessels and be carried through to consumption. The fish should be stowed as soon as possible after catching, but always in a clean condition. Guts, trash fish, etc., should be kept separate and not allowed to contaminate fish for storage or processing. Offal and refuse should be kept away from processed fish and there should be an adequate system of disposal. All plant and equipment, fish rooms, containers, tables, etc., should be designed for ease of cleaning, and they should preferably be made of non-corroding, washable material, especially, where in contact with fish. They should be kept clean by frequent washing. Care must be taken in the choice of cleaning and sterilising materials and methods.

Personnel should be trained to understand the causes of food poisoning and to practise high standards of hygiene. Coughing, sneezing, spitting, smoking and some minor injuries are potentially dangerous. Proper toilet and washing facilities are essential. Suitable clothing must be worn and kept clean. Personnel should be medically free from diseases.

All facilities and operations should be checked regularly with regard to care and cleanliness. The importance of high hygienic standards at the cold store cannot be overemphasised. In order to assure that

storage facilities are continuously maintained in a manner which satisfy both company and regulatory agency standards and regulations, a store quality assistance audit should be scheduled on a regular basis and followed point by point. Obviously, such a programme must take local requirements into consideration.

#### Personnel Working in Cold Stores

Working in a cold store means exposure to extreme cold and demands high physical and mental standards. Heat losses from the body must be minimised by proper clothing. In addition, working in a low temperature environment creates special effect on the human body, which must be counteracted by a special working routine and provisions for personal welfare. As for anybody else working in the food industry, the employees must undergo regular checks and maintain the necessary level of personal hygiene required for this industry.

Among the initial effects of exposure to low temperatures are numbness in the fingers and toes and reduction in dexterity. Muscular activity and increased metabolism would help to maintain the body temperature around 37-degree C. On average, the heat dissipated by a man in W/min varies according to the physical activity e.g. at rest 1.5, light work 2.5-3, moderate work 4.5-5 and hard work 8. Shivering is the principal mechanism of the body to momentarily increase its metabolism, but a shivering worker becomes ineffective, when the heat losses

are greater than the heat generation, the body temperature will continue to fall and thus, causes unsatisfactory physical response. It is usually considered that the metabolism will decrease by 12 per cent for every 1-degree C decrease of the body temperature. The lungs begin to freeze at about (-) 53-degree C. The human body will lose liquid through cold when exposed to low temperature. However, working in a low temperature environment is not hazardous to health, provided the worker is physically fit, i.e., submits himself to the necessary medical examination before employment and uses all the precautionary measures provided by the cold store properly.

## Protective clothing

The term clo was introduced in order to define the insulating quality of clothing assembly. By definition, one clo will provide thermal comfort to a man sitting in an ambient of 21-degree C, 50 per cent relative humidity and 0.1 m/s air velocity. A long suit corresponds roughly to one clo, a linen suit to 0.8 clo, and a woollen suit under which is waistcoat, shirt and underclothes to 1.3-1.5. One clo is equal to 0.18-degree C m<sup>2</sup> h/kcal. In polar climates 3 clocs generally are considered suitable for moderate activity in a (-) 20-degree C ambient with a low wind velocity. However, this relates to selected individuals and for similar conditions in a cold store a value of 4 clocs may be considered necessary.

## Alarms

An acoustic alarm system must be provided for anyone who is accidentally locked up in a low-temperature room or for an injured person who cannot open the doors. The switches for the alarm should preferably be placed by every door and not more than 0.5 m from the floor. Other places for alarms are gangways around evaporators, roofs, engine room, etc. The sounder should be positioned where there is always someone in attendance, e.g., the loading bank or in the reception office.

Fire alarm systems are normally placed outside the cold rooms (to allow anyone to escape before raising the alarm). The alarm should sound both inside and outside the storage chambers. Automatic systems and smoke detectors are normally not a good alternative inside the low temperature rooms due to frosting up and reacting on to warm, moist air, etc.

## Safety instructions

Safety instructions must be issued to all employees and cover emergencies such as fire, refrigerant leaks, escape doors, assembling points, etc. The instructions should be written in simple language and kept brief and to the point.

ANALYSIS OF COST OF 10MT COOLCHAMBER TABLE - A		
Description	Specifications	
Chamber size	20	MT
Dimensions L x W x H	30 x 8.5 x 11	ft
Cost of DC compressor based chillers	280,000	Rs.
Cost insulated mobile unit	235,000	Rs.
Solar Panels + Batteries + Ice Banking + Fabrication	550,000	Rs.
Insurance	20,000	Rs.
Accessories, Plastic crates etc.	90,000	Rs.
Misc expenses	10,000	Rs.
Installation	50,000	Rs.
Sub total	1,235,000	Rs.
GST @ 12%	148,200	Rs.
Total cost of project	1,383,200	Rs.
Subsidy @ 40%	553,280	Rs.
Net cost to the beneficiary	829,920	Rs.

PAYBACK CALCULATION FOR ROI TABLE - B		
Net rounded up cost to the beneficiary	830,000	Rs.
Own capital @ 20% of project cost	277,000	Rs.
Loan from Bank	553,000	Rs.
Rate of interest on loan	12%	
EMI paid	28200	Rs./month
Payback period - ROI	1 yr 10 months	

INCOME FROM THE UNIT and PAYBACK EMI TABLE - C		
If the product stored on rented basis, the rent charge is Rs.0.30 kg / day (maximum 300 days storage in a year and loading factor of 75%)		
Average material stored per day	15 MT	
Rate charged for storage per day	300	Rs/MT
Revenue earned per day	4500	Rs/day
Business operational days per year	300	days/yr
Revenue earned per year	1,350,000	Rs/year
Amount that can be spared for EMI @ 25%	28,125	Rs/month
Revenue retained as income for first 1yr10months	1011600	Rs/yr
Net earning per year after payback	1,350,000	Rs/yr

## Hygiene

Keep your workplace, wash-room, shower and toilet clean and use the facilities available. Cleanliness promotes health and comfort. Play your own part in maintaining healthy conditions and do all you can to encourage others to do the same.

An accurate cost can only be determined for each individual case since so many factors have to be considered which depend on local conditions and economics. ■

**Prof. Dr. OmPrakash G. Kulkarni,**  
Scientist, Mentor, Adviser, Technology Provider &  
Consulting Engineer in Automation, Instrumentation,  
Energy Management, IPR,  
CDM & Renewable Energy  
NSS (NASA) Certified Space Ambassador



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## International “ISK-SODEX” – The Meeting Point of HVCA&R Industry in Istanbul-Turkey in October



Deutsche Messe

ISK-SODEX Istanbul is the first and most important fair in HVAC&R industry and the companies will be presenting their latest products at the TÜYAP Fair and Exhibition Center.

As of 2018 November, the HVAC&R sector that includes the air-conditioning systems, insulation components, installations and equipment and heating and cooling systems has witnessed a boost in exports in the first 11 months by 17.5 per cent as compared to the same period of 2017 and reached a total export value of USD 4.2 billion. Having increased its cooperation in strategic markets like the USA, Canada, India, Germany, Russia and the United Arab Emirates, the sector is now looking forward to the ISK-SODEX fair which is an opportunity to meet international buyers in between 2 – 5 October 2019 at Istanbul. ISK-SODEX Istanbul is the first and most important fair in HVAC&R industry and the companies will be presenting their latest products at the TÜYAP Fair and Exhibition Center.

With the International Buyers Delegation Program to be organised within the scope of this fair, the largest companies and unions of these markets will be coming together in Istanbul.

Emphasising that the air-conditioning sector has a significant export potential in the Turkish industry and is breaking new records in exports every year, Alexander Kühnel, the General Manager of Hannover Messe Sodeks said, “The sector has a significant competitive power in the foreign markets and it is very important that it demonstrates this potential in an international fair. Our ISK-SODEX fair hosted important buyer groups from 105 countries in February 2018. In this scope, our target this year is to increase the number of buyers visiting our fair from these existing countries and also to attract new visitors to our ISK-SODEX fair from new markets where our export potential is high but export volume is low so that they can meet our sector representatives.”

“In this context, regions and countries such as Pakistan, West Africa and Tanzania are among the main new markets with which we have been establishing close relations. Furthermore, we know that the African and the South American countries are very important for the Turkish exporters. We are continuing to shape all

promotion and communication activities of ISK-SODEX in line with the 2019 export roadmap and expectations of the sector. We will be realising supporting programs showing the advantages of the sector and will be providing new opportunities for the participants and visitors to meet, network and to exchange information and experiences during our ISK SODEX fair which will be realised on 2 - 5 October 2019.”

For ISK-SODEX fair, 33 thousand square meter exhibition area has already been sold. There are participants from Germany, China, France, India, the Netherlands, Italy, South Korea and Thailand. This year domestic and foreign companies will have the opportunity to present in the fair their wide range of new trend products and services such as heating, cooling, air-conditioning, ventilation, insulation, pumps, valves, installation, water treatment, fire systems and solar energy systems.

Being organised by Hannover Messe Sodeks Fuarcılık, which is the Turkish affiliate of the major German fair organisation company Deutsche Messe, the ISK-SODEX Fair 2019 will be realised with the co-organization and support of ISKAV (Heating, Cooling, Air-Conditioning Research and Education Association), DOSIDER, (Natural Gas Appliances Industrialists and Businessmen Association), İSKİD (Air Conditioning and Refrigeration Manufacturers' Association), İZODER (Heat, Water, Sound and Fire Insulators Association), TTMD (Turkish Society of HVAC and Sanitary Engineers), POMSAD (Turkish Pump and Valve Manufacturers Association), SOSİAD (Association of Refrigeration Industry and Businessmen), ESSİAD (Aegean Region Refrigeration Industry and Businessmen Association), MTMD (Mechanical Contractors' Association) and KBSB (Boiler and Pressure Vessel Manufacturer's Association). ■

For detailed information and to make your online registration for your ISK-SODEX Visit please kindly visit ISK-SODEX web site from [www.sodex.com.tr/en](http://www.sodex.com.tr/en).



# How IoT is transforming HVACR Industry

Internet of Things and Artificial Intelligence are radically transforming the way HVAC works.

The Internet of Things (IoT) is becoming a buzzword word in today's world of data. It is said that, now data is more precious than oil. Data can help you to expand the business, customer reach, product quality and productivity etc. As per definition: IoT is the network of devices, vehicles, and home appliances that contain electronics, software, actuators, and connectivity which allows these things to connect, interact and exchange data.

In HVACR, IoT means extending Internet connectivity to non-Internet devices to get the data and in future do the

automated analytics to get more insight into the HVACR equipment operating efficiency.

At present IoT is utilised in HVACR sector to detect any anomaly with the help of technique like AFDD (Automated Fault Detection and Diagnostic).

## Application of IoT in HVACR

For long time, HVACR equipment were operated and maintained by site engineers based on the physical or Building Automation system (BAS) data. The physical data like equipment operating data log sheet are used to evaluate the

equipment and operational efficiency. The BAS engineers are responsible to monitor and analyse the BAS data and make necessary corrections if any issue identified.

Now, the trend is changed with the arrival of IoT technologies. IoT is enabling to get the data remotely and analyse it with automated technology to detect any anomaly. This is leading to quick decision making and helping the operators in preventive maintenance.

## What is the transformation?

The major transformation with the rise of

IoT is, HVACR equipment are now less dependent individual human. The remote data and automated data analysis are helping the building owners to get informative about what happening in a building. The mode of communications also enhances by automated alarm or alert over mail or phone within a second after or before the event occurs (in case forecasting).

### The barriers

At present most of the HVACR as well as IT companies are having solution in the building efficiency sector based on IoT technology. These solutions are based on few graphical dashboards and AFDD. But this may not fulfil the absolute level of requirement by HVACR sector. Thus, we need to go beyond these simple techniques. The new area which need more research is Artificial Intelligence (AI). AI can give more strong result on detecting the anomalies in building utilisation and equipment level. This will

also largely minimise the human interference.

Let us consider a situation like low chiller efficiency to understand the AI requirement. There are many reasons for this like part load operation, low ambient, condenser and evaporator poor efficiency etc. To find out the reason for the particular issue, we need to start with the chiller and end with the end-user like AHU. With simple process we can find out the issues in individual areas and its need human interference to find out the root cause. Now if the entire solution needs to be provided by the automated FDD tool, we need to use AI.

To develop complete AI tool, we need to implement multidisciplinary techniques. These techniques are like mathematical and statistical method to be used for data normalisation, data sanity etc. Thus, cross functional team is required to develop more efficient analytical tool.

### Future HVACR

The future of HVACR industry is to be energy efficient and self-operated system. The present technologies available are enough to achieve this goal. But it requires more details analytical approach to establish the relationships with all equipment (chiller, pump, cooling tower, AHU, FCU and VAV etc.), building demand (based on occupancy, orientation envelop and material), outdoor condition and building schedule.

### Conclusion

The holistic effort toward making AI based HVACR analytical tool is the need of the hour. Using AI to fill in gaps where some type of oversight or referral from human experts are still required. ■

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Advisory Services,  
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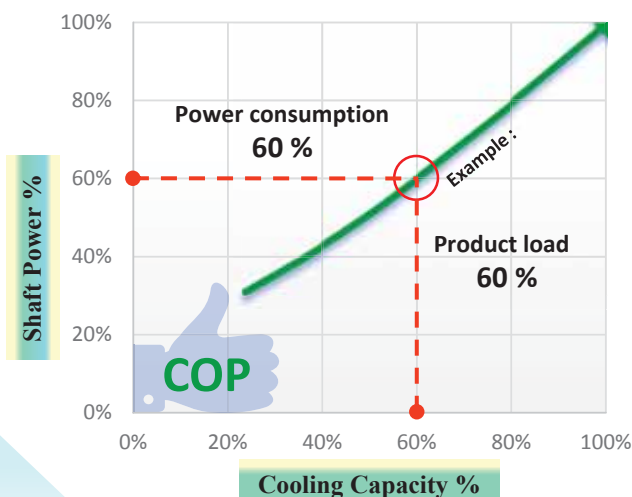


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- : Above graph for iZN 20TXII-4A @ ET=-45 / CT=40 °C
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# GANDHI AUTOMATIONS CHANGING LANDSCAPE OF ENTRANCE AUTOMATION



Our current target for export is Gulf countries and European countries. In coming years we will be aiming neighbouring countries like Bangladesh, Indonesia, Bhutan, Sri Lanka and few African countries, informs **Kartik Gandhi, Director, Gandhi Automations Pvt Ltd** in an interaction with **Cooling India**.

## How has been the journey so far?

In order to grow, all companies need to perform better with every passing year and ensure that they achieve higher and bigger milestones. Gandhi Automations has had its share of achievements and milestones through its life. Since inception in 1996, Gandhi Automations has continuously strived for innovation and changing the scenario for the entrance automation, logistics and warehousing industry. Over the years, we successfully completed

European collaborations, set up state-of the-art manufacturing and warehousing facility, started manufacturing rolling shutters, high speed doors, clean room high speed doors, dock levelers, aircraft hangar doors, sectional doors, and industrial doors. The company achieved ISO: 9001, ISO: 14000, OSHS and CE certifications for our products and also started exporting and installing aircraft hangar doors overseas and India. We continued with further advanced certification and manufacturing production to meet the increasing demand. Today, we have worldwide presence.

Gandhi Automations is known for its research and development, quality and commitment towards customers. We have catered to industries like chem-pharma, food, automotive, logistics, warehousing, shopping malls, marine, aviation and many more. Our customers' trust has helped us to grow by demanding challenging requirements. We, hence, invested in research and development, factory-trained sales and service team PAN India, 24x7 customer care, factory and warehouse to achieve those challenges. Our constant efforts towards innovation with focus on latest technology have acknowledged our products and solutions for reliability and sustainability.

### What are the products offered by the company catering to HVACR industry, particularly, cold chain and food processing industry?

Many manufacturing industries nowadays need a controlled environment in which you limit the amount of dirt and dust in the manufacturing premises. Medical instrument manufacturer, electronics and computer manufacturer, food industry, pharmaceutical industry and some military applications are but a few of the examples that have strict requirements for maintaining the dust-free environment.



**To compete, companies need to be equipped with the best possible technologies, including an integrated automation system, to manage all of the logistical and business complexities found in the supply chain.**

High-speed doors have, thus, become an integral part of all these industries. Prime High-Speed Doors benefit various operations, including areas with special requirements for temperature control, hygiene, storage and handling of frozen foods. Atex rapid doors are required in explosion-proof areas; deep freezer automatic roll-up doors fulfill the needs in cold storages, warehousing, loading bays and on conveyor systems. Prime Reset features a special advanced self-repairing system.

## New Product Range of Gandhi Automations

### Prime Freezer



Gandhi Automations has come up with Prime Freezer High Speed Doors which are a perfect solution where cold storage with negative temperatures as low as – 35-degree C is required. The curtain is made of reinforced PVC vinyl with heated side guides. Optionally, a special and innovative insulated flexible curtain is also available. High Speed Freezer Doors are the solution when temperature control is critical and where forklift traffic is high.

### Prime Food

Fast roll up doors for food industry are designed to meet the stringent demands of hygiene in the food industry; Prime Food fast roll up doors are resistant to humidity, temperature, corrosion and detergents. It is very easy to clean and disinfect and where tight sealing while partial or full wash down is required. The smooth surface with shiny finish prevents dust build up and is resistant to pressure washing. The self-repairing system automatically resets the door after an accidental impact. The robust construction of Prime Food provides high cycle operation even in wet applications. Optionally, Prime Food can be offered with FDA approved polyethylene guides. Fast roll up prime food doors are very useful in FMCG sector.

## New Product Range of Gandhi Automations

### Inflatable Dock Shelters



Inflatable Shelters are elastomeric tubes calculated to round out with the overview of a medium (usually air) to form a close-fitting barrier between a mounting and striking surface. Inflatable Shelters deliver the most versatile seal offered to service the widest diversity of truck and trailer configurations. Different to other types of Dock Shelters, the truck does not push towards the shelter. In its place, the shelter is inflated around the docked vehicle providing complete seaming.

### Telescopic Lip Dock Levelers

Overcoming the problem with the gaps between the vehicle and loading bay; Gandhi Automations has introduced a telescopic dock leveler that has an extended arm for resolving this issue. Telescopic Lip Dock Levelers are perfect for joining trucks unable to drive close to dock i.e. sea containers, side loading railway wagons etc. These types can be provided with a lip covering up to one meter.

**It has been 22 years that Gandhi Automations is in the Entrance Automation systems. So, what are the evolutions that you have witnessed over the years in the industry?**

The world of logistics is moving to an on-demand model called as an 'Uberized' model where owning traditional assets is no longer a requirement to be a viable logistics company. A competitor to a traditional logistics service provider needs not just be another LSP, but can be any platform provider, industrial automation or technology company that can aggregate supply and demand, as well ease logistic solutions in one place and meet a customer's requirement. This could look ideal or theoretical to a few but it is not impossible. To compete, companies need to be equipped with the best possible technologies, including an integrated automation system, to manage all of the logistical and business complexities found in the supply chain.

Gandhi Automations has been an effective service provider being able to tailor services so as to minimise the impact of market dynamics on a client's supply value chain. We also are able to proactively ensure compliance at all junctions of business operations. Emerging technology and the proliferation of digital technologies have opened up avenues for new business models and service delivery frameworks. We leverage such technologies in providing value added services to the clients.



**We are number one in the domestic market. There is huge untapped international market for our products. Our products meet international safety standards and with right kind of product portfolio.**

The emerging trends which are becoming very popular are remote operated high-speed doors and rolling shutters. However, the challenges are sustainability and access. The opportunities to the Indian industry with automation is to maintain an efficient production cycle, safe inventory, cutting-edge technology, speed of movement, functionality and safety- are the must-haves for this line of Gandhi automations products. If we add the high quality of design with personal touch, they become unique elements necessary for daily logistics operations and for the visibility of customer identity.

**Which are the most selling products of the company? How do your products help to achieve the goal of energy efficiency?**

Our high-speed doors and dock levelers are relatively more popular in the logistics industry as its main focus is to maintain



seamless operations and minimal downtime while meeting its manufacturing, storing and supplying needs.

There are several products where our research and innovations have resulted in curating a state-of-the-art product which has not just delivered efficiency but also additional safety. For example, our adjustable Radius lip dock levelers help adjust itself to move up and down for smooth loading and unloading from containers. Telescopic Lip Dock Levelers are perfect for cold storage.

Inflatable dock shelters provide perfect sealing by inflating themselves around the docked vehicle, which makes them ideal for applications within the food industry. They are suitable for a wide range of vehicle sizes and provide continuous weather protection throughout the entire loading and unloading operation.

High-Speed Freezer Duo can be used in cold storage and Load-out doorways, where speed and good insulating properties are a critical requirement. These doors have a revolutionary soft bottom edge and sensor combine to ensure operator safety at all times. These manufactured by Gandhi Automations are sturdy, dependable and an ideal fit for maintaining temperature control. To prevent ice formation during intensive cooling, they have a functionality of partial and full opening. Its intelligent dual curtain technology - simultaneous open and close operation has blower or dryer to maintain temperature balance.

### What are your growth plans for the next fiscal?

We are number one in the domestic market. There is huge untapped international market for our products. Our products meet international safety standards and with right kind of product portfolio. We are ready to meet the demands of this huge international market.

With increased globalisation and countries opening up for business, we see a great opportunity in neighbouring countries also. For instance, in Myanmar, last few years foreign investments have increased from few million to several billion dollars (300 million-dollar 2009 to 5 billion 2014). The Myanmar Government has relaxed import restrictions and abolished export taxes. Such policies boost our confidence and we will venture in such countries. Our current target for export is Gulf countries and European Countries. In coming years, we will be aiming neighbouring countries like Bangladesh, Indonesia, Bhutan, Sri Lanka and few African countries. I have visited few of these countries and we have better products to offer them, than the ones they are currently using. We are targeting 50 per cent revenue from export in 2019. ■



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# Regulating Comfort for Energy Efficiency

“It is important to push for spaces with mixed modes of cooling and comfort and not just air-conditioned spaces with efficient technologies”



**T**he 2019 conversation on sustainable buildings cannot ignore the 2018 discussion on the idea of codifying Adaptive Thermal Comfort Standard to create opportunities for design options for improving indoor comfort and reduce operational hours or need of

mechanical cooling for energy efficient buildings. This idea has been mooted in the India Cooling Action Plan (ICAP) that charts a 20 years roadmap to combat energy impacts of highly energy intensive cooling requirements. If implemented Adaptive Thermal Comfort Standard can



be a game changer in the way buildings will be designed. This will be different from the current regulatory practice that gives primacy to uptake of energy efficient cooling technologies over passive and bioclimatic options for delivery of comfort. ICAP has only floated this potentially big idea. But this has not yet been scripted as a regulatory framework. This idea must not fall by the way side. Even globally, there is growing interest in not binding solutions only to energy efficient cooling or heating technologies but allow bouquet of design solutions for indoor thermal comfort. We adapt to seasonal temperature variation naturally but now we know how this works and can be codified based on adaptive comfort model. Link this knowledge and experience more explicitly with building design and operations. Energy regulations have neglected architectural design opportunities to reduce dependence on active mechanical cooling for sufficiency. It is important to push for spaces with mixed modes of cooling and comfort and not just air-conditioned spaces with efficient technologies.

#### Evolving Mandate

It has taken a while to acknowledge and evolve towards this idea. When the original Energy Conservation Building Code (ECBC) was scripted to govern energy efficiency in buildings, formal requirement of passive architectural systems for low energy solutions was almost non-existent.

The revised version of ECBC has taken a step forward to introduce Energy Performance Index (EPI) score for all designs that can be used as benchmark to track operational energy performance of buildings. But there is no mechanism to ensure that building operators continue to maintain EPI score awarded at the completion of the construction.

The ECBC has also added a section on regulating indoor temperature threshold for Heating Ventilation and Air-conditioning (HVAC) design to prevent energy penalty. This refers to Indian Adaptive Comfort Model for better energy efficiency in thermal comfort delivery. But this is not a binding requirement and stops short of banning unnecessary cooling or heating of indoor, disregarding outdoor weather conditions and realistic thermal comfort expectations of occupants.

In 2018, the government also woke up to the risk of uncontrolled consumer behaviour to operate room air-conditioners (RAC) at unnecessarily low temperature set points with huge energy penalty. The Ministry has proposed to fix the starting temperature of RACs at 24°C, as against the current switch ON temperature at 18-20°C. New RACs, when switched ON, will start at 24°C unless changed. Now, manufacturers are free to set the default temperature at any level and often this can be lower than 20 or 18°C. Set point control can make users more aware of energy penalty of very low set points. With just one degree drop the energy penalty can be up to 6 per cent. The ministry has estimated that this voluntary move can save 20 billion kw hours of electricity a year if adopted by all consumers. This may be made mandatory later, which is one of the

many moves planned. All these developments foreshadow the idea of adaptive thermal comfort standards. It is tacitly recognised that comfort needs can be met even at higher temperatures setting if several environmental and behavioural parameters are accounted for.

#### Towards Adaptive Thermal Comfort

It is not easy to regulate human thermal comfort as it involves indoor and ambient temperature along with environmental variables—temperature, humidity, heat radiation and air movement—and human variables—clothing and an individual's metabolism rate. There is also the "forgiveness factor", when people can disregard or ignore actual physical discomfort in recognition of unique nature of their surroundings. Combination of these variables can help to achieve comfort goals.

The 2016 version of National Building Code (NBC) has adopted adaptive or dynamic approach that models indoor temperature in relation to optimum range of outdoor temperature at which occupants are expected to feel comfortable. These ranges have been developed for naturally ventilated buildings, mixed mode buildings with different types of cooling systems, and air-conditioned buildings. Supported by the research of Centre for Advanced Research in Building Science and Energy, CEPT University, the concept of mixed mode building is gaining ground.

This can encourage designers to fix envelop, design, insulation, and orientation to improve air movement and cut down radiant heat and usage of air conditioning. Most of the problems stem from poorly designed buildings. Sensibly designed mixed mode buildings with adaptive thermal comfort approach offer a range of 'adaptive opportunity' to improve thermal comfort. One can open a window, draw a blind, use shading, allow air movement, use fans, and change clothes as needed. Comfort delivery through design and system approach is necessary for lower income groups as well. The UN looks upon thermal comfort as a human rights issue. Therefore, it is not necessary to pull down the standard for poor people if design and material solutions are available.

#### Mandate Change

To influence mass construction, codifying some basic requirements can help to promote sustainable practices. This can allow planning for passive strategies and sizing of cooling systems dictated by design to meet thermal comfort goals. This will give people greater control and ability to adjust to indoor climate. The standards and design guidelines will help architects to assess & forecast comfort range of indoor temperature through seasons (which they do) but now more deliberately to reduce operational time of air conditioning or the need of it. People can play around with shade, wind speed and direction to maintain temperatures and comfort conditions in buildings.

With wider adaptive comfort range, as against narrow temperature band maintained in fully controlled AC buildings, occupants will have more control over operation of buildings than the operators of HVAC systems of the

building. Low energy solutions will become more viable including bioclimatic strategies.

India with its climatic advantages will have to work harder on this. Centre for Advanced Research in Building Science and Energy, CEPT University have worked out the comfort ranges for naturally ventilated, mixed mode buildings and air-conditioned buildings that have informed the NBC 2016. This, for instance, shows that when outside running mean temperature is 35°C, people in a mixed mode building can have a comfort range of 24.2-31.1°C. But in an AC building the comfort range is much narrower (24.5-27.5°C). This mixed mode offers more opportunity for adaptive comfort and low energy solutions.

Changes have happened even in ASHRAE Standards 55 in 2010. Even though it is meant for buildings without HVAC, this can be adapted and further improved for mixed mode buildings. It includes processes that consider operative temperature, radiant heat, humidity limits and higher air movement and air speeds etc to allow some control to occupants. They can use fans, window, and ventilation to reduce mechanical cooling and adapt.

#### No other option

Mixed mode buildings and bio climatic strategies based on adaptive comfort model that are now well understood backed by science need to inform regulations to moderate demand for mechanical cooling. According to the ICAP draft, cooling demand is expected to grow 8 times by 2037-38 with space cooling in building sector alone witnessing 11 times increase. If not tamed, this can incite massive energy guzzling affecting climate, wellbeing and health.

Other countries are responding to this concern. Japan has recommended 28°C and bush shirt rules for offices. China, Hong Kong, Korea and UK are adopting similar approaches. California does not allow set points below 26°C for summer and heating above 20 for winter. Australia is more nuanced—20°C to 28°C depending on local climate; buildings are designed to provide indoor temperature conditions of 28°C most of the time and air-conditioning comes on when upper limit of indoor temperature conditions are breached; systems can reduce or extend non-AC hours to meet comfortable conditions and promote acclimatisation. Under the Cool UN programme summer temperature set points have been changed from 22.2 to 25°C.

These regulations will also have to be defined right so as not to limit design choices. But these regulations are inevitable and should not be resisted on erroneous grounds of invasion of privacy and state dictating private comfort. This is about sensible holistic approach for public good and sustainability. ■

**Anumita Roy Chowdhury,**  
Executive Director  
Research & Advocacy,  
Centre for Science &  
Environment (CSE)





# Dry All Introduces Next Generation Range of HVAC&R Line Products

Dry All has been perfecting the art of developing a full range of HVAC&R line products since 1990. Now Dry All introduces three more products with cutting-edge technology.



exact source of a leak in a HVAC&R system.

Tracer Wafer (TW) (manufactured by Spectroline – USA) charged with a fluorescent dye is placed along with the desiccant. When the system starts and the TW comes in contact with refrigerant and oil, the dye in wafer is released and circulates with the refrigerant. In case of a leak, dye escapes leaving a mark at the point of the leak. The exact point of a leak is easily visible under a UV light through yellow glasses. This dye is compatible with all refrigerants and oil. The dye has also been approved by all leading compressor and component manufacturers.

## Oil Separator with Demister Pad

The role of oil separator is to separate oil from refrigerant in the discharge line and maintain oil level in the compressor to prevent system breakdown. This eventually increases the life of the compressor. The efficiency of conventional oil separator is approximately 75 per cent and with the introduction of demister pad, the efficiency of oil separators with demister pad can go up to 99 per cent.

'Dry All' high-efficiency UL certified 'Oil Separators with Demister Pad' is specially designed with SS Wire Mesh. Demister Pad is capable of capturing even smallest oil molecules and separate it from refrigerant. These separated oil molecules collide and forms larger drops. Due to gravity, these larger heavier oil drops fall at the bottom of the oil separator vessel. Float ball mechanism helps the oil return to compressor crankcase through oil return port.

These oil separators minimise the noise and pulsation at the discharge side. This has a very wide application in VRF systems.

## Brazed Plate Heat Exchanger

'Dry All' introduced Brazed Plate Heat Exchangers (BPHE) in collaboration with 'Kaori'. BPHEs can be used both on evaporator and condenser side in chiller and heat pump respectively. BPHEs are designed to offer the following advantages:

- Highly efficient thermal design - high performance
- More efficient use of materials – cost effective
- Mass reduction in size—compact, less space, less weight
- Proven and reliable quality - long lifetime durability

These are the trailblazer in the realm of the HVAC&R industry. ■

Looking back at the 1990s, Dry All's range of HVAC&R line products i.e. Filter Driers, Receivers, Oil Separators, Accumulators was a humble beginning to its quest for excellence. Over the years, HVAC&R technology and customers' needs have gone through a big change. This continues to challenge the company to upgrade the products and technologies they offer.

The Engineers at Dry All acknowledged the need of consumers and developed new products designed to detect leaks, provide highly efficient oil separation and highly efficient thermal exchange design in HVAC&R System. The year 2019 saw the introduction of following new products from Dry All:

- Filter Driers with Fluorescent Dye
- Oil Separators with Demister Pad
- Brazed Plate Heat Exchangers

## Filter Drier with Fluorescent Dye

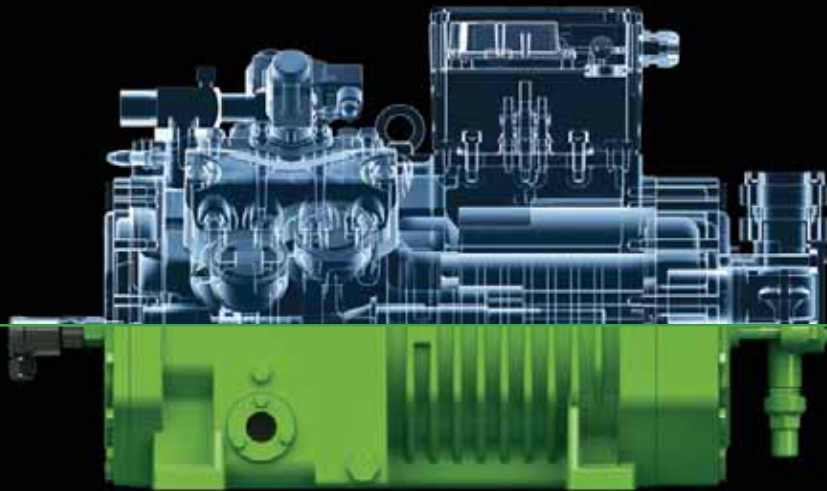
'Dry All' is a leading manufacturer of Filter Driers in India. The nuanced understanding about HVAC&R system has helped the company to engineer new Filter Drier that will not only provide filtration, adsorb moisture and acid but will also help to detect the

**Dry All is demonstrating these next-generation ranges of products in ACREX 2019. To know more, visit Booth D-67# Hall 1.**



DAS HERZ DER FRISCHE

## IQ MODULE



ECOLINE



ECOLINE CO<sub>2</sub>



ECOLINE+ CO<sub>2</sub>

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**HFO** HFO READY

**R744** CO<sub>2</sub>

**❄️** COMMERCIAL REFRIGERATION

## INTELLIGENTLY COMBINED. FLEXIBILITY GUARANTEED.

ECOLINE reciprocating compressors from BITZER are now available with IQ MODULE for much more reliable compressor operation, even within the limit area. This combination enables maximum flexibility when using new refrigerants and can be quickly and easily integrated into all refrigeration and air conditioning systems. In addition, cabling requirements and the number of electrical components in the switch board are reduced to a minimum while saving costs at the same time. Optimal adjustment of the VARISTEP mechanical capacity control can also increase the efficiency of the entire system. Learn more at [www.intelligent-compressors.com](http://www.intelligent-compressors.com)



## Cold Storage: Effect of Unregulated Supply Source & Complex Tariff Structure

In this article, an attempt has been made to bring out the desired corrective measures to look up to a favourable electricity consumption index in an environment of rising electricity cost and unpredictable supply source, especially in cold storages. A case study from West Bengal.

**P**rice escalation of energy, in any of its form, as has been a regular feature in recent years, exerts unfavourable impact on techno-socio scenario of our country. The very rise in cost of energy, the basic ingredient of industrial production, disturbs the economics in users' establishment in a significant way and calls for corrective measures to mitigate its adverse impact.

In a situation such as this, relevance of efficient energy management is obvious to plug in energy waste. Accordingly, identification of the poor operating areas responsible for unreasonable rise in energy index in a set-up deserves priority to make out a right strategy for energy conservation.

On top of that, the performance of Supply Utility operating under watchful cover of State Electricity Regulatory Commission obviously comes in because of its direct bearing on the success of any conservation measure in consumers' set-up. Again, the scale of charges of tariff and associated regulations also hold relevance on cost saving on electricity account.

In this article, an attempt has been made to bring out the desired corrective measures to look up to a favourable electricity consumption index in an environment of rising electricity cost and unpredictable supply source, especially in cold storages.

### Load Management

Load management in consumer's establishment, connected to supply system of Distribution Licensee, involves reduction of load demand and consumption of electrical energy for the task under specific operational parameters. Here, the matter of availability of quality supply source is important. The issue holds pertinence since success of end-use

conservation measures is directly linked thereto.

Accordingly, fluctuation of supply voltage and frequency beyond the permissible limits, for obvious reasons, is not a pleasing state of affairs for consumers since it affects directly the operating performance of facilities. The outcome makes the consumer unhappy for holding back the benefit of his energy conservation measures.

Further, unplanned interruption of supply is equally embarrassing for consumers since it upsets the operational continuity of electricity driven facilities and requiring support of stand-by captive source to re-commence operation.

### Load Survey

For implementation of an energy conservation scheme, the accepted practice relies on information about usages of electrical energy for a considered analysis thereof. Such data over a period of one month, so also over a year, would demonstrate the profile of two tariff components of electrical energy usage. The study also reveals the weak areas of energy use and helps planning out an effective energy conservation scheme for the set-up. The measure would, as management consultants feel, lead to reduction of maximum demand and electricity consumption index as well.

### Load Management in Cold Storages

In West Bengal there are about 390 cold storages for potato storage. They consume a considerable quantum of electrical energy primarily from supply source of the West Bengal State Electricity Distribution Company Limited (WBSEDCL). All these units receive the supply at 11 kV. Thereafter, it is transformed down to utility voltage of

415 V with the aid of a distribution transformer rated 11 / 0.415 kV.

Energy conservation in a cold storage, an electricity dependent rural industrial set-up, alike other industrial counterparts, recognises efficient end-use of load as the key factor to accomplish saving of electrical energy. Thus, an electrical conservation scheme is, in practice, drawn up by considering availability of constant supply of power at rated voltage and frequency. In reality, it is very seldom occurs in well spread out rural network of WBSEDCL operating under regularity control of a statutorily constituted the West Bengal Electricity Regulatory Commission.

Understandably, poor quality of prime supply cannot guarantee anticipated success of electrical energy saving schemes by users of electrical energy. Sadly, in West Bengal, such problem prevails and consumers suffer thereby since decrease in illumination output from lamps, drop off speed of fans and reduction in operating efficiency of electricity driven equipment occur at a voltage lower than the rated one.

### The West Bengal Electricity Regulatory Commission

The West Bengal Electricity Regulatory Commission, constituted in accordance with section 82 of the Electricity Act, 2003, takes care matters relating to quality supply in its (Electricity Supply Code) Regulations, 2013 (Ref. Notification No. 55/WBERC dated 07.08.13). The provision lays down fluctuation limits for supply voltage and frequency. In respect of HT supply, it is set at 6% on higher side and 9% on lower side of the rated supply voltage. However, for medium voltage supply it is 6%. However, a variation of supply frequency between 50.5 Hz and 49.5 Hz is permissible.



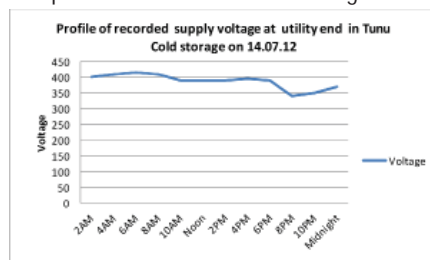
In fact, at far flank rural areas, where most of cold storages are located, as of now, availability of constant supply of electricity at rated voltage from WBSEDCL, particularly during loading period, does not appear to be encouraging (Table 1). Occasionally, abnormally low supply voltage, particularly during evening hours, affects performance of electricity driven facilities. The graphs below show the profile of supply voltage recorded over the day in a cold storage located in the district of Hooghly, West Bengal. Graphs 1 and 2 not only endorse the above observation but also demonstrate its persistence.

Table 1

Month / year	March '16	April '16	May '16	June '16
Supply voltage fluctuation limits	10.50 kV – 10.53 kV	9.86 kV – 9.90 kV	10.17 kV – 10.21 kV	10.07 kV – 10.03 kV

Ref.: Tunu Cold Storage, West Bengal.

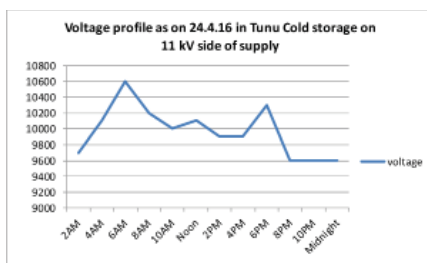
Importantly, fluctuation of supply voltage beyond permissible limit is regarded as a situation not in keeping with clause 10 (1) of WBERC (Standards of Performance of Distribution Licensees Relating to Consumer Services) Regulations, 2010. The provision speaks of corrective action by the Supply Utilities within a set time-limit. Any default thereof has also been taken care of under compensation clause of the said Regulations.



\* Graph 1

Again, unplanned short-time interruptions of supply, too, create similar situations of abnormality in cold storages, even worse than utility voltage fluctuation, since for every supply-outage the operation of refrigeration plant would remain on hold for nearly half an hour for switching over to standby supply mode and switching back again on restoration of power supply. The situation, particularly during potato loading months in March and April, tends to disturb the set environment in cold rooms requiring immediate support of stand-by supply to commence operation of the plant and, in turn, adds to the cost of electrical energy.

Accordingly, such recurrent short-time black out of supply is not a welcome situation



\* Graph 2

\* Courtesy of Gautam Nayek of Tunu Cold Storage

for service users of electrical energy.

The WBERC, in clause 9(1) under Notification No. 46/ WBERC dated 31.05.10, also takes care of the issue relating to unplanned interruptions of supply. The above provision does not uphold such lapse except under circumstances of unforeseen contingencies, such as natural calamities, grid failure etc. Despite that, in reality, supply outage occurs, even more frequently in loading months in remotely located cold storage establishments in West Bengal, while onus of maintenance of power supply at rated voltage free from unplanned interruption vests in the supply utility as per agreement.

### Tariff vis-à-vis Electricity Cost Index

Cost-analysis of energy conservation scheme in an establishment, be it industrial or commercial, has been the practice to quantify the probable economic success thereof.

Accordingly, economics in energy conservation measures, with short-time pay-back period, in rural electricity intensive cold storage establishments has been the subject of the study. Importantly, the scales of charges of the applicable electricity tariff and quality supply source too come under ambit of scrutiny.

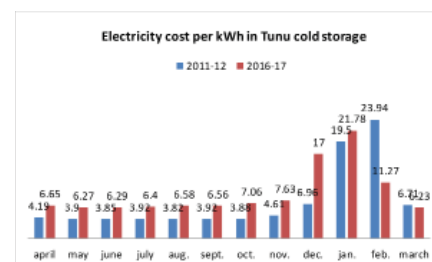
However, to gauge financial impact of applicable tariff structure of the Supplier on an energy conservation scheme at the premises of cold storage consumers, mostly located far flank rural areas, an insight into the unique operating features of cold storages, as mentioned below, would be supportive.

Depending upon usage of electrical energy the operating period of the cold storages, inter alia storing potatoes is markedly divided into four parts. They are loading, holding, unloading and lean periods. The operating characteristics of cold storages having been different over different time-slots, the load demand to run the plant varies accordingly. It is highest during loading period, but it comes down appreciably in subsequent holding and unloading periods. However, the requirement of power during the

lean period, generally extending over three months from December, when the refrigeration plant remains non-operational, becomes negligible.

The WBERC, in exercise of its authority under Section 86 and Section 62(1) of the Electricity Act 2003, annually takes up revision of electricity tariff for Distribution Licensees operating in West Bengal. The one for the year 2017-18, as has been reported by the news media, would come about shortly. Because of rise in overall operating cost of Distribution Licensees, the tariff hike is a certainty, and electricity would be more expensive for consumers, be it industrial, commercial or domestic, in the coming year. In such a situation, economies in respect of electrical energy conservation measures would expectedly differ according to change in the electricity tariff structure of the Supply Utility.

For cold storage consumers, adopting refrigerated storing of potatoes, the prevailing electricity tariff of WBSEDCL prescribes a season-related two-part scale of charges with TOD (time-of day) option. One part of two-part tariff is linked to kWh consumed and the other on amount of maximum demand in kVA recorded during the billing period. However, in respect of maximum kVA demand charge, contract demand-based levy, with a minimum of 85% of the contract demand, would be applicable in terms of Tariff Regulations of WBERC (clause 4.3.5 of WBERC Notification No. 48 dated 25.04.11 refers). Besides that, power drawl in excess of contract demand too would attract penal levy. It is felt that the method of levy of contract-demand-linked demand charge is a worrying situation for cold storage consumers financially because of seasonal nature of working of the establishments. The profile of monthly electricity cost index over the year, as reflected from the Graph 3, supports the above contention. Notably, the electricity cost index in lean months, when the refrigeration plant remains out of operation, is the highest owing to contributory impact of minimum demand



\* Graph 3

Table 2: Two-part tariff under S(F) category

Consumption	Energy charge / kWh in Rs.	Demand charge / kVA /month in Rs.
In Summer	5.81	320.00
In Monsoon	5.80	320.00
In Winter	5.79	320.00

Table 3: TOD tariff under S(FT) consumer category

Consumption	Energy charge/kwh in Rs. Summer : Monsoon : Winter	Demand charge / kVA /month in Rs.
Normal Period (0600 hrs to 1700 hrs)	5.64 : 5.64 : 5.62	320.00
Peak Period (1700 hrs to 2100 hrs)	7.89 : 7.88 : 7.86	320.00
Off-peak Period (2100 hrs to 0600 hrs)	3.72 : 3.79 : 3.70	320.00

charge factor of the tariff on kWh consumed. Abnormal rise in effective per unit cost of electricity in December, January and February, as demonstrated also in Graph 3, was all due to contributory impact of demand charge on lesser number of units (kWh) consumed.

In the circumstances, there is every reasonableness in exempting cold storage consumers from the purview of the minimum demand charge clause of the Tariff Rules of WBERC because of seasonable nature of electrical energy usage. Hence, the matter, as one feels, bears the merit for consideration afresh by the Commission to safeguard the interest of seasonal cold storage consumers {Section 61(d) of the Electricity Act, 2003 refers}.

Again, in TOD scale of charges, cost of per unit of electricity usage differs at different time-slots of day. It is minimum in off-peak slot, whereas highest in peak period. Therefore, to achieve a favourable electricity cost index with regard to usage of electricity, the off- peak period should receive preference over other two time-slots. Accordingly, operating practices of refrigeration plant, prime electricity consuming facility in a cold storage, need evaluation in reference to the Tariff structure for cost benefit.

Besides that, the Tarff includes levy, as rebate/surcharge depending on value of power factor, and other miscellaneous charges. Two different modes of charges, as given in Table 2 and 3, provide scopes for analysing the favourable features thereof.

## Short-term electrical conservation scheme

For a short-term energy saving scheme in cold storages the following measures are usually considered:

Corrective measures involving little or no capital expenditure to minimize cooling load, namely heat given off by heat producing

equipment located inside the refrigerated space, and warm air venting into the refrigerated space through open doors, particularly during potato loading and unloading period.

Modification in operating practices of the plant with reference to the supplier's tariff structure.

## Energy Audit

Since energy audit is regarded as a logical step to identify the weak areas of energy-use requiring corrective action to translate energy conservation ideas into realities, the mechanism is being practiced for comprehensive energy saving scheme for the establishment. On top of that it also quantifies energy usage by the facilities according to their discrete functions. Accordingly, energy audit even those remotely located units holds relevance to get their energy performance index improved. Primarily there are two main operating expenses in cold storages, namely electricity and labour.

Presently, in most of cold storages in West Bengal, mechanised lift-loading system is resorted to minimise labour-dependence on loading and unloading of potatoes. Such modification has since become popular because of its cost saving feature.

It is also believed that availability of constant quality supply source and favourable electricity Tariff structure are prerequisite for economic success of an electrical energy conservation scheme in cold storages having unique operational features.

Unfortunately, in practice, such vital factors are usually left out in weighing up the success of an energy conservation scheme. As a result, misleading findings are immersed out. Therefore, acceptance of findings of Energy Audit report as a "benchmark" (reference point) in managing energy in any organisation, be it industrial or commercial

would be a deceptive conjecture and adoption of the same to translate electrical energy conservation ideas into realities would not be rewarding. Unfortunately, more often than not, the adverse impact of unpredictable supply source and unfavourable tariff structure on electrical energy conservation schemes is usually not being looked into in the right perspective and as a result the projected cost-saving from electrical energy conservation scheme may not come about.

## Conclusion

Conservation of electrical energy, alike it's other forms, is a campaign intended to achieve savings towards cost of energy. Generally, as a perquisite, economic appraisal of the data relating electrical energy usage in an establishment is undertaken to quantify economic advantage of energy conservation scheme. But, in reality, such study is seen to be leaving out such factors as unreliable supply source and unfavourable tariff structure of the supply utility, despite relevance, in predicting the probable cost saving in conservation schemes.

An attempt has been made in this article to highlight the adverse impacts on operation of the cold storage plant, and on conservation scheme on account of unpredictable supply source and a tariff structure not consistent with mode of usage of electricity.

The issues arising out of non-availability of constant quality supply from Distribution License and superintending role of the Electricity Regulatory Authority in that regard have also been analysed in reference to electrical energy saving scheme in seasonal cold storage industries.

## Recommendations

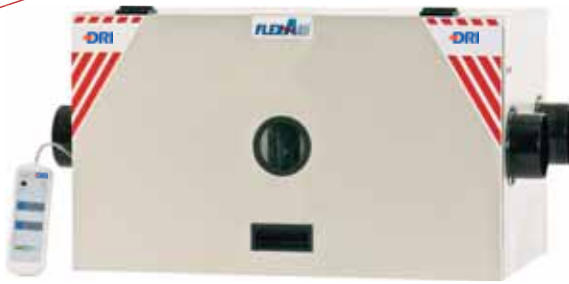
The WBERC may consider exempting seasonal cold storage consumers from the purview of the clause 4.3.5 of its Tariff Regulations to ease out the effect of abnormally high electricity cost index on electricity account during their lean operating period. The WBERC may consider extending load factor rebate to seasonal cold storage consumers alike other industrial consumers in West Bengal. ■

**Ritabrata Sanyal, FIE,**  
Accredited Energy Auditor  
Department of Power  
Govt. of West Bengal



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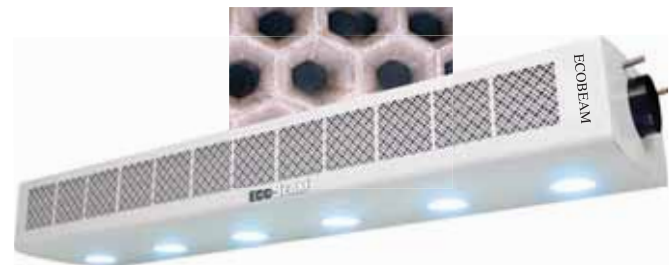
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# Embraco To Showcase Extended Portfolio At ACREX

Embraco will be showcasing solutions with inverter technology – FMX and FMF line-up; products for merchandisers – EM2X and FFU for food retail – FMFD and NJX; for food service – NE; and for aftermarket – condensing units and EM.

**E**mbraco will be participating in ACREX India 2019 from February 28 to March 2 to reinforce its position as one of the world's largest in the segment and to showcase an extended portfolio according to India's market needs connecting with value to the end user. The global company will present solutions that are differentiated by natural refrigerants usage, low energy consumption and with wide voltage range (stabiliser free) for household and commercial segments.

Embraco has been positioning itself as a global specialist in its segment while presenting its new business approach – shifting from product to solution oriented. "Visitors will be able to get to know our portfolio in four different zones such as aftermarket, merchandisers, food services and food retail. We'll be there with a team that understands the Indian market and demands," explains Esequias Pereira, Senior Sales Manager for Asia-Pacific.

At ACREX booth #J-62, Embraco will be showcasing solutions with inverter technology – FMX and FMF line-up; products for merchandisers – EM2X and FFU for food retail – FMFD and NJX; for food service – NE; and for aftermarket – condensing units and EM.

## Embraco Inverter Technology

Embraco will present the next inverter technology generation such as the FMF line up, the most efficient compressors for



FMF line-up

the commercial segment available in its capacity range as well as FMX, a compact product for household refrigerators that allows natural refrigerant R600a (isobutane) usage. Moreover, Embraco FMX solution has been certified and approved by the VDE Institute with a 25-year lifetime. "FMX is also a bugless solution, a very relevant feature in India. It handles wide voltage fluctuations (stabiliser free) and is designed to work reliably and safely maintaining refrigerators performance integrity despite energy fluctuations," emphasises Pereira.

Embraco's solutions are differentiated by low energy consumption, meeting all new regulatory requirements. The FMFD, from the FMF line-up, for example, has the potential to reduce energy consumption by up to 30 percent when compared to traditional solutions available in the market and is ideal for light commercial applications, such as reach-ins and supermarket islands. Fullmotion portfolio is present in markets all over the world, bringing more convenience to the consumer because, through variable speed technology, the ideal food and beverage temperatures are quickly attained, providing fresher food.

## Global Company with Local Expertise

Embraco is a global refrigeration company that, through its local team and

47-year journey has invested in developing innovative solutions with the aim of providing a better quality of life for society. The company invests around 4 per cent of its annual net revenues in research and development, in order to maintain a strong presence in the market. "Now-a-days one of every five hermetic compressors sold in the world carries the Embraco brand. We understand that we can boost our presence with our efforts in India, since it has a huge refrigeration market potential, which increases 13 per cent annually. To achieve our goals and win over the market, we've reinforced our business through a local technical support and sales team, partnerships with local laboratories as well as providing training to customers about our innovations," reinforces Pereira.

## Pioneers in Natural Refrigerants

For the past 25 years, the company has used natural refrigerants in its portfolio for both the commercial and household segments as an alternative to reduce the negative effects on the ozone layer, greenhouse effects and to improve the equipment's energy efficiency. The solutions that Embraco has been offering to the Indian market meet the increasing demand of the government and the Indian population for solutions capable of providing more quality of life. In this sense, the company believes that natural refrigerants are the most compliant way to fulfill the population's and customer's interests.

In addition to the new launches, Embraco is still one of the leaders of the R134a market, delivering reliable and robust solutions focused in India, including wide-voltage range compressors. ■

Visit: [www.embraco.com](http://www.embraco.com)



FMX

## Aggreko Offers Cooling & Power Equipment

**A**ggreko India has a wide range of cooling and power equipment offering for any interim needs that may arise. In its cooling portfolio, the company has chillers of capacity starting from 150 kW to 1400 kW that includes air cooled as well as water cooled chillers, portable cooling towers, air-conditioners ranging from 30 kW to 100 kW including split and packaged units, 100 kW-300 kW of air handling units, Shell and Tube and Plate type heat exchangers of various areas. Accompanying the above products are accessories such as fluid pumps of various capacities, in-line duct heaters, blowers, flexible hoses, flexible ducts and buffer tanks.

In its portfolio, Aggreko claims an enviable fleet of various capacities and accessories of various ranges that are mobile and modular and can be shipped within a short notice.

On the application front, Aggreko caters to comfort cooling (space cooling), process cooling and dehumidification. Comfort cooling deals with cooling of large structures for events, cooling of confined spaces and mine cooling. Process cooling applications



involve engineered solutions with chillers, cooling towers and heat exchangers for process enhancement, process augmentations and removing process bottlenecks that may arise in the operations.

More than a decade, Aggreko India is serving various industries with the above solutions such as petrochemical and refineries, fertilizers, pharmaceutical, food and beverage, manufacturing, mining, oil and gas, construction, shipping, events and contracting for major building maintenance. ■

## One-Stop-Shop for Air-conditioning Components

**S**unraj Industries was established in 1999 as a 'One-Stop-Shop' provider of an integrated package to air-conditioning and heat exchanger customers by supplying complete range from component to raw materials. Sunraj Industries is a government recognised export house and also member of Federation of India Export Organisation, Indo-Arab Chamber of Commerce and Industries. The company is approved with an ISO 9001:2008 certificate.



Sunraj Industries exports its products to more than 21 countries and is an exporter of largest range of copper and aluminium tubular components, brass fittings and complete range of copper and aluminium brazing rods and rings. The company exports to countries in Middle East, Africa, Far East and Europe. Sunraj has earned accolades for quality and strict delivery schedules. Raw materials and components are of world class quality and meet or exceed customer requirements. ■

## LS Metals: Pioneer in Production of Finest Copper Tubes

**L**S Metal is providing a vision of hope in the metal working field. In the field of copper tube, the company produces high quality copper tubes using the horizontal continuous casting and rolling process. Through full use of advanced techniques and research, LS Metal produces the finest copper tubes such as Thin Wall Tube and Inner Grooved Tube with 70 years' worth of know-how and the highest quality copper tubing equipment.



LS Metal offers oxygen-free copper tube and pipe characterised in 99.99 per cent pure copper. So, it features its purity, corrosion resistance, and processability. LS Metal ensures a high yield rate, productivity, and stable quality with the casting and rolling process (C&R) which the company developed for the first time in the world. By retaining core manufacturing technology of Thin Wall Tube and Inner Grooved Tube based on its consistent quality and high technology, the company puts its competitiveness forward. Also, LS Metal advances the air conditioning market by developing and manufacturing IHF and recognised and respected by customers not only in the domestic market, but also in Japanese market where it is very particular regarding quality control.

LS Metal also produces oxygen-free copper tube and pipe that is excellent in electric conductivity and supplies materials for coaxial cable that is used for the base station of mobile telecommunication. LS Metal is receiving an exceptional reputation worldwide with outstanding technology, supreme quality, and stable supply capacity. LS Metal produces Inner Grooved Tube, Level Wound Coil, Pancake Coil and Straight Tubes. ■



# Cooling without Heating the Earth



A system that utilises less energy for cooling and does not use refrigerants? Yes, you read it right. Here's a case study of an office building in Nashik.

Cooling buildings is a requirement in warm and hot climates, for most part of the year. Globally, cooling consumes 3,900 TWh (almost three times the annual energy consumption of India) and is likely to consume 7,500 TWh by 2050 if we continue at present rate of consumption, according to 'A Cool World' Report published by the University of Birmingham and the Institute for Global Innovation in 2018.

The report points out that the CO<sub>2</sub>

emissions from the cooling sector amounts to approximately 4 Gigatonnes of CO<sub>2</sub> annually, amounting to 11.8 per cent of the world's direct CO<sub>2</sub> emissions. Almost 80 per cent of these emissions are due to the indirect emissions of electricity generation to drive the cooling appliances. According to the Draft National Cooling Action Plan (NCAP) released by the Ministry of Environment, Forests and Climate Change (MOEFCC), 60 per cent of India's primary energy supply (TPES) for cooling is

accounted for by space cooling in 2017-18. Air conditioning demand by commercial buildings is set to increase from 30 million TR in 2017-18 to 140 million TR in 2038.

The Intergovernmental Panel on Climate Change's (IPCC) Special Report on Global Warming of 1.5-degree C approved by governments in Incheon, South Korea, in October 2018, proposed 'rapid, far-reaching and unprecedented changes in all aspects of society'. The Kigali Amendment to the Montreal Protocol, of which India



has been a signatory since 1992, focuses on the greenhouse gas emissions related to Hydrofluorcarbons (HFCs), and the need to integrate energy efficiency to refrigeration transitions.

Do we have an alternative low or zero energy system of cooling our buildings? A system that utilises less energy for cooling and does not use refrigerants?

### **Rationale for a Natural Cooling System – ThermOdrain (TOD)**

The ThermOdrain (TOD) is one such solution that uses water - cooled by night sky to drain the radiant heat within a building. The heat from the structure is absorbed by the water and dumped into the atmosphere by means of a radiator exposed to air. The method aims at reducing sensible heat by removing structural cooling load.

Indoor thermal comfort is achieved if a body can effortlessly remove its metabolic heat from itself. Air conditioning uses chilled air in sufficient quantity to remove the heat and moisture gains from the space and maintain its temperature and humidity to specified values. It also provides treated outside air to maintain indoor air quality through ventilation. However, the assumption is that all solar gains, both direct and transmitted, are sensible loads to be absorbed by air and carried away before they reach the occupants.

This assumption is true in the temperate climate. The houses are lightweight and insulated. They are designed to reduce the heating load during the cold winters by keeping the heat in. Summers are mild. So, the cooling loads are low.

In India, we have hot summers and buildings are un-insulated. They absorb the solar heat and emit it inside. The interior surfaces get heated up and radiate heat. The challenge is to keep the heat out. Instead buildings allow heat to enter through large window openings (or even worse, curtain glass façade) within and then use an energy hungry technology - air conditioning - to pump it out. Sufficient evidence has been gathered till date to show that un-insulated buildings in India absorb solar radiation during the day and

release it in the night.

The disadvantage in using air for cooling is that it has very low capacity for absorbing heat. One litre of air weighs one gram and can absorb only one Joule of heat per Kelvin. So, to remove 150 watts (heat generated by one person) would require 540,000 litres/hour of air per person. This figure will increase due to low coefficient of convective transfer for air. While dry air does not need much energy to cool, the moisture in it condenses while chilling and releases its latent heat. Pumping this heat out through refrigeration requires tons of energy.

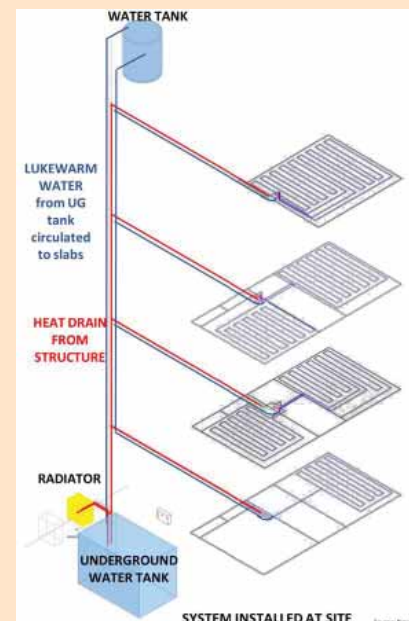
### **Case Study of Green Space Realtors' Office Building in Nashik:**

The case study office building – of Green Space Realtors – is located in the city of Nashik in Maharashtra. Nashik is located at an elevation of 700-metre above mean sea level, has a maximum Dry Bulb Temperature (DBT) of 37-degree C in April/May, while minimum temperatures can reach 10-degree C in January/February. Diurnal range of temperature is about 15-degree C. Average annual rainfall is about 705 mm. Relative humidity fluctuates significantly in a single day. It.

The building is a ground + 2 storeyed building with flat roof admeasuring 258.5 sq.m. carpet area. It is oriented north-south. Entrance is from the North while the South wall is common to adjacent plot building. Overall Wall Window Ratio (WWR) is 30 per cent. Windows are well shaded and have an equivalent SHGC of 0.66. Passive design strategies used in the building include appropriate orientation (South side is a common wall with neighbouring building), use of double wall in the building envelope made of fly ash bricks and brick cladding with air gap, use of turbo ventilators to facilitate stack ventilation and use of high albedo reflective paint with SRI>0.5 to reduce heat gain from roof.

### **ThermOdrain system at Green Space Realtors' office, Nashik:**

The TOD system installed at the office building in Nashik comprises of 21 mm diameter plastic pipes laid out in a grid on the plinth of all floors. The system is



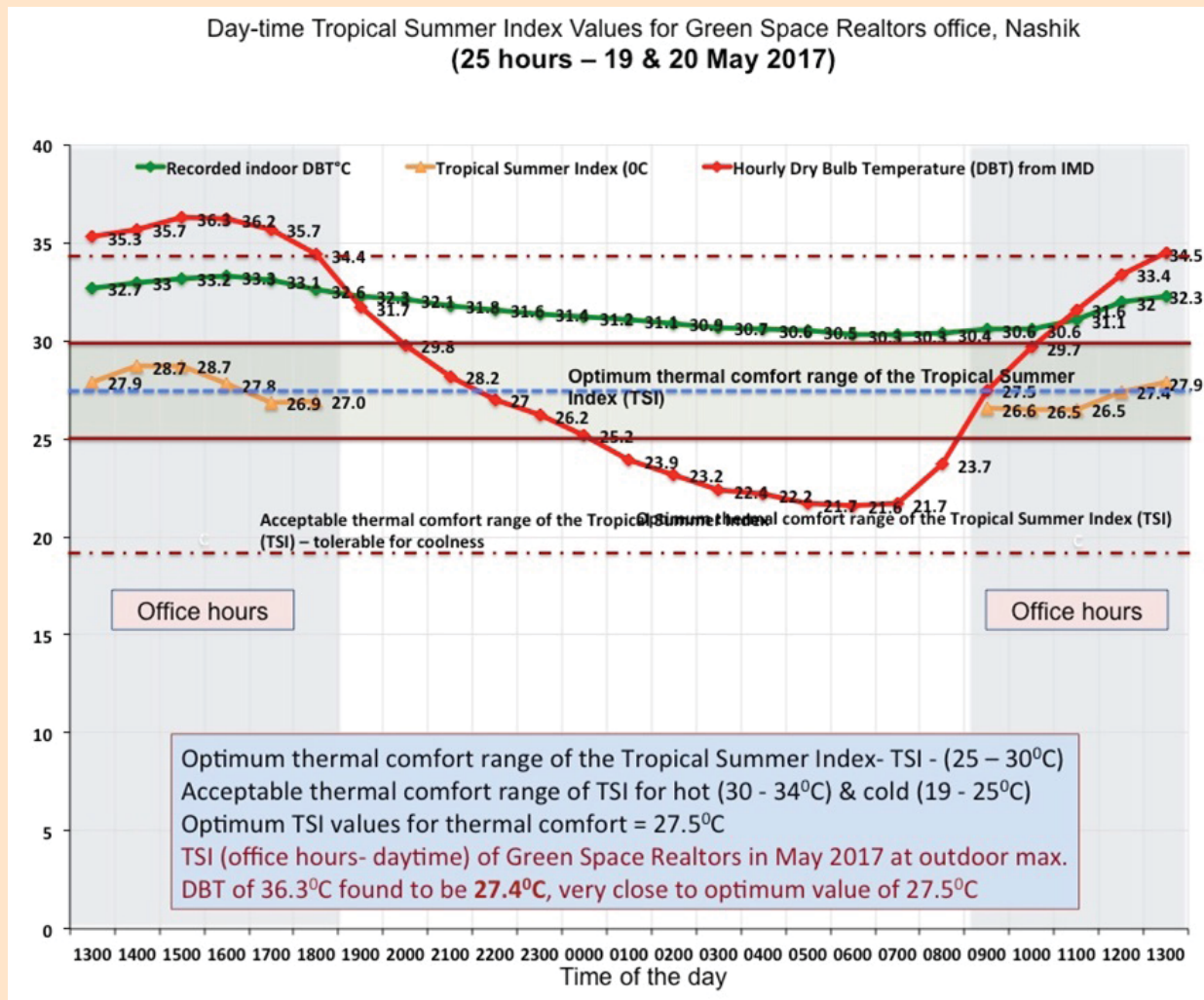
Schematic diagram of the TOD system for the Office Building in Nashik



Laying out the coil of pipes above RCC slab with screed below tiling at the time of construction of terrace



Completed terrace with water pipes below tiling and high albedo paint above



designed to remove 242 Btu/ sq. ft. / hour (763 W/m<sup>2</sup>) of heat from the plinth mass of the structure. The schematic layout of the system is shown in Figure 1. Figure 2a and b show the TOD system on terrace slab - during construction and post construction - the finished terrace slab.

The water picks up the roof heat (water absorbs 4,100 joules per litre per Deg. C) and passes through a radiator that rejects most of it. Lukewarm water is stored in the tank and recycled through the radiator at night, when the cool night air absorbs the residual heat. The cycle starts again the next morning. Energy for the pump and the fan is supplied by solar PV system.

#### Assessment of ThermOdrain system

The ThermOdrain system was validated through empirical assessment by recording hourly surface temperature of top and

bottom of the terrace slab - with and without high albedo paint. Measurements were made in peak summer (May 2017) using calibrated data logger and thermocouple sensors; hourly indoor air temperature/dry bulb temperature (DBT) and relative humidity (RH) were measured using Ebro temperature and humidity logger; hourly globe temperature was manually recorded using JRN 76 mm black globe thermometer. Monthly electricity bills were obtained from the office to determine Energy Performance Index (EPI) and compared with prevailing benchmarks provided by the Bureau of Energy Efficiency.

#### Reference Thermal Comfort Standards for India

The National Building Code (NBC) 2016 India refers to three thermal comfort

indices that find applications for Indian climate viz:

- Effective temperature (ET)
- Tropical summer index (TSI), and
- Adaptive thermal comfort.

Since effective temperature or ET “appears to have an inherent error if used as an index of physiological strain, the error increasing with the severity of the environmental conditions” as per NBC, it was not considered. For IMAC standards, running mean outdoor temperature for 30 days is required. Hence Tropical Summer Index or TSI was used as a benchmark. Operative temperature was calculated. TSI is defined as the temperature of calm air at 50 per cent relative humidity that imparts the same thermal sensations as the given environment. Mathematically, TSI (°C) is expressed as:



$$TSI = 0.745t_g + 0.308 t_w - 2.06\sqrt{(v+0.841)}$$

Where  $t_w$  = wet bulb temperature, in degree C;  $t_g$  = globe temperature, in degree C; and  $V$  = air speed, in m/s.

The thermal comfort of a person lies between TSI values of 25-degree C and 30-degree C with optimum condition at 27.5-degree C. As per the index, the warmth of the environment was found tolerable between 30-degree C and 34-degree C (TSI), and too hot above this limit. On the lower side, the coolness of the environment was found tolerable between 19-degree C and 25-degree C (TSI) and below 19-degree C (TSI), it was found too cold.

### Thermal Performance of TOD system

**Diurnal range of temperature:** Outdoor diurnal range of Dry Bulb Temperature (DBT) was 14.7-degree C as compared to indoor DBT range of 3-degree C. Outdoor diurnal range of Relative Humidity (RH) was 71 per cent in contrast to indoor RH range of 27.6 per cent.

**Tropical Summer Index:** Indoor operative temperature of Green Space Realtors office building in May 2017 at outdoor maximum DBT of 36.3-degree C was found to be 27.4-degree C, which is within the range of acceptable TSI values of 25-degree C and 30-degree C and close to optimum value of 27.5-degree C (Figure 3).

**Energy Performance Index (EPI):** The EPI, an outcome-based metric for building

energy performance, was calculated from monthly electricity bills from June 2016 to May 2017. The EPI for the office building in Nashik was calculated to be 26.5 kwh/m<sup>2</sup>/year. This falls within the BEE's voluntary 5-Star benchmark for energy efficient buildings (less than 50 per cent air-conditioned) for composite climate of <40 kwh/m<sup>2</sup>/year, and is way below the national benchmark of 86 kwh/m<sup>2</sup>/year for commercial buildings in this climate zone.

### Conclusions and cost-benefit analysis

The study shows that TOD system provides thermal comfort indoors in peak summer without use of mechanical air conditioning system. The system prevents the solar heat re-radiation from roof and floors by absorbing it before it adds to the sensible heat load of the building and cause thermal discomfort to the occupants.

In terms of capital cost, the structural cooling system is 50 per cent less costly than a conventional HVAC system and the recurring energy cost is a mere 8.7 per cent of a conventional system. The total life cycle costing (capital and running cost) of the TOD system for a period of 10 years amounts to Rs. 6/ sq. ft./ year (US \$

1 per sq. m) as compared to Rs. 30/sq. ft./year for a conventional HVAC system.

The system is passive except for 3 elements – Pump for the pipes grid, Fan for Radiator and Pump for Overhead Tank. The total energy consumption of these amount to 3,000 kwh/year as compared to 34,560 kwh/year required for 12 TR of conventional HVAC system (at 1.2 kw/tonne of refrigeration and set temperature of 24-degree C) required for the building. The difference in energy consumption is more than 10 times. The active components of the system are supplied energy primarily from solar PV panels.

A scientific paper on the above article was presented and published at the 34th International Passive and Low Energy Architecture, Hong Kong University, in Hong Kong on 10 – 12 December 2018 and was adjudged as the 'Best Paper Award'.

### Acknowledgment

Author wishes to thank Kiran Chavan, Owner of Greenspace Realtors, Nashik; Architect Sanjay Patil; and structural cooling expert Surendra Shah. She acknowledges the assistance of Dr. Ashok Joshi in validating the empirical set up for the research. ■

**Dr. Roshni Udyavar Yehuda**

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## Grundfos Pumps Leveraging Efficiency

### What is the range of products that offered by the company for HVACR industry?

Grundfos has a long history of supplying superior, intelligent, quality pumps that guarantee performance and reliability in the HVAC industry. Our controls and integrated or external frequency converters ensure maximum system intelligence, flexibility and the lowest lifecycle costs. Pumps are the heart of any circulation system and accurately controlled circulation is the key to the users' comfort and the efficiency of the entire system.

### How unique are your products as compared to your competitors?

Grundfos' electronic speed control pumps give intelligent pump operations that always match system loads. Our solutions deliver high efficiency and a minimum of energy consumption. Furthermore, operating profiles can be adjusted to meet both seasonal and climatic changes, so we make sure your systems adapt to

**Gaurav Mathur,**  
Head – Business Development  
(Building Services), Grundfos  
India gives a sneak peek into  
uniqueness of its products in  
an interaction with Cooling  
India.

**Product range includes:**

- Circulator pumps, canned-rotor type electronically controlled
- In-line circulator pumps – standard/electronically controlled
- Single-stage – standard/electronically controlled
- Horizontal Split case pumps
- Control and monitoring units for Variable Primary, Secondary and Tertiary Pumping systems
- HVAC System Manager and Optimiser
- Relative, Differential pressure and Vortex flow sensors
- Grundfos Remote Management

the environmental changes.

What differentiates us is our value driven approach. We not only manufacture the world class and energy efficient pumps, but we also take care that we deliver cooling or heating demand as needed in the most environment friendly and sustainable way. We get the digitally enabled benefits from better monitoring, better control, better information for maintenance etc.

### **What are the growth drivers of your business? Which sector does generate the maximum demand?**

Our growth is driven by increasing demand for energy efficient and intelligent pumping systems to achieve energy, climate change and water related sustainability goals. For commercial buildings, more than 40 per cent of the building's energy consumption is attributed to air conditioning, thus, HVAC industry generates a significant demand for energy efficient and intelligent pumping systems.

### **How energy efficient are your products as compared to your competitors?**

We say, "Pump is more than a pump", as is evident from the latest and integrated technologies that Grundfos is bringing into the air-conditioning market.

Magna3 is one of the most cutting-edge innovation from Grundfos stable. The product has been improvised over its earlier versions to suit a range of applications, which includes CHW application, boosting, radiant cooling, hot water recirculation to name a few. EEI (Energy Efficiency Index) is a measure of seasonal efficiency with measurements taken at 25, 50, 75 and 100 per cent of flow for defined periods of time. The lower the EEI, the smaller the amount of energy used by the pump in a year. The EEI applies to circulating pumps, and the only way to achieve a

low EEI is with a variable-speed drive

To put that EEI into perspective, the European Energy-related Products Directive requires a maximum EEI of 0.27 from January 2013, reducing to 0.23 from August 2015. This requirement for ever-more efficient pumps is driven by the EU target of halving the energy used by circulating pumps by 2020, equivalent to the output of six medium-sized coal-fired power stations. Magna3 scores lowest on EEI of 0.17, turning out to be the most efficient circulator in its class.

When it comes to innovation, Magna3 stands out as it is more than a pump. With permanent magnet motor, stator is more compact which reduces copper losses. The impeller, which is a composite material reduces the energy losses across the impeller blades.

Magna3 has differential pressure probe and temperature probe in-built with onboard electronics, which allows the pump to run on various control modes based on constant pressure or temperature, constant curve and differential pressure or temperature. The capability of setting a maximum flow as an aid to commissioning and system operation can be set from the display of the pump itself, which replicates the throttling aspect of balancing valves. The capabilities of flow limiting can be further enhanced with a feature called Auto Adapt, which uses built-in intelligence to gather information about operation data and conditions and reset operating parameters automatically if required.

Magna3 has an analogue I/O point that can take external set point influence from a sensor and modulate its speed accordingly. The pumps can directionally also play the role of BTU meters with an addition of external temperature transmitter. Information can be fed to a BMS based on recognised global protocols and shown on each pump's integral display.

With the increased usage of control and automation in HVAC plant room and with the advent of integrated control strategies to arrive at lowest IKW/TR performance in HVAC plant room, stand-alone controllers are becoming obsolete.

Interoperable systems have become the industry's norm and same is being looked at HVAC plant room encompassing the chillers, pumps, cooling tower fans and other ancillaries.

### **What is your outlook for the industry?**

HVAC industry will continue to show growth in the future with the rising construction of residential as well as commercial buildings. As applications in HVAC industry contribute significantly to energy consumption and global warming, this industry will play a significant role in achieving the UN sustainability goals for energy and climate change, by developing innovative, energy efficient and intelligent solutions. ■



## BRIGHT FUTURE AHEAD FOR HVACR

Technological innovation in automation, control devices and IoT will accelerate the future growth of HVACR industry.

– Supriya A Oundhakar, Associate Editor

**B**urgeoning urbanisation has generated an impetus for advancement in smart buildings, metro rails, food processing, agriculture and cold chain industry. In turn, these sectors enhance the requirement for the efficient heating, ventilation, air conditioning and refrigeration equipment (HVACR) equipment. HVAC& R systems have become an integral part of daily life. Further, changing lifestyle, rising disposable income and younger generation will be driving the growth of the HVACR industry.

The future of the HVACR industry is very bright with the market increasing at CAGR of more than 10 per cent. Rapid

urbanisation, is driving the growth in the demand of AC&R equipment. Various vertical segments like healthcare, hospitality, industry, commercial office space, residential are all on the growth trajectory, observes C Subramaniam, National President, ISHRAE.

“The industry is poised to grow and more so as the urban population is expected to grow from current 34 per cent to 50 per cent by 2025. Cooling requirement for both human comfort and temperature-controlled logistics will continue to grow. However, the challenge is to act on sustainable methods of cooling,” asserts Vishnu Sasidharan, VP – New Product

Initiatives, Pluss Advanced Technologies Pvt Ltd.

The trend for the industry is to innovate for optimisation of resources, increase efficiency and use passive cooling methods. Subject matter expertise and creative thinking are the need of the hour as this industry is one of the most resource intensive. Unless the energy requirement for cooling is reduced, it will have substantial effect on the climate change. Clean and energy efficient cooling can advance three internationally agreed goals simultaneously i.e. the Paris Climate Agreement; the UN Sustainable Development Goals; and the Montreal



Protocol's Kigali Amendment, he further adds.

All the industry sectors have been witnessing major transformations, and the HVACR sector is no exception. The Internet of Things (IoT) in the HVACR system has made rapid strides, making it more efficient and convenient. Due to IoT, the devices can communicate with each other on real time basis providing feedback on real time basis. Automation in the system adjusts the temperature of the system sensing the activity of the user with the help of sensors fitted in the system. So, the future of HAVC&R industry lies in adoption of IoT and automation.

"Digitalisation, automation and innovation will play an important role in future of HVACR industry. There is a rising demand for the star rated and energy efficient products across the country; this may call for a significant brand shift over a coming year. Overall, future of HVACR Industry is very bright and looks promising," informs Amit Deshmukh, Program Chair for ISHRAE Thane Chapter.

The expected demand will be more than the supply, which will generate opportunities for manufacturers, supply chain and contractors in the HVACR industry. Smart cities projects will call for a demand in multi-split type air conditioner for commercial buildings that uses variable refrigerant flow control, as well as split or window ACs in the residential market. Health consciousness has escalated the demand for organic food. This rise in demand in organic food will drive the growth of refrigeration and cold chain industry.

Frozen foods and ready-to-eat foods



Future for the HVAC & R Industry is very bright with the market increasing at the CAGR of more than 10 per cent. With rapid urbanisation, the growth in the demand of AC&R equipment is on the rise.

**C Subramaniam**  
National President, ISHRAE

are gaining momentum due to changing lifestyles and younger generation. This growth will be visible in the cold chain sector covering cold stores, frozen food plants, packhouses, reefer transport, ripening units, distribution centres, retail, etc.

The Government of India's approval for development of 42 Mega Food Parks in the country will generate modern infrastructure, creating potential for the food processing sector. The scheme will link agricultural production to the market by bringing together farmers, processors and retailers under one umbrella. This will automatically leverage the potential for the cold chain and logistics industry.

Future growth is in temperature-controlled logistics for pharma, agriculture and perishables, which is still an untapped opportunity. "Integration of IoT and artificial intelligence-based control and monitoring systems would drive growth for both new and existing systems. Secondly, utilisation of renewable energy and free cooling using Thermal Energy Storage materials (Phase Change Materials) would play an important role in reducing dependency on grid power or diesel generator sets," states Vishnu

Sasidharan.

The global HVACR industry has been witnessing a shift towards use of refrigerants with lower carbon footprint. The Montreal Protocol, the Kigali Amendment, the Convention on Climate Change (COP21) etc. have been adopted in order to lower or eliminate the impact of Global Warming Potential (GWP) and Ozone Depletion Potential (ODP) refrigerants. "There are a lot of opportunities in research and development of green refrigerants and use of natural working fluids like Ammonia and carbon di-oxide," avers C Subramaniam.

Spurt in demand for sustainable and energy efficient building will drive the growth of green building and energy efficient products. Overall, the HVACR industry is poised for the development of solutions and products having good energy efficiency, lower environmental impact and better Indoor Air Quality (IAQ). "This will call for increase in demand for non-conventional systems like radiant cooling or passive ventilation etc. Concisely, the future HVACR growth lies in innovation, digitalisation and automation," asserts Amit Deshmukh.

Technological innovation in automation, control devices and IoT will accelerate the future growth of HVACR industry. IoT-enabled devices having benefits of more energy savings, convenience and comfort over the traditional electro-mechanical devices will gain prominence in the near future. The future will witness the advent of the smart control in HVAC units by using cloud-based systems. ■



Cooling requirement for both human comfort and temperature-controlled logistics will continue to grow. However, the challenge is to act on sustainable methods of cooling.

**Vishnu Sasidharan**  
VP – New Product Initiatives,  
Pluss Advanced Technologies Pvt Ltd.

# Improving IAQ in a multi-tenant building: A retrofit case study

This article describes a case study where the land lord and the occupant in the building collaborated to provide the occupants with a very high standard of indoor air through a retrofit project in an operational building.





With the rapid urbanisation that India is witnessing, there are more and more buildings being constructed and occupied in large cities all across the country. This means there are more cars on the road, there is more construction activity in the vicinity of these buildings, there are more industries supporting these buildings. All this leads to a greater impact on the air quality around these buildings and we are now witnessing poor Air Quality Index (AQI) days as the normal, with visuals of city inhabitants moving around in thick smog, with masks for protection. While pollution of the environment around is a fact, it is also imperative to have these large buildings to house the huge number of people who come to work every day and help push India's GDP to one of the highest in the world. Thus, while there is a problem of air quality and long-term solutions are being addressed by the various stakeholders, there is also a need to find a short term, local solutions to see that the occupants of buildings are working in a safe and habitable space.

Multi-tenant buildings pose a challenge to providing good quality air to the occupants as the Air Handling Units (AHU) are managed by the developer while the ducting and internal air circulation is in the control of the occupants or tenants. A good HVAC system, with the appropriate ventilation design and collaboration between the occupants and the landlord will enable the Indoor Air quality (IAQ) to be of the desired standards. This article describes a case study where the land lord and the occupant in the building collaborated to provide the occupants with a very high standard of indoor air through

a retrofit project in an operational building.

## Air quality requirements for buildings

ASHRAE Standard 62.1-2013 - Ventilation for Acceptable Indoor Air Quality is the widely used reference document for ventilation in buildings. The standard defines and lays down various processes and parameters that ensure the minimum acceptable levels of air quality in the work space. The standard primarily addresses the design considerations. In addition to adhering to a good design, best practices in operation of the ventilation system as well as workplace hygiene help to improve the air quality.

The outdoor air quality is measured using the AQI scale. Eight parameters are measured and there are six categories of air defined in the AQI scale used in India. Figure 1 lists the AQI scale and the air constituents that are measured and their values for each category.

While the current focus in the large cities is around Particulate Matter (PM) 2.5 and PM 10 values, the other pollutants are equally harmful to the human body. The ASHRAE standards take a reference to external levels of certain pollutants such as CO<sub>2</sub> and hence, the indoor air quality is a function of the external air quality.

## The air quality challenge

The building where this retrofit was undertaken was in the NCR region and the ambient air quality had deteriorated to a very large extent. Heavy construction around the building, increased traffic on the roads, pollutants carried over in the air from neighbouring states due to the stubble burning by farmers were some of

the reasons for the high AQI. While the landlord had provisioned for the best in class air filtration systems and ventilation design when the building was built four years back, these systems were not designed to cater for the level of pollution that the city was witnessing. The landlord was keen to provide the required air quality for a grade A development and a few of the tenants were also keen to provide their employees with a good and safe work environment. Thus, the developer undertook a retrofit project to improve the air quality in the building.

## Building overview

The building ventilation consists of AHUs on each floor. The air to the AHU is via Treated Fresh Air (TFA) units in the terrace to cater for the 5 – 10 per cent fresh air requirement to maintain the IAQ as per the ASHRAE Standard. The AHUs and TFA units are controlled by a building management system and the fresh air openings are controlled by CO<sub>2</sub> sensors. The AHU has a flow rate of 22000 CFM and MERV 8 and 13 filters are placed in the AHU in the existing arrangement.

## Retrofit solution

### Air quality assessment

To get an assessment of the quality of air that was being delivered by the existing system, air quality sensors were installed at pre-selected points in two floors. These systems enabled continuous monitoring of the air quality to see the trend of the air quality variation over the period of the day as well as over the weeks. The implementation team also studied the foot falls and usage patterns of the occupants, the openings in the building and the two

AQI Category, Pollutants and Health Breakpoints

AQI Category (Range)	PM <sub>10</sub> 24-hr	PM <sub>2.5</sub> 24-hr	NO <sub>2</sub> 24-hr	O <sub>3</sub> 24-hr	CO 8-hr (mg/m <sup>3</sup> )	SO <sub>2</sub> 24-hr	NH <sub>3</sub> 24-hr	Pb 24-hr
Good (0-50)	0-50	0-30	0-40	0-50	0.-1.0	0.40	0.200	0.0.5
Satisfactory (51-100)	51-100	31-60	41-80	51-100	1.1-2.0	41-80	201-400	0.5-1.0
Moderately polluted (101-200)	101-250	61-90	81-180	101-168	2.1-10	81-380	401-800	1.1-2.0
Poor (201-300)	251-300	91-120	181-280	169-208	10-17	381-800	801-1200	2.1-3.0
Very poor	351-430	121-250	281-400	209-748	17-34	801-1600	1200-1800	3.1-3.5
Severe (401-500)	430+	250+	400+	748+ *	34+	1600+	1800+	3.5+

Figure 1: AQI Parameters



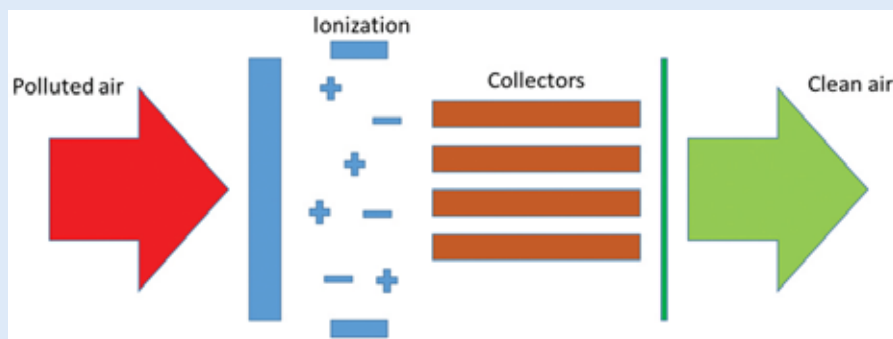


Figure 2: Electrostatic Air Purification

floors where air could leak into from outside. Another aspect that was assessed was the quality of the existing air filtration system and the condition of the filters in the AHU and TFA.

## Proposed solution

Based on the study undertaken by the building O&M team and the air quality assessment team, the most optimal solution arrived at was to install an electrostatic based air filtration system. The filter consists of specialised panels that are fitted in place of the existing filters on the AHU and works on the principle of ionisation of the air which breaks down the pollutants in the air. The pollutants are collected on collector plates and clean air passes through to the occupied space. Figure 2 shows the working principle of an electrostatic filter.

## Benefits to retrofit

Post installation, the air quality was monitored for a period of three weeks using the same continuous monitoring sensors used during the assessment phase. The data was analysed and normalisation carried out in case of any abnormal values on account of sudden changes in external or internal conditions such as a dust storm or a significantly higher footfall. The external AQI was also monitored to ascertain the improvement in the air quality inside the building. The system performed as per the expectations and there was significant improvement of the air quality at the AHU outlet. The

improvement was on all the parameters, but more significantly, the PM 2.5 values were seen to be continuously below the WHO guideline lines thus validating the installation of the air purification system. In addition to the sensor data, the feedback from the occupants was also taken and there was a perceptible improvement in the air quality as per the inputs received from the sample occupants queried.

No retrofit project passes scrutiny unless the benefits are clearly identified by the users. In this case, there were multiple benefits as follows:

- **Air Quality improvement:** With outside PM 2.5 in the range of 300 – 350 (very poor AQI), the PM 2.5 levels before fitting the system were in the range of 150 – 180 which were above the desired values. With the retrofit, the PM 2.5 levels achieved were consistently below 60 and mostly in the range of 15-30. This purification approach reduces lower value PM's as well and equivalent to a MERV rating of 14. In addition to lower 2.5 lower levels, the filtration system also brought other pollutants including biological count and VOCs.
- **Energy Savings:** The typical media filters on AHUs cause a pressure drop across the screen resulting in higher energy usage. Since the retrofit system is based

on ionisation, the pressure drop is significantly lower which results in lowering the energy usage. In this particular case, the energy consumption was reduced by 25-30 per cent. Taking into consideration that AHUs run for 12 hours a day, this leads to a substantial savings for the occupants.

## Conclusion

Deterioration in the outdoor air quality is a major environmental issue and is being addressed by the various stakeholders in the fight against pollution. However, there is a crisis at hand and it is impacting the health of the occupants of buildings as they spend a large amount of the time in their workplace. Indoor air is more polluted than the outside air, especially if not treated or the fresh air quality injected to the system is inadequate. Thus, building owners and occupiers should look at ways to treat the outdoors as well as the recirculating air. While there is a cost involved in retrofitting these purification systems, the benefits far outweigh the expense. Employee turnover, loss in productivity due to respiratory problems, absenteeism is some of the hidden costs of poor air quality. While new constructions have purification systems built in, older buildings require an upgrade in the air purification system. The benefits will accrue to both the landlords through higher retention and rentals as well as to the occupants through a healthier workforce. ■



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# Patton Ref is now Beijer Ref India

**P**atton Ref India Private Limited has been successfully doing business in India since 2007. In March 2015 Patton Ref was acquired by Beijer Ref AB, Sweden. Beijer Ref group has carved much bigger plans for business in India under the leadership of its Managing Director Swatantra Gagneja. The success story of Beijer Ref group has been its inorganic growth, apart from its organic growth worldwide. In India, Patton Ref is renamed as **Beijer Ref India Private Limited** and the business under new name will come into operation with effect from 01 April 2019. So, **Patton Ref is now Beijer Ref.**

Beijer Ref AB is one of the largest refrigeration wholesalers in the world and is represented in 34 countries. The company has 330 branches, 1200 suppliers, 100,000 products and 60,000 customers worldwide. Beijer Ref is a technology-oriented trading group which, through value-added products offers its customers competitive solutions within refrigeration and air conditioning industry.

Beijer Ref is represented in Belgium, Denmark, Estonia, Finland, France, Ireland, Italy, Latvia, Lithuania, Poland, Holland, Norway, Romania, Switzerland, Slovakia, Spain, United Kingdom, Sweden, the Czech Republic, Germany, Hungary, South Africa, Mozambique, Zambia, Botswana, Namibia, Ghana, Malaysia, Thailand, India, Australia, and New Zealand.

Beijer Ref India Private Limited has its PAN India network of warehousing, offices and dealer network to cater to its esteemed customers. Beijer Ref India is committed to offer state-of-the-art refrigeration technology to industries like supermarkets, hotels, restaurants, fast food joints, dairy products, ice cream, fruits, vegetables, meat, seafood, pharmaceuticals, biotechnology, hospitals, research labs, horticulture and floriculture. Post the

merger with Beijer Ref AB, Beijer Ref India continues to expand its product range, design, solutions and distribution network to meet the global demand for efficient, reliable and cost-effective refrigeration equipment for today and the future.

Apart from Patton and Bohn brand of evaporators and condensing Units, Beijer Ref India represents leading US and European brands like Bitzer, Danfoss, Embraco, Henry, Carel, EBM, Gomax, Swep, SICCOM, Uniweld, Value, Fieldpiece, Appion, Mastercool, Armacell, Supco, AVI Oil and Synergy. Beijer Ref India is marketing and trading various

HVAC and refrigeration products, equipment, tools and instruments like semi-hermetic, screw, scroll and FHP compressors, evaporators, air cooled and shell and tube condensers all kind of refrigeration controls, oil management systems for refrigeration, Gomax hoses and fillings, refrigerant recovery units, vacuum pumps, HVAC digital instruments, vacuum gauges, refrigeration oils, vibration eliminators, oil separators, PRVs, ball valves, Copper fittings, service tools, manifolds, charging hoses, filter driers, hand shut off valves, axial fans or shaded pole motor, electronic controllers, condensate pumps, tubeller and sheet insulation, etc. ■

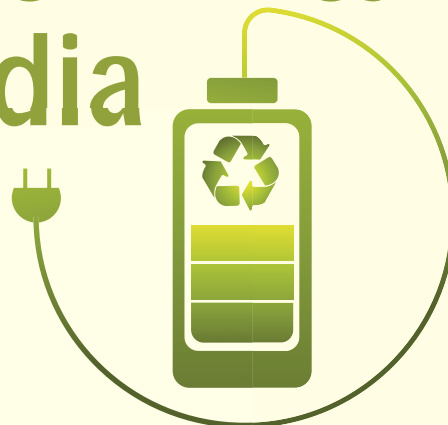
For more details, visit: [www.beijerref.in](http://www.beijerref.in) & [www.beijerref.com](http://www.beijerref.com)



Swatantra Gagneja  
Manager Director, Beijer Ref India

**BEIJER REF**  
**India**

# Saving Energy for India



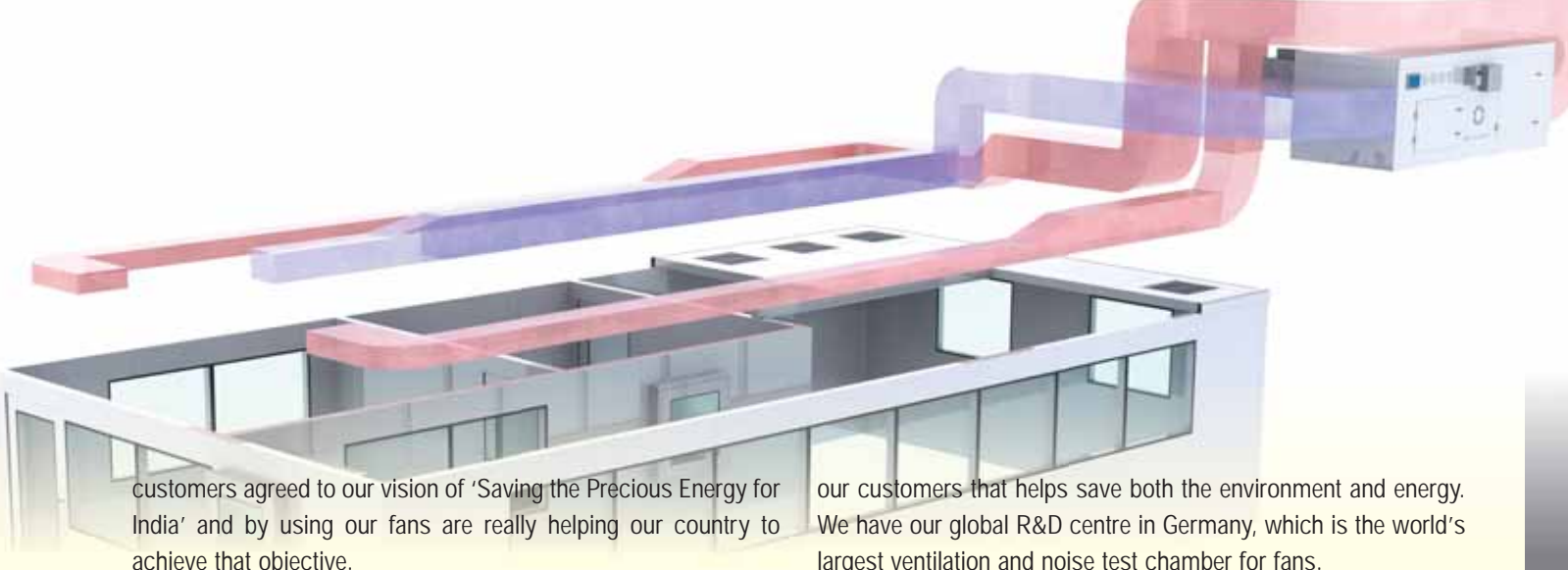
**Vikas Kundra, Managing Director, ZIEHL-ABEGG India Private Limited** sheds light on the journey of the company in India, its product, R&D, his outlook for HVACR industry and many more in an interaction with **Cooling India**.

## How has been the journey in India?

Our journey in India has been very exciting and encouraging. We completed 10 years of our presence in India in 2018. From the time we started in 2008 till date, there has been a big and positive change in the industry. The customers are demanding and accepting the fans with low ownership cost rather than focusing on the low capital cost only, as they appreciate the fact that the operating and maintenance cost is much more than the capital cost of a fan.

The journey has been a great learning experience for us that helped us to understand and offer the right products at the right value-for-money proposition to our customers in India. We invested in a manufacturing facility at Chakan in Pune in 2013 and have been adding new product range and expanding the facility as we move forward. We are happy about the fact that all our





customers agreed to our vision of 'Saving the Precious Energy for India' and by using our fans are really helping our country to achieve that objective.

### What kind of product range does the company catering to HVACR sector?

We offer high efficiency and low noise fans for the HVACR industry that includes Axial fans with both AC and EC motors in external rotor motor design; Tube Axial fans with IE2/IE3 motors; Direct Driven Backward Curved Centrifugal fans with AC and EC motors in external rotor motor design; Direct Driven Backward Curved Centrifugal fans (Plug Fans) with IE2/IE3 motors; Sensors and Controllers to vary the speed of the fans, and customised Axial fans for applications like ammonia refrigeration

All the products offered by us are German engineered and manufactured according to the German standards that ensure that our customers get what they pay for in terms of air performance, noise, efficiency, dimensional details, etc. We offer our fans to the original equipment manufacturers of air handling units, air cooled chillers, condensers, evaporators, dry coolers, etc.

The methodology we adopt while working with OEM customer is that we focus on first understanding the application of our customers and all the limitations of the same, and based on that we select, optimise and customise, as and when required the fans to be offered so that we meet all the criteria asked for by our OEM customers. This way we ensure that our customer focuses on and grows his core business.

### Do you have R&D hub in India?

ZIEHL-ABEGG started its journey in Germany in 1910 with an innovation- External Rotor Motor. Even after 108 years, we continue to stay focused on innovations by investing about 6 per cent of our global turnover in R&D every year. We work on technology with a core objective of making our fans more energy efficient and low in noise. This way we are able to offer a fan to

our customers that helps save both the environment and energy. We have our global R&D centre in Germany, which is the world's largest ventilation and noise test chamber for fans.

### What is your take on clean room technology?

India has been one of the major pharmaceutical hubs wherein clean room is a necessity. Clean room applications are 24x7x365 and need products that are reliable and low in energy consumption. Clean room is also required for manufacturing of electronics and R&D labs. We see this industry growing as more manufacturing facilities to cater to these applications are being set up in the country.

### What is your outlook for HVACR industry for 2019-20?

HVACR industry in India will continue to grow and we see that more and more end users are demanding products with lower life cycle costs wherein they want the products to have the highest

India has been one of the major pharmaceutical hubs wherein clean room is a necessity. Clean room applications are 24x7x365 and need products that are reliable and low in energy consumption. Clean room is also required for manufacturing of electronics and R&D labs.

efficiency and minimal maintenance costs with the convenience of operation. With the government investing in infrastructure projects like airports, etc. the requirement for HVAC products will continue to grow.

The cold chain industry is also on the upswing as more organised players are getting into this field. There is still a long way to go wherein India can reach a stage where food products, fruits and vegetables are not wasted but are treated properly, stored in the right climate and transported to the consumers. ■



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**Lighting India**

**Cooling India**  
India's foremost monthly dedicated to the growth of HVACR industry

**Medical Equipment & Automation**

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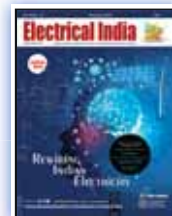


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# Schlachthof Bochum Relies on Natural Refrigerant Ammonia



Christoph Beidecker (left), Technical Director at Bochumer Fleischhandel, and Moritz Kruse, responsible for planning and project management at 3K Kälte- und Klimatechnik Kruse GmbH (3K), are delighted with the successful project

Moritz Kruse takes motorway exit no 34 on the A 40, Bochum-Freudenbergstrasse, and then it is just a short drive of a few minutes to EG Schlachthof Bochum. Approximately 350 cattle and some 1,500 pigs arrive here every day from all over the region to be processed into meat. A few months ago, Moritz Kruse and his colleague from company 3K Kälte- und Klimatechnik Kruse GmbH installed a BITZER ammonia compressor pack (ACP) at the slaughterhouse. Up until September 2017, an outdated NH<sub>3</sub> refrigeration system had been maintaining the correct temperature in the cold stores. The project team was also tasked with tempering the production cooling, which at that time was still operated with refrigerant containing CFC, in the future using the new set-up and a brine system.

So, it was a good job Andreas Schulaks, Head of Industrial Refrigeration at BITZER, had already approached the 3K company in 2015 to introduce the BITZER ammonia compressor packs. "This was the optimal time for a field test for us," he says. "We were certain that our ACP with three BITZER OSKA 85 screw compressors was just the right solution for the slaughterhouse operations based on the set-up." The slaughterhouse required an actual cooling capacity of approximately



The ACP with three BITZER OSKA 85 screw compressors is just the right solution for the slaughterhouse operations based on the set-up

400 kW at that time. As a result of the planned conversion to non-CFC refrigerant, a decision was also made to equip the processing rooms with a brine system which is cooled by means of the ammonia circuit of the refrigeration system.

## A COP of 4.28

"We, therefore, needed a cooling capacity of around 1,150 kW. The three screw compressors each have a capacity of 400 kW at 2,900 rpm. Thanks to the option to have the compressors turn at 4,200 rpm, we can also ensure that, in the case of a machine malfunction, we have sufficient redundancy, without having to deal with a significant loss in capacity and thus, production downtime," says Moritz Kruse. "So, we have access to cooling capacity of 1,548 kW at full machine capacity. The economiser capacity is then 125.8 kW." Thanks to the economiser with sliding suction position, operation is also effective in part-load. "We therefore obtain the highest cooling capacity and coefficient of performance possible in full- and part-load. In April 2018, the total power consumption of the system was 67,988.0 kWh for the three BITZER screw compressors, putting the system's COP/EER at 4.28 at the machine shaft – a figure that can actually be measured," Moritz Kruse adds.

The system's oil cooling also offers heat recovery to preheat the feed water for the heating system: the water is heated to 56°C, with 124.6 kW oil cooler capacity available at full-load. The 3K company has installed an additional emergency cooler on the roof for system reliability. "Our BITZER screw compressors are responsible for cooling the pig and cattle cold stores and ensure continuous operation of the ammonia refrigeration system," says Andreas Schulaks. "In the future, they will also provide tempering in the production facility in a secondary circuit. According to plans, the capacity for this circuit will be around 750 kW."

## Challenge

Minimal production downtime during system replacement 3K began planning the project in October 2016 and, three months later, the technicians received the order from Schlachthof Bochum. In turn, BITZER delivered the unit in April 2017, which was then installed with the corresponding pipelines and additional devices. "At the same time, the company Automatisierungs- und Steuerungstechnik Austmann (ASA) replaced the system controls and the switch board for machine regulation," says Moritz Kruse. "We've been successfully working with our partner for many years." And then in September 2017, the 3K technicians switched over from the old to the new system. "One of the biggest challenges for us during system construction was minimising cooling downtime to the highest degree possible," says Moritz Kruse. "But because the engine room is so spacious, we were able to set up the new system alongside the existing one." And with the support of BITZER experts from Denmark, Moritz Kruse and his colleagues actually managed to keep downtime to a bare minimum. The new system went online after 54 hours rather than the



Thanks to the economiser, the ACP achieves the highest cooling capacity and coefficient of performance possible in full- and part-load initially estimated 72. As a result, production at the slaughterhouse was back up and running much earlier and production downtime was limited.

### **BITZER as a Reliable Partner**

The decision to go with the BITZER ACP was obvious for project manager Moritz Kruse. "We've been working with BITZER since 2016. Andreas Schulaks introduced us to one of the ACP prototypes during a factory tour in summer 2015," says Moritz Kruse. "BITZER compressors are durable, ultra-reliable machines that are well established in commercial refrigeration. And now that BITZER also offers entire units, we're more than happy to also use the high-quality screw compressors, which until recently were rarely ever utilised in industrial refrigeration. After all, the fact that we no longer have to construct the units ourselves is an absolute competitive advantage for us," Moritz Kruse adds. And thanks to the integrated IQ

*The EG Schlachthof Bochum slaughterhouse has especially high requirements when it comes to hygiene and quality in production and storage. Up until 2017, an outdated NH3 system had been doing the job. The slaughterhouse has been using a BITZER ammonia compressor pack (ACP) since September 2017, installed by company 3K Kälte - und Klimatechnik Kruse GmbH based in Versmold.*

module, the cabling required very little effort on the part of 3K – for both installation and commissioning. There's also the fact that BITZER compressors can be operated continuously. Even if the capacity control were to malfunction, hand operation would also be a good option that doesn't require much effort. "All that together, the simple servicing of the units and compressors, made the decision to go with BITZER an easy one," says Moritz Kruse. And Andreas Schulaks adds, "Because our ACPs boast such a compact, well-structured design, they can also be used for renovations in smaller engine rooms and represent a simple, cost-effective solution for new structures, as engine rooms can be that much smaller." BITZER manufactured the open drive screw compressors in Rottenburg-Ergenzingen in southern Germany, whilst the ammonia compressor pack was premounted at the neighbouring Rottenburg-Hailfingen site. Moritz Kruse is now standing in front of the system in the Schlachthof Bochum engine room. "The entire project has run smoothly and continues to do so to this day, from the planning and implementation to collaboration following commissioning," says Moritz Kruse. "All that is a great recommendation for BITZER, who will continue to be a reliable partner well into the future." ■

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## EC fans from ebmpapst for efficient cooling towers

Cooling towers are used for cooling processes, installations, data centers and buildings. The ebm-papst range now includes axial and centrifugal fans with the appropriate corrosion protection specifically for such applications.

Fans dissipate surplus and non-usable heat to the ambient atmosphere. A high air flow rate is required for this purpose. Efficiency is becoming an ever more important criterion, as energy consumption is a significant factor in terms of operating costs.

### EC technology marches on

The advantages of EC technology, namely efficiency, infinitely variable demand-based control characteristics and uncomplicated operating state monitoring via MODBUS RTU, guarantee a rapid return on investments. For use in cooling towers, for example, the ebm-papst portfolio contains a new axial fan with double flange housing of size 1,250 mm which is particularly suitable for high pressure ranges and is already available for delivery.

### Fans withstand corrosion and wear

The extremely harsh ambient conditions with 100 per cent humidity in combination with high temperatures inevitably lead to corrosion and a high degree of wear. So, a particularly robust fan

design with a special coating for metal parts and electronics circuit boards is essential. ebm-papst fans for cooling towers are rigorously checked in various tests (thermal cycling or wet test, salt fog test, Highly Accelerated Lifetime (HALT) testing, shock and vibration tests) and are thus, ideally equipped to provide reliable operation in cooling towers. The noise level is

another reason for using EC technology, as outdoor installations are subject to maximum noise generation regulations in many countries. Reducing the speed to half air flow cuts the noise level of GreenTech EC fans by 15 dB(A), whereas an improvement of only 3 dB(A) is attained with AC fans.

### FanGrid as the ultimate solution

The fans are excellently suited to use in FanGrid arrangement, in other words in a system of centrifugal or axial fans operating in parallel. This offers the advantages of a better air flow through the cooling tower and quick and easy fan replacement. Operational reliability is an essential prerequisite for cooling towers. With an appropriate number of fans, the necessary air flow can always be attained even if one fan is out of operation (redundancy). The speed of the other fans is then simply increased to compensate for the missing air quantity, and the same flow through the cooling tower can be maintained. ■

For more info: [www.ebmpapst.com](http://www.ebmpapst.com)



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### Shock-Resistant VS70 Videoscope from FLIR

The FLIR VS70 is a rugged, waterproof, and shock-resistant videoscope with a large 5.7-inch colour LCD display. It features intuitive handset controls that enable users to manoeuvre the narrow camera probe into tight spaces to deliver vivid and sharp video and images.

Advanced inspection solutions, expansion cameras, and add-on accessories enable users to expand their FLIR VS70 to address many different inspection needs.



#### Key features

- Intuitive handset controls for selecting angle of view
- Drop-tested and IP rated for splash and water resistance
- Long battery life plus car-charging option for all day use
- Includes headset for recording voice annotations
- Multiple articulation options

• Expansion cameras and add-on accessories available ■

For more information, write to [flirindia@flir.com.hk](mailto:flirindia@flir.com.hk)

### BELIMO sensors, the perfect complement to actuators & valves

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

#### Sensible expansion of range

Belimo has many years of experience in developing high-quality sensors for the HVAC industry that assure the reliable recording of information and guarantee the best possible data quality. The company is expanding its core business of components with integrated sensors by adding autonomous



sensors that can be applied to any system design.

Belimo's complete product range of sensors is optimally tailored to Belimo actuators and valves that can be seamlessly integrated into existing or new building automation systems.

#### Innovation in detail

For instance, the new air quality sensor measures CO2 content with two channels to compensate for possible deviations. That means greater accuracy and long-term stability.

In addition, the same device also records humidity and temperature values and feeds the data into the system through just one bus interface. As

a result, installation and integration costs can be reduced. ■

For more information, write to [info.india@belimo.ch](mailto:info.india@belimo.ch)

### ULTRACORR ACX: India's First Anticorrosion Nano Coating for HVAC

Nanova Care Coat is a manufacturing company of nano coating that is the first of its kind in India. The company has started by a group of Indian



scientists having global experience of research and development in the field of surface coatings. The company has developed pioneering anti-corrosion nano coating (ULTRACORR ACX) for HVAC coils and condensers. ULTRACORR ACX provides a long-lasting corrosion protection of copper and aluminium condenser coils, thereby, preventing leakage of gas due to atmospheric and chemical corrosion, saving huge energy cost and additional expense of coil maintenance and replacement.

Coating meets international standards. Being based on nano technology, the coating offers protection at a very low film thickness without affecting heat transfer and pressure drop.

The system can efficiently be applied in the factory as well as on the site. The specialised product with simple application procedures makes ULTRACORR ACX the best choice to prevent air conditioning failure and unnecessary energy consumption due to corrosion.

#### Salient Feature

- Excellent anti-corrosion performance in any harsh environment
- Provides sacrificial and barrier protection
- Enhance service life of condenser
- Excellent adhesion and film hardness and heat dissipation
- Excellent resistant against chemical, acids and alkaline cleaners
- Can be applied at both industry or on site
- Ideal for residential, commercial and industrial AC, HVAC, AHU, VRF and Chillers
- Compliant with international standard like US FDA 175.300, RoHS, and certified by IIT Bombay. ■

## Two Stage Inverter Drive Compressors from KOBELCO

**K**obe Steel Ltd, brand of Kobelco, is Japan's top manufacturer of refrigeration compressors with high market shares in its home country and East Asia. Kobe Steel is renowned for the high technical capabilities of its refrigeration compressors.

It developed Japan's first ammonia screw refrigeration compressor package in 1963. In 2002, it succeeded in developing the world's first refrigeration compressor equipped with an inverter.



Kobelco patent enables iZN series to increase its cooling capacity for 20% more than the conventional compressor at lower than -30°C.

The iZN series can control its cooling capacity with its inverter drive linear speed control to avoid excessive cooling, thereby, permitting outstanding energy-saving performance.

A slide valve used for capacity control has been replaced to inverter drive compressor control to ensure optimum operation in accordance with cooling capacity fluctuation. ■

Visit: [www.kobelco-comp.co.jp](http://www.kobelco-comp.co.jp)

## LAMILUX AntiBac Ensuring Safety in Food & Medical Sectors

**H**ygience is the top priority in places where it may not only have devastating health consequences but also financial ones if standards are not met. This is particularly important in hospitals, food processing and food transport industries. LAMILUX AntiBac is the innovative partner for the food and medical sectors: a fibre-reinforced composite with a silver nanoparticle coating which produces an antimicrobial effect on its surface. Even multidrug-resistant germs die within a few hours on its surface and new, critical germ masses are prevented from forming.

Many resistant germs have their origins in industrial livestock farming, caused by massive antibiotic use. That's why sterility is also a top priority in animal husbandry. The mass transport of refrigerated and sensitive foods is also subject to strict requirements for cleaning and hygiene logistics to protect people, especially as the loading and unloading



process exposes food to dirt and contaminants.

### A material as protective shield

The antimicrobial LAMILUX AntiBac neutralises even multidrug-resistant germs and bacteria efficiently on a lasting basis in a way that no other material can. A completely new standard of hygiene is achieved if its surface is also cleaned and disinfected using conventional methods. This minimises hygiene risks while maximising hygiene safety.

This innovative composite material is already being used as a structural face sheet in truck refrigerated truck bodies, refrigerated warehouses and processing facilities in the food sector and in operating theatres in hospitals. This can reduce downtimes throughout the entire food and refrigeration chain, often averting related untold damage to the image of the companies involved. ■

Visit: [www.lamilux.com](http://www.lamilux.com)

## Zero Leakage Vibration Eliminator

**D**esign and manufacturing of a leak proof Vibration Eliminator is an art itself. That is why many companies manufacturing controls for HVAC&R are not including this product in its range.

Hongsen, one of the world's leading name in HVAC&R Controls, understands the need of perfect Vibration Eliminator, keeping in view zero leakage concept. Recently, launched VAF model of vibration eliminators is having both inside and outside leakage protection to provide double safety.

Not only perfect design, Hongsen has set up state-of-the-



art assembly and testing line for their Vibration Eliminators. Each Eliminator is 100 per cent tested for any possible leak during working and only products clearing these tests are sent to the market.

Hongsen is leading supplier of controls and valves in refrigeration and air conditioning system. Many of

Hongsen controls and specially their Vibration Eliminators are successfully used by many Indian OEMs from last few years.

Hongsen products are exclusively distributed in India by Synergy Business Pvt Ltd. They can be reached at [rajesh@synergybusiness.co.in](mailto:rajesh@synergybusiness.co.in). ■

# Forthcoming Events At A Glance

## ACREX India 2019

**Venue:** Bombay Exhibition Centre, Goregaon, Mumbai

**Date:** 28<sup>th</sup> February to 2<sup>nd</sup> March 2019

**Website:** www.acrex.in

## China Refrigeration

**Venue:** Shanghai New International Expo Centre (SNIEC), Shanghai

**Date:** 9<sup>th</sup> to 11<sup>th</sup> April 2019

**Website:** www.cr-expo.com

## IRAQ HVAC Expo 2019

**Venue:** Baghdad International Fair Ground, Baghdad, Iraq

**Date:** 25<sup>th</sup> to 27<sup>th</sup> April 2019

**Website:** www.iraqhvacexpo.com

## ASHRAE 2019 Annual Conference

**Venue:** Kansas City, MO, USA

**Date:** 22<sup>nd</sup> to 26<sup>th</sup> June 2019

**Website:** www.ashrae.org

## MEGACLIMA Nigeria Expo 2019

**Venue:** Landmark Centre, Lagos, Nigeria

**Date:** 11<sup>th</sup> to 13<sup>th</sup> July 2019

**Website:** www.megaclimaexpo.com

## AVAI China 2019 - Guangzhou International Exhibition

**Venue:** China Import & Export(Canton Fair) Complex, Guangzhou, China

**Date:** 16<sup>th</sup> to 18<sup>th</sup> August 2019

## China International Cold Chain Equipment & Fresh Logistics Exhibition 2019

**Venue:** China Import & Export(Canton Fair) Complex, Guangzhou, China

**Date:** 23<sup>rd</sup> to 25<sup>th</sup> August 2019

**Website:** www.coldchain-china.com

## Megaclima Kenya Expo 2019

**Venue:** Kenyatta International Convention Centre, Nairobi, Kenya

**Date:** 27<sup>th</sup> to 29<sup>th</sup> August 2019

**Website:** www.megaclimaexpo.com

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Belimo HVAC sensors offer trusted reliability, easy installation, and seamless integration with major Building Automation Systems and are designed with an innovative screwless snap-on cover housing that allows for easy commissioning and provides NEMA 4X / IP65 protection. The new range includes accurate sensors for measuring temperature, humidity, pressure, CO2, and VOC in pipe, duct, and outdoor applications. Belimo sensors provide the highest quality and are backed by world-class service and support.

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# EMBRACO COMPRESSORS

Complete portfolio range designed around your needs



*Compatible with a wide variety of applications*



*Trusted brand known for high quality and efficiency*



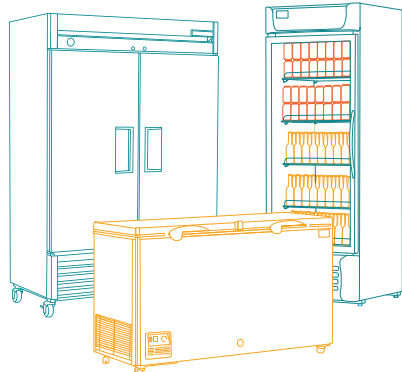
*Extended voltage range*



*Solutions ready for natural refrigerant*

## SOLUTIONS FOR MAIN APPLICATIONS

Reach-in Cooler



Horizontal Freezer

Bottle Cooler

Vertical Freezer

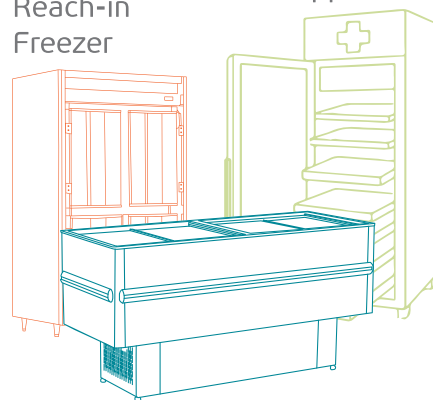
Bottle Cooler



Display Cases

Reach-in Freezer

Medical Applications



Frozen Islands

**EM** SERIES



**FFU** SERIES



**NE** SERIES



**FMF** SERIES



**NJX**

