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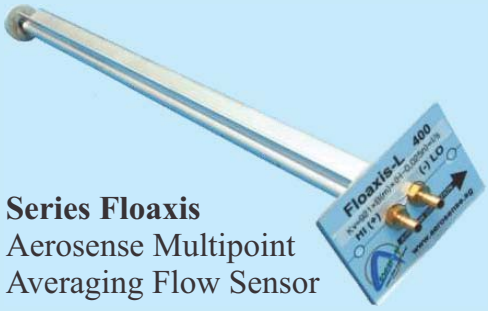

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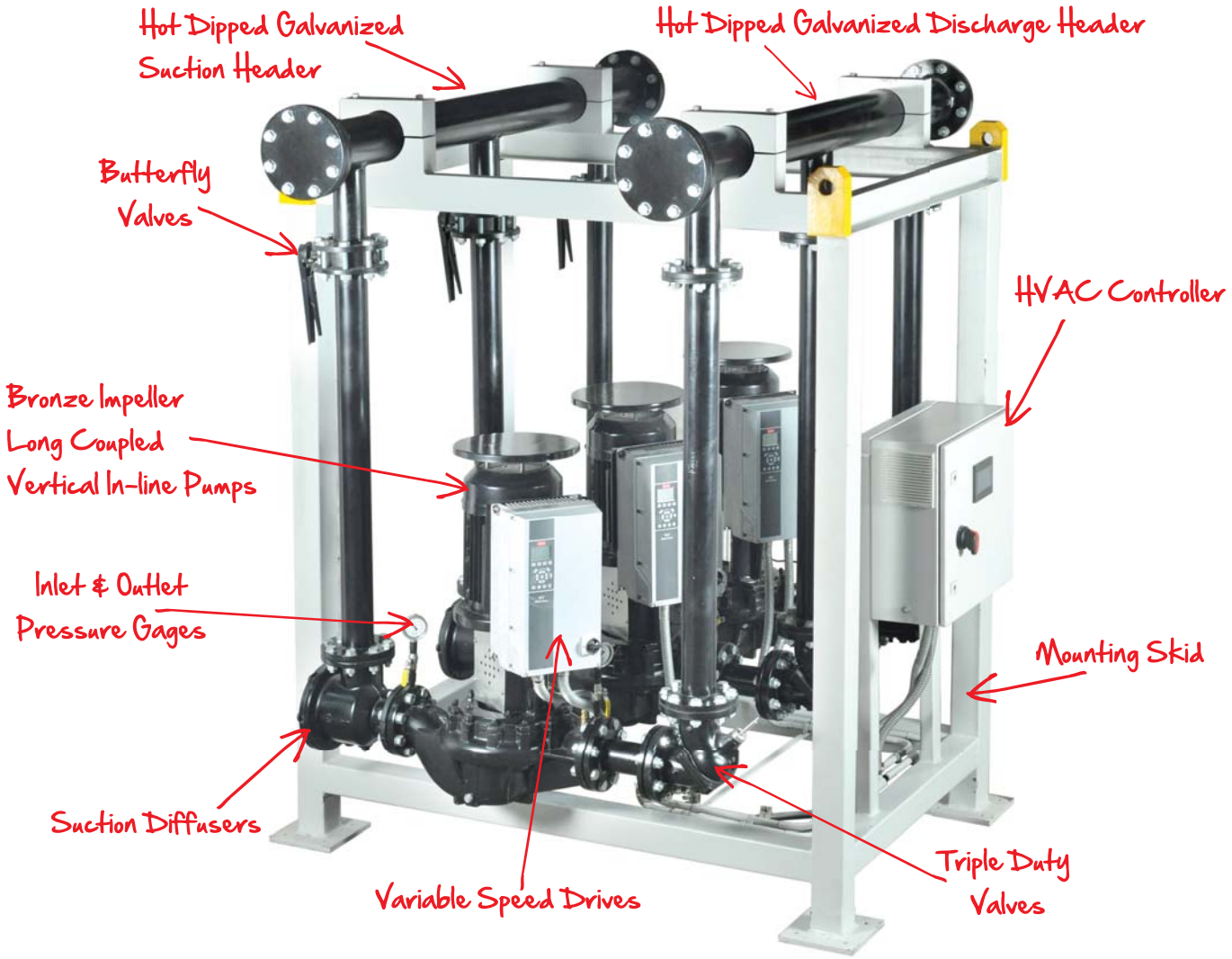

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Publisher's Letter

Hello and welcome once again to **Cooling India**, the one stop guide to the HVAC&R industry in India. When I say that, I must also point out that the website of the publication, ***www.coolingindia.in*** is ranked among the world's top publication websites in the HVAC&R industry. To be precise, as I write this note to you, I am happy to inform that ***www.coolingindia.in*** is ranked among the top 3 in the world.

Later this month, Dairy Tech exhibition will be held in Bangalore. Cooling India will be present there. I invite our readers to visit our booth No. L-37 in Hall 2. When we talk about dairy industry, India ranks at top of the world. The country's milk production is estimated at around 170 mt. Refrigeration and cold storage industry plays a crucial part in this. According to The International Association of Refrigerated Warehouses (IARW), India recently surpassed the US and has now the biggest cold-storage capacity in the world with 131 million cubic meters of space. Refrigeration in the dairy industry has made great advance in the past decade. Refrigeration is crucial for the food sector because it helps in ensuring optimal preservation of foodstuffs that are perishable and thereby provides consumers with safe and wholesome products. Efficient production of any dairy product also depends on the careful selection of refrigeration equipment. The use of appropriate refrigeration system provides optimum cooling power and the required temperature range at all times.

With all these technologies in use, the per capita availability of milk in India has more than doubled to about 340 grams per day today, which is more than the world average, thus representing a sustained growth in availability of milk and milk products for the young population of our country. The success of the dairy industry has resulted from the integrated co-operative system of milk collection, transportation, processing and distribution.

Modern dairy industry is highly technological and the demands for temperature control throughout the value chain are rigid. In dairy production, end products such as milk, yoghurt and ice cream require precise temperature management to achieve a consistent quality in a safe and efficient way. Continuous and ubiquitous refrigeration is necessary throughout the perishable food chain, from production to consumers

Introduction of modern equipment in the HVAC&R industry will definitely play a vital role in the years to come, not just for the dairy industry but for the entire food industry. Look forward to meeting and interacting with the manufacturers at the exhibition.

Do send in your comments to me at pravita@charypublications.in.

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1	Wet Bulb Temperature	29°C	29°C
2	Chilled Water Temp in °C (Assumed)	5°C	5°C
3	Supply Temp. from CT / LTMCS	33°C	30°C
4	Approach to WBT	4°C	1°C
5	**ΔT for Chiller**	**28°C**	**25°C**
6	Chilled Water Compressor Motor Kw for 1200 TR	720	643
7	Energy Saved in %	-	10.7%
8	**Energy Saved in Kw**	**-**	**77 Kw/Hr**
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Daikin Announces Lower GWP Refrigerant R-407H

Daikin America, a subsidiary of Daikin Industries, Ltd, announces the availability of R-407H refrigerant for R&D and test marketing samples in the United States. Samples are intended for refrigeration contractors and distributors working on supermarkets, grocery stores, walk in coolers and freezers and mini grocers. Samples are applicable to OEM systems and R-404A and R-22 retrofits.

Daikin R-407H has been submitted for approval to the EPA SNAP Program as a replacement for the legacy ozone depleting refrigerant R-22, and high GWP refrigerants, such as R-404A and R-507A, which are widely used today for supermarket, warehouse, and marine vessel refrigeration equipment. "Due to increased regulations, high GWP and ozone depleting refrigerants, such as R-22, are being phased out.

Daikin's 407H was developed to comply with global regulations while allowing for simple and economical retrofits. Additionally, Daikin's 407H proven track record and efficiency is uniquely positioned to achieve EPA's GWP targets," stated Jim McAliney, EVP-Sales & Marketing, Daikin America. Daikin's non-ozone depleting, GWP 1495, non-flammable, refrigerant R-407H compares favorably to R-404A which is commonly used today. R-407H has been classified by ASHRAE as safety group A1, and is compatible with common POE oils. Performance details, test results, case studies and compatibility information are available upon request. ■

FETA Announces Leadership Changes

The Federation of Environmental Trade Associations (FETA) has announced changes to its senior positions, with Graham Wright standing down as FETA Chairman, and the British Refrigeration Association (BRA) President John Smith taking over the role.

John is Technical Director for the Beijer Ref UK & Ireland group of companies and has been chairing the Equipment & Components section of the BRA since 2014. He has spent last 29 years working predominantly in wholesaling for Dean & Wood and for electronic controls manufacturers such as Danfoss, JTL and Honeywell.

John Smith (left) and Graham Wright (right)

Graham Wright also handed over his role as HEVAC President, with this position being filled by Nick Howlett. Nick is Managing Director of Titon Ventilation Systems and a Director of Titon Holdings plc. He was instrumental in creating Titon's mechanical ventilation division in 2005. ■

Carrier to Provide VRF Units for Haiyue Square in Xi'an

Carrier China has been awarded a contract to supply more than 300 variable refrigerant flow (VRF) units to Haiyue Square, a new shopping, recreation and business center in Xi'an slated to be completed by the end of 2017. This contract demonstrates Carrier's commitment to providing customized technology and energy-efficient solutions to high-level commercial buildings. Carrier China, which includes Carrier Air Conditioning Sales Service (Shanghai) Co, Ltd, is a part of Carrier, a world leader in high-technology heating, air-conditioning and refrigeration solutions, a part of UTC Climate, Controls & Security, a unit of United Technologies Corp.

Carrier China will provide Haiyue Square more than 300 VRF units that operate about 25 to 45 percent above the national efficiency standard. The dual-rotor DC variable-speed compressor contributes to a power savings of 30 percent while delivering superior operational stability. The world-class performance and quality makes Carrier VRF units an ideal choice to satisfy Haiyue Square's requirements for energy efficiency and comfort.

"Improving energy efficiency is of significant importance when constructing commercial and residential buildings. We are pleased that our VRF solutions are helping Haiyue Square and other construction projects in China take a further step toward environmental responsibility," said Yinghua Zhu, light commercial sales director, Carrier China, "Our broad portfolio of solutions, combined with in-depth expertise and capability, means that we can better understand the needs of our end users and deliver fully integrated solutions to our customers."

Haiyue Square is located in the Xi'an Economic and Technological Development Zone, the core administrative center in Xi'an. The Square will include an A-Level office building and a five-star hotel. Upon completion, it is expected to be one of the largest and most comprehensive urban complex projects in the Xi'an Economic and Technological Development Zone and will become another popular landmark for shopping, recreation and business. ■

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Emerson to Launch $100 mn Renovation Project in Sidney

Building on its long-standing commitment to west-central Ohio and to advance its global leadership in the heating and cooling industry, Emerson announced plans for a major renovation and expansion of the labs and offices at its existing one-million-square-foot facility in Sidney, Ohio. The project is expected to require $100 million in investments over the next four years. Renovation will include building a two-story office addition onto the current facility and converting existing space to new and expanded

engineering laboratories. With a focus on creating an environment to attract tomorrow's engineers, scientists and industry leaders, the renovated facility will facilitate cross-functional collaboration and provide an efficient, modern workplace. A highlight of the project will be an upgraded, cutting-edge lab space to conduct advanced performance and refrigerant testing with its compressors and related products. "Emerson is committed to growing our global leadership position in the heating and cooling industry. To do that we need best-in-class facilities that provide our current employees a cutting-edge space to continue their critical work—and that help us attract the next generation of engineers and scientists," said Bob Sharp, Executive President for Emerson's Commercial and Residential Solutions business. ■

Airedale Appoints Wisely

Global air conditioning manufacturer Airedale has strengthened its management team with the appointment of Duncan Wisely as Business Development Manager for the Artus™ Hybrid Low Energy Fan Coil Unit (FCU).

The appointment follows the forthcoming launch of Artus™, a revolutionary, award-winning, hybrid air conditioning system designed to save energy, money and space. Artus™ was born in partnership with Arup, and is a hybrid low-energy fan coil that combines the flexibility of a fan coil unit with the low energy consumption of a chilled beam.

Recently, selected as a winner in the Ecobuild and M&S 'Big Innovation Pitch' Artus™ addresses current ceiling based AC challenges; it provides FCU performance and flexibility, with the low energy consumption of a chilled beam, enhancing office comfort via swirl air distribution, eliminating unwanted draughts.

Duncan's remit includes the commercial launch of Artus™ developing new routes to market and key account management to architects, developers, consultants and contractors. Commenting

on his new role, Duncan said, "My new role within Airedale is to promote and sell the Artus™ unit. Having been involved with the unit in my previous employment, I am very excited to have the opportunity to promote this award-winning unit and really make a difference to the air conditioning of the future." ■

Canada Committed to Improving Building Efficiency

The Government of Canada is committed to making federal buildings more energy efficient and reducing greenhouse gas emissions. Following a successful pilot project, Public Services and Procurement Canada (PSPC) is now implementing the Smart Buildings initiative in up to 100 buildings across Canada through a phased approach over the next three years. Smart Buildings is a technology that improves the way the government monitors and controls mechanical, heating, cooling and lighting systems in federal buildings across the country to increase the efficiency of these systems. Currently, installed in 13 buildings in the National Capital Region, the Smart Buildings technology has resulted in energy savings of up to 17%, which translates into savings of approximately USD 1,000,000 annually. Once installed, the technology collects raw data from mechanical or electrical systems, analyzes it and uses the results to detect inefficiencies that can be solved right away.

PSPC has put in place a National Standing Offer, which includes two companies, to support the ongoing implementation of the Smart Buildings technology in federal buildings. Through the Smart Buildings initiative, the government is reinforcing its commitment to improve energy performance management of federal buildings, which will result in reducing its environmental footprint and lowering energy costs. The National Research Council of Canada (NRC) is providing PSPC with expert advice on green building technology for this and other initiatives. Since 2015, energy saved by smart buildings is equivalent to 128 vehicles taken off the road and 496 acres of forests saved. ■

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Vilter Celebrates 150th Anniversary

Vilter Manufacturing has marked its 150th year in business. Emerson acquired Vilter in 2009, enabling further growth and an increased presence within the industrial refrigeration and gas compression industries that Vilter had been building on since its inception in 1867.

Over the past 150 years, Vilter has contributed to some of the industry's most significant advancements, which recently included: building a 7,000-pound ammonia test lab in 2012; developing the 401 mm line, the largest single-screw compressor, in 2013; and the development of a high-suction pressure solution that can handle suction pressures up to 750 psi.

"Vilter has kept equipment, maintenance and energy costs at the foundation of development and innovation throughout our history," said Tom Hoopes, Business Development Director, Emerson's Commercial and Residential Solutions platform. "With increasing regulations prompting a shift toward sustainable alternative refrigerants such as CO2, our business is focused on maintaining that lower total cost of ownership while addressing the needs of our customers to lower the charge of ammonia systems and in some cases, even remove ammonia out of occupied spaces."

To address those needs, Vilter has developed systems that utilize CO2 as a volatile secondary fluid, cascade systems that use CO2 in the low stage and a CO2 transcritical booster system. As a natural refrigerant with near zero global warming potential, CO2 is becoming a preferred option for retailers seeking to meet sustainability goals and achieve regulatory compliance. ■

Elanpro Flexi Drawer: A Fresh Approach to Refrigeration

Reiterating its commitment to provide innovative solutions for food preservation, Elanpro, India's leading commercial refrigeration company, included flexi drawer to its product portfolio. A professional range of integrated refrigeration drawers with variable temperature option, Elanpro Flexi Drawer is a fridge and freezer model that fits underneath countertop in place of cabinet.

Flexi Drawers preserves the cold air providing unrivalled temperature control for the food items. With no visible grilles or hinges, the product seamlessly merges with the décor and provides convenient storage solutions. Elanpro Flexi Drawers can be used in restaurants, hotels, ice cream parlours, stand-alone units and food vans. A suitable product for refurbishment, these drawers do not allow condensation or dehydration of food products. This drawer allows users switch the drawer from fridge to freezer at the push of a button. The product is equipped with LED temperature display and upgraded refrigeration system that enhances temperature control and cuts food wastage. The new offering uses eco-friendly hydrocarbon refrigerant, R290, which has a GWP of just three. It also features 'green' polyurethane insulation, which has an ODP (Ozone Depletion Potential) of zero. The product us ergonomically safe while delivering excellent energy efficiency. It is a customizable refrigeration option available in 2- 6 drawer variations with a maximum pan depth of 700mm. Standard features include hot gas defrost, flush door handle, Hi/Lo audio visual temperature alarm, a waste heat recovery condensate vaporiser and a system to protect the compressor from blocked condensers. The refrigeration system is designed to operate effectively even in ambient temperatures up to 40°C. Product efficiency is further enhanced by a variety of options, including a worktop and the ability to stack units. An individually refrigerated, drawer storage solution for the modern commercial kitchens, Elanpro Flexi Drawer ensures food is maintained in the best possible condition. ■

Eurammon Symposium 2017 Held in Switzerland

The eurammon Symposium 2017 was held in Schaffhausen (Switzerland) on 22 and 23 June 2017. The speakers gave altogether ten lectures on current trends and developments in refrigeration and air-conditioning technology, with a special emphasis on 'Small Applications < 200 kW with Natural Refrigerants.' As in previous years, the lecture event was fully booked with about 70 participants from 16 countries. "The European F-Gases Regulation and the Kigali agreement have brought natural refrigerants more than ever into the focus of the refrigeration and air-conditioning industry," explained Bernd Kaltenbrunner, Chairman of eurammon.

"The growing demand for the classic large applications is currently also accompanied by a trend to using natural refrigerants in smaller plants with capacity of less than 200 kW – not just in refrigeration plants but also in heat pumps and air-conditioning systems," said Kaltenbrunner.

The eurammon Symposium 2017 was held in the picturesque Klostergut Paradies in Schlatt near Zurich in Switzerland.

Besides legal framework conditions and safety aspects, the key symposium topic also illustrated pioneering application examples. A special emphasis was placed on small applications with hydrocarbons such as propane. The first day of the symposium looked at the environmental and safety requirements that have to be met by refrigeration and air-conditioning technology with natural refrigerants. Attention on the second day turned to specific reference projects which were the subject of intensive discussions about relevant parameters such as plant design, component selection and operating costs. ■

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A-Gas Buys Dutch Reclamation Business

A-Gas has acquired the Dutch reclamation business BTC and will be investing several million Euros in the operation to strengthen its offering to customers across Europe. The deal was completed and will result in A-Gas increasing its capacity to handle, clean and return waste gases to the market for resale. A-Gas UK & EU Managing Director John Ormerod said, "BTC are specialists in the reclamation and disposal of special gases, refrigerants and fire suppressants which can often be a complex and difficult process. It's a very good fit for us as reclamation and disposal of gases is a key part of our business at Portbury near Bristol.


A-Gas UK & EU Managing Director John Ormerod

"One of the aspects of BTC which attracted us to the deal was the entrepreneurial culture within the company and this fits well with us. This is our first acquisition in Continental Europe and we will put in place a significant investment programme to enhance the recycling and reclamation capabilities at BTC."

A-Gas is planning to add to the workforce and invest in new equipment. In recent years A-Gas has invested heavily in the reclamation and recovery side of its operation and this has been reflected by the development and installation of a new gas separator onsite in Portbury – bringing the total to three – and the launch of the A-Gas Rapid Recovery business in the UK. This purchase of BTC highlights the commitment of A-Gas to providing the industry with the capacity and infrastructure to support the F-Gas phasedown. The demand for the recovery and reclamation of mixed refrigerants from customers across Europe is growing. ■

BTO Investing $ 15.8 mn in Projects

The Building Technologies Office (BTO) announced it is investing up to $15.8 million in 13 projects that will drive innovation in early-stage research and development for advanced building technologies and systems that will serve as a foundation for future technological developments and reductions in building energy consumption. The outcomes and advancements of these selected technologies will ultimately result in improving the efficiency of our nation's buildings and will help American consumers and businesses save energy and money on their utility bills.

"Technological innovations enable energy efficiency advances in the buildings sector, providing a tremendous opportunity to reduce energy waste and costs – boosting the competitiveness of US companies and easing energy bills for American families," said David Nemtzow, Director of the Building Technologies Office. "As buildings account for 40% of the energy consumption in the United States, these efficiency innovations allow us to further improve upon past progress."

The BENEFIT FOA awards this year span the building technology innovation spectrum, from novel materials exploration that will lead to more efficient insulation and windows, as well as more accurate sensors, to exploration and validation of both electric- and fuel-driven hybrid vapor compression technologies for more efficient heating, ventilation, air conditioning, and refrigeration (HVAC&R), as well as advanced control algorithms, modeling, and analytics for reducing the power consumption of miscellaneous electric loads (MELs). ■

Transicold Secures Top Slot in Carrier Safe Awards

Cambuslang-based Carrier Transicold Glasgow has secured the top spot in the 2017 Carrier Safe awards for the first time, scoring 98 per cent in Carrier's independent health and safety programme. Carrier Transicold, which operates in the UK as Carrier Transicold (UK) Limited, is a part of UTC Climate, Controls & Security, unit of United Technologies Corp.

Created in 2011 in collaboration with the Engineering Employers' Federation (EEF), the Carrier Safe programme was developed to promote high environmental, health and safety (EH&S) standards across Carrier Transicold's network of service partners operating in 22 key locations across the UK.

All network service partners are audited annually with the highest scoring firm rewarded with the opportunity to conduct further training with the EEF.

"Winning this award is recognition for the incredible effort our team puts in to ensure health and safety practices are strictly followed across the business every day," said David Hogg, managing partner, Carrier Transicold Glasgow. "This accolade demonstrates to our customers that our professional approach always places compliance and the safety of our employees at the forefront of what we do, which, in turn, helps us deliver the best service possible."

Carrier Transicold Eastern's Ipswich and Carrier Transicold Manchester service centres were jointly awarded second place, each scoring 95 per cent. The stringent 172-point independent judging criteria allows network service partners to continually evaluate their performance and identify any areas in need of improvement in order to develop an action plan to help maintain consistently high EH&S standards.

"Safety can't be taken for granted so it's important to us, as a manufacturer, to ensure that our customers are supported by skilled engineers who always adhere to a strict safety code," said Scott Dargan, managing director, Carrier Transicold Northern Europe and Service EMEAR. "Since Carrier Safe began, we've seen a real commitment from our network service partners – scoring an average of 92 per cent across our network this year." ■

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The Emerson Cup continues on this momentous journey of excellence, firmly focused on its objective - to promote deserving talent and create a healthier, friendlier planet for all.

This year The Emerson Cup is on **October 6th** at **Jaipur.**

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Joanna Robinson Elected as Chair of BESA Ventilation Group

Joanna Robinson has been elected as the new chair of the Building Engineering Services Association (BESA) Ventilation Group. The Association said this was a key appointment at an "exciting and challenging time for the ventilation sector". The managing director of Bradford-based Mansfield Pollard was also described as a "fantastic role model for women in building engineering" by BESA chief executive Paul McLaughlin. BESA is the UK's leading trade organisation for building engineering services contractors – representing the interests of firms' active in the design, installation, commissioning, maintenance, control and management of engineering systems and services in buildings. Its members are enjoying a growing reputation because the role the built environment plays in improving the health, safety, well-being and productivity of people is becoming better understood and more widely recognised. "We are delighted that Joanna has agreed to take on this important role for the Association. She is a fantastic role model for women in our profession," said McLaughlin.


Joanna Robinson

"We are doing some very important work in the area of indoor air quality (IAQ) as we strive to make buildings 'safe havens' that protect people from worsening levels of outdoor pollution. Joanna has extremely valuable expertise in this area to share with fellow members and the industry at large." Robinson said she would also be using her time as chair to promote women in engineering and share her knowledge and experience with other industry professionals. ■

EPEE Appoints Stefan Thie as Technical Consultant

The European Partnership for Energy and the Environment (EPEE), representing the refrigeration, air-conditioning and heat pump industry in Europe, is pleased to announce the appointment of Stefan Thie as the Technical Consultant for the association.Stefan Thie's main task will be to provide technical support to the Secretariat on all HVACR matters. He will also contribute, from a technical perspective, to the longer term vision of the association, and represent EPEE at external events if required. His will mostly work on Ecodesign but will also cover energy efficiency, F-gas, and any other technical issues that are critical for the association. Andrea Voigt, EPEE Director General, said, "EPEE has grown quite substantially over the past years. Today, we have nearly 50 members and cover a broad range of topics with a very strong focus on energy efficiency. Extending our team has therefore become a necessity as in this fast evolving context, where energy is a top priority, it is more important than ever to combine political intelligence with in-depth technical expertise. We are delighted to welcome Stefan, who will provide great added value to our association. He combines broad technical knowledge with more than 20 years of experience in the HVACR sector." Following his appointment, Stefan Thie said, "Being as passionate as I am about the HVACR sector, the possibility to work with EPEE is a great opportunity. I look forward to working with the EPEE team and the EPEE family, helping to bridge between the technical world and the EU policy context wherever necessary." ■


Stefan Thie

BES Promotes Jonathan Morton to Engineering Director

Cleanroom and laboratory design and construction firm, Boulting Environmental Services (BES) has promoted Jonathan Morton to the position of engineering director. His appointment strengthens the company's management structure at a time of high growth and demonstrates our commitment to career development for our staff.

Jonathan has 30 years of industry experience including 20 years in the life science market. He started his career as an apprentice, obtaining an OND and HNC in Building Services Engineering before completing his degree in the same subject.

The new director has been with the company since 2004, when he joined as a senior HVAC designer. In 2009, Jonathan progressed to the role of project manager, where he delivered many successful projects for blue chip pharmaceutical clients. More recently, he was promoted to the role of design manager for a multi service term contract for a major client, where he excelled in leadership and management.


Jonathan Morton

"I joined BES in 2004, when the company was made up of just nine people," explained Morton. "The company is now 120 strong and I'm excited to be involved in helping the company to growth further and reach new heights. There are fantastic opportunities for progression at BES and my promotion is testament to the company's commitment to career development and internal promotion. Apprentices and junior designers at the company can move up and across into new roles and build successful careers." ■

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Bitzer Condensing Units Win HVACR Trust Award

Bitzer couldn't be happier about the confirmation of customer trust with its condensing units, the company won the 2017 HVACR Trust Award (Vertrauenspreis der LüKK) in the condensing units category.The HVACR Trust Award of specialist publishing house cci Dialog GmbH was presented in June for the first time. What makes the award so unique is the fact that customers assume the role of jury, evaluating the participating manufacturers and products. Relevant criteria included the quality of the technology, the advice and the service.

A total of 14 categories were evaluated using the German school grading system, with '1' representing the best grade. Bitzer's condensing units performed very well, achieving an impressive average grade of 1.69 and thus first place. The overall average in this category was 2.13 in the competition.

Rainer Pelzl, Head of Technical Sales for Germany and Switzerland at Bitzer, accepted the award. "What makes this award so special to us is that it was customers rather than a specialist jury who selected the winners," he says. "Contractors, specialist planners, consultants and end users of refrigeration systems have thus expressed the fact that they trust Bitzer and recommend our products to others."

The latest condensing units Bitzer has developed include the ECOSTAR LHV5E and LHV7E series. These two air-cooled and particularly energy-efficient condensing units offer intelligent technology for efficient capacity: the specific regulator, the system-optimised mini-channel condenser and infinitely adjustable operation of the integrated, speed controlled ECOLINE VARISPEED reciprocating compressors and EC fans facilitate future-oriented planning. The ECOSTAR condensing units are therefore optimally prepared for the F-gas Regulation and the Ecodesign Directive. They also promote user safety even in extreme operating conditions: ECOSTAR condensing units are used in a whole host of climates and application ranges. Reliable, low noise operation, simple installation, ease of use and low maintenance are further distinguishing features of the LHV5E and LHV7E models.

The next HVACR trust award is planned for 2019.Rainer Pelzl, Head of Technical Sales for Germany and Switzerland, accepted the award. ■

USGBC Recognizes California State Leaders with Green Hard Hats

USGBC recently recognized the achievements of two of California's state leaders who are driving forward California's vision of healthy, efficient and high-performing buildings at USGBC's annual Green Hard Hat Awards event in Sacramento. 2012 awardee Senator Nancy Skinner kicked off the event with enthusiastic remarks about the two new awardees and about USGBC. State Senator Scott Wiener and Commissioner Andrew McAllister of the California Energy Commission were awarded the USGBC Green Hard Hat in recognition of their transformational leadership in creating a more sustainable California. "We're immensely proud to be working with such influential and passionate people, especially Senator Wiener and Commissioner McAllister," said BrendenMcEneaney, Pacific regional Director at USGBC. "California has led the charge at the state level, and we'll continue working with these leaders to deliver sustainable, healthy communities for all Californians."

Senator Wiener served as county supervisor in San Francisco before being elected to the state senate in 2016, but has taken up the mantle with full force, authoring several bills that promote more efficient use of water and energy in buildings, as well as making way for more affordable housing.

State Senator Scott Wiener and Commissioner Andrew McAllister of the California Energy Commission were awarded the USGBC Green Hard Hat.

USGBC is thankful for the senator's outstanding leadership on these issues on behalf of his district, covering the city and county of San Francisco (a global leader in green building policy and planning). Commissioner McAllister has been leading many of the energy efficiency and clean energy efforts at the California Energy Commission since 2012. He administered two of California's signature renewable energy programs and has overseen important research and state programs to unlock the potential of energy efficiency. McAllister carefully pursues the climate nexus of the energy programs and research he oversees, including recognizing the important potential of green buildings as a key part of the solution. ■

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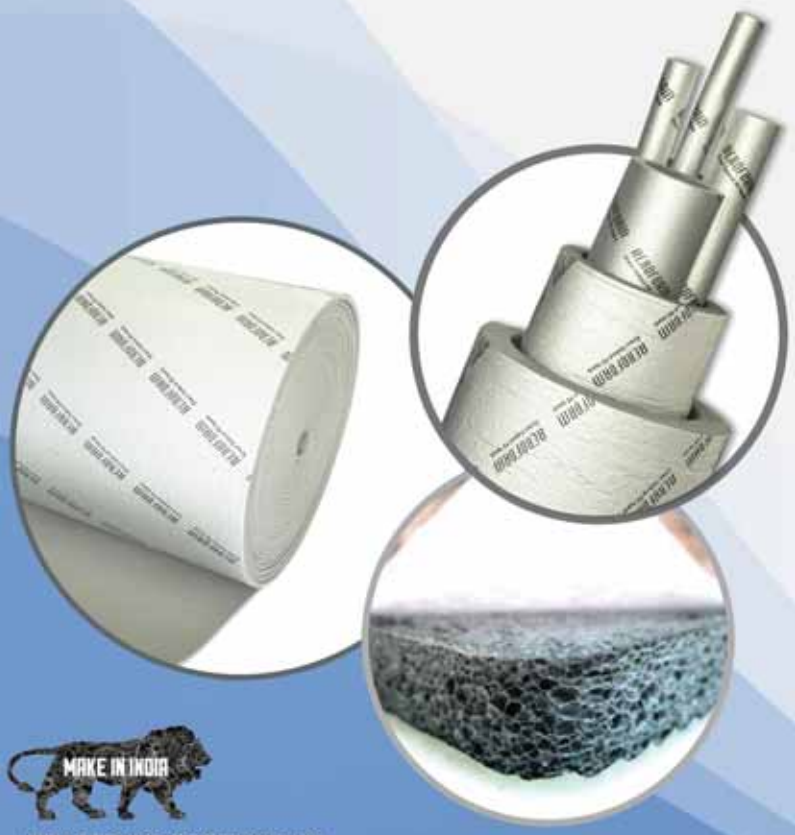

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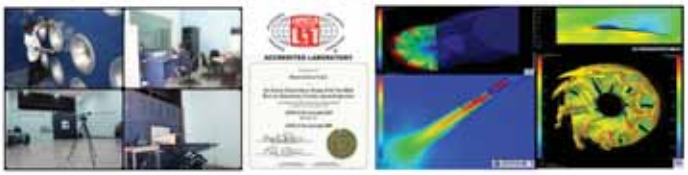

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Refrigerant Market worth USD 18.05 Billion by 2022

Rising end-use applications such as refrigerants, large-scale refrigerators, chillers, air conditioners, and heat pumps are driving the market for refrigerants....

Refrigerant Market by type (HCFC, HFC, HFO, Isobutane, Propane, Ammonia, and CO_2), Application (Refrigerators, Large-scale Refrigerators, Chillers, Air Conditioners, and Heat Pumps), Region - Global Forecast to 2022, published by MarketsandMarkets(TM), the global market was estimated at USD 14.49 Billion in 2017 and is projected to reach USD 18.05 Billion by 2022, at a CAGR of 4.5%.

Rising end-use applications such as refrigerants, large-scale refrigerators, chillers, air conditioners, and heat pumps are driving the market for refrigerants. Along with these, the growing demand for consumer appliances and the cold chain market are also driving the market.

Air conditioners application accounted for the largest share in 2016. The air conditioners segment is projected to be the largest market for refrigerants from 2017 to 2022, owing to its rapid growth in the Asia-Pacific. Factors such as rising disposable incomes; rising living standards; flexible government taxation policies; rapid technological advancements in products & product offerings, by major international and domestic players, at competitive prices; are a few of the major factors driving the market for the air conditioners application. These factors, along with upcoming infrastructure projects on transport networks, institutional sites, and residential projects are also expected to drive the refrigerants market in the air conditioner application. Hydrocarbons are expected to be the fastest growing segment in the refrigerants market.

The main reason for the high demand for hydrocarbons can be attributed to the increasing consumption of refrigeration and AC equipment, which are its largest applications. Additionally, the demand for fluorocarbon refrigerants is expected to decline in the near future mainly due to the required 100% phase-out of HCFC by 2040 and 85% phase-out of HFC by 2047, which is expected to lead to an increase in the demand for alternative refrigerants. Thus, the growth of inorganics and hydrocarbons is expected to remain high between 2017 and 2022.Asia-Pacific was the largest refrigerants market in 2016. The Asia-Pacific is projected to be the largest market for refrigerants from 2017 to 2022. Factors contributing to market growth in this region are the rise in demand for consumer appliances in emerging countries, growing urbanization, and the growing cold chain market. These factors, along with upcoming infrastructure projects in energy, transport networks, institutional sites, and residential projects are expected to drive the Refrigerant Market across various applications in the region. Large-scale investments along with the increasing standards of living provide opportunities for infrastructure developments that are expected to lead to the high growth of the refrigerants market.

The global refrigerants market has a large number of market players; however the market is led by some of the major players, such as The Chemours Company (U.S.), Honeywell International Inc. (U.S.), Arkema S.A. (France), Dongyue Group Co. Ltd (China), Asahi Glass Co., Ltd. (Japan), Daikin Industries Ltd. (Japan), Sinochem Corporation (China), Mexichem S.A.B. de C.V. (Mexico), The Linde Group (Germany), and SRF Ltd. (India), among others. ■

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Ultra Efficient Desiccant Based Evaporative Cooling for AC

DEVap system, developed by NREL (National Renewable Energy Laboratory) is designed to address the inefficiencies in present day less energy intensive air-conditioning systems. This article informs about DEVap, its working principle and evaluation and limitations and advantages...

Air-conditioning system is the major energy juggler in energy juggler when compared with other energy consuming components in the building. It contributes approximately 40 – 60% of overall energy consumed in facility. In present market, there are systems available, which are of less energy intensive when compared with active vapor compression (and vapor absorption systems, like conventional evaporative coolers, EAT (Earth Air Tunnel) etc. Limitations with respect to evaporative coolers (direct and indirect type) are that, fundamentally these are limited by the moisture content in the air. Alone, these coolers can achieve temperatures that approach the dew point of the ambient air without adding humidity; however, they cannot dehumidify. Thereby, it is suitable for arid and semi-arid climates. Whereas, EAT is complex in execution, could not control the humidity and it requires additional active cooling systems to achieve the thermal comfort year round (Refer Figure 1).

DEVap system, developed by NREL (National Renewable Energy Laboratory) is designed to address the inefficiencies mentioned above in present day less energy intensive air- conditioning systems. This article informs about DEVap, its working principle and evaluation and limitations and advantages.

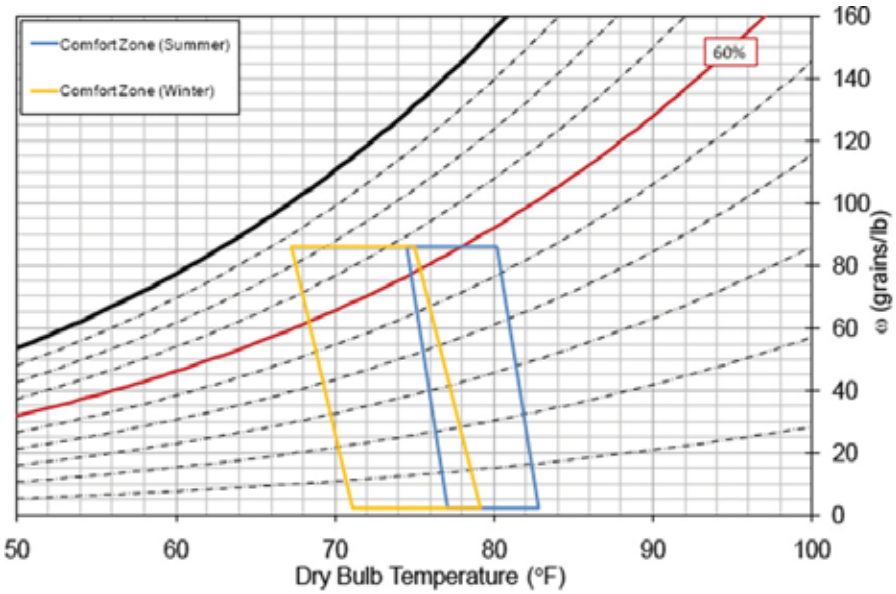

Figure 1: Human Comfort Zone

DEVap Introduction

DEVap is a concept of desiccant enhanced evaporative air conditioner (DEVap) with the objective of combining the benefits of liquid desiccant and evaporative cooling technologies into an innovative 'cooling core.' Liquid desiccant technologies have extraordinary dehumidification potential, but require an efficient cooling sink. Direct combining of desiccant driven dehumidification and indirect evaporative cooling technologies is customary, but it leads to too large and complex system. DEVap attempts to clear this hurdle and combine, in a single cooling core, evaporative and desiccant cooling. DEVap's crucial advantage is the intimate thermal contact between the dehumidification and the cooling heat sink, which makes dehumidification many times more potent. This design uses membrane technology to contain liquid desiccant and water.

When used to contain liquid desiccant, it eliminates desiccant entrainment into the airstream. When used to contain water, it eliminates wet surfaces, prevents bacterial growth and mineral buildup, and avoids cooling core degradation.

DEVap's thermodynamic potential overcomes many shortcomings of standard refrigeration- based direct expansion cooling. DEVap decouples cooling and dehumidification performance, which results in independent temperature and humidity control. The energy input is largely switched away from electricity to low-grade thermal energy that can be sourced from fuels such as natural gas, waste heat, solar, or biofuels. Thermal energy consumption correlates directly to the humidity level in the operating environment.

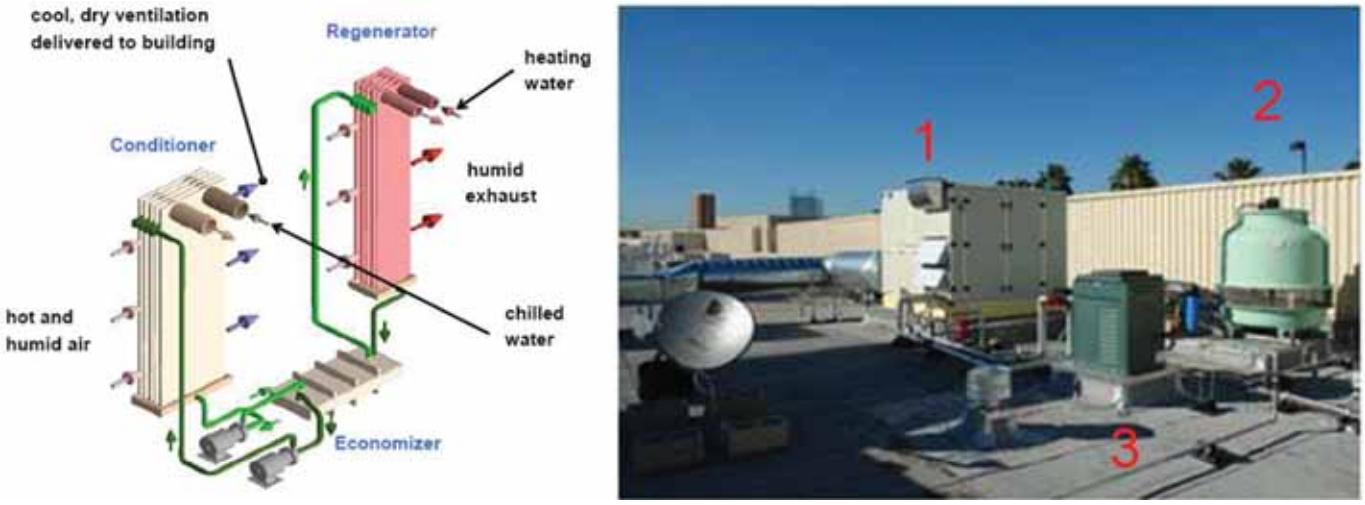

Figure 2: Major components and packaging of the AILR LDAC (Photograph shows packaged HMXs, water heater and cooling tower)
1: Packaged HMX; 2. Heater; 3. Cooling Tower

DEVap System Working

DEVap concept is an enhancement of LDAC (Liquid Desiccant Air Conditioner). LDAC technology uses novel heat and mass exchangers (HMXs) to perform dehumidification with desiccant and desiccant reactivation using desiccant conditioner and scavenging air regenerator (Refer Figure 2). The liquid desiccant is absorbed into the conditioner (absorber) where the inlet ambient air is dehumidified. The liquid desiccant is regenerated in the regenerator (desorber) where the water vapor desorbs into the EA stream. This technology is called low flow liquid desiccant A/C, because the desiccant flow is minimized in both HMXs to the flow rate needed to absorb the necessary moisture from the air stream. The HMXs must, therefore, have integral heating and cooling sources (55°–85°F cooling tower water is supplied to the conditioner). The regenerator uses hot water or hot steam at 160°–212°F. The cooling or heating water flows internal to the heat exchange plates shown. The desiccant flows on the external side of the HMX plates. The plates are flocked, which effectively spreads the desiccant. This creates direct contact surfaces between the air and desiccant flows. The air passes between the plates, which are spaced 0.25" apart.

Figure 3 provided below, illustrates the three basic ways to regenerate the desiccant system with a thermal source: solar, water heater, and a double effect. The water heater or boiler can be fueled by many sources, including natural gas, combined heat and power (CHP), or even biofuels.

The DEVap process follows (Refer Figure 4):

1. Ventilation air [1] and warm indoor air [2] are mixed into a single air stream.
2. This mixed air stream (now the product air) is drawn through the top channel in the heat exchange pair.
3. The product air stream is brought into intimate contact with the drying potential of the liquid desiccant [d] through a vapor-permeable membrane [e].
4. Dehumidification [ii] occurs as the desiccant absorbs water vapor from the product air.
5. The product air stream is cooled and dehumidified, then supplied to the building space [3].
6. A portion of the product air, which has had its dew point reduced (dehumidified), is drawn through the bottom channel of the heat exchange pair and acts as the secondary air stream.
7. The secondary air stream is brought into intimate contact with the water

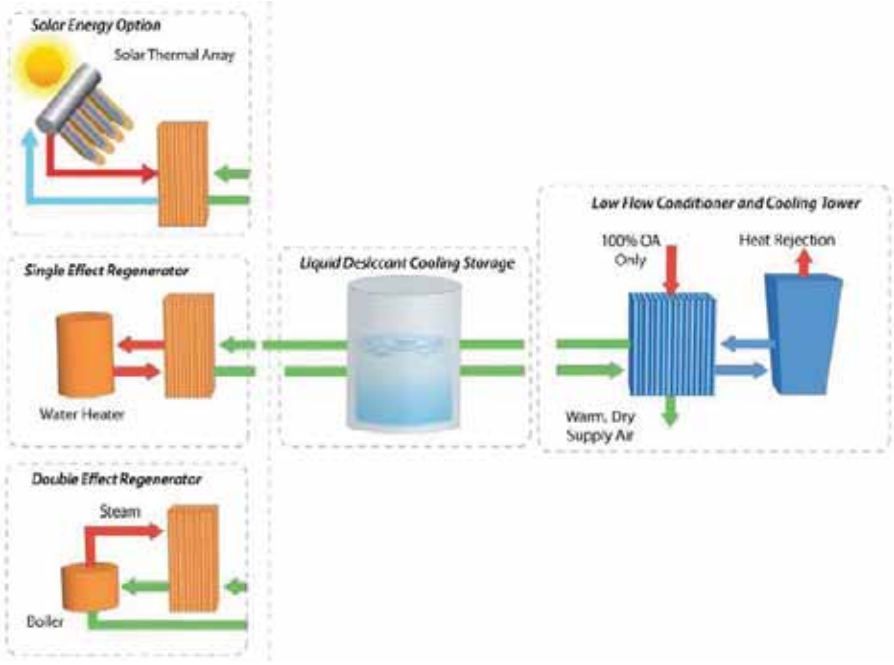

Figure 3: LDAC Schematic

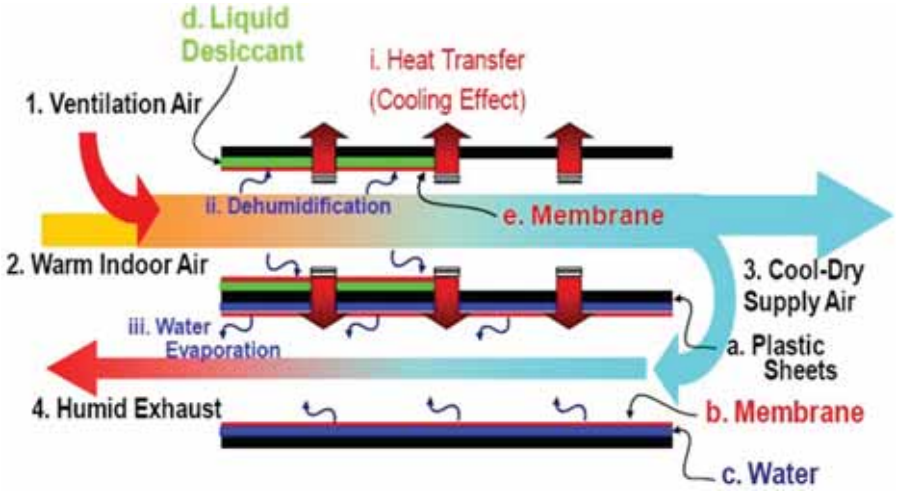

Figure 4: DEVap concept description

layer [c] through a vapor-permeable membrane [b].

8. The two air streams are structurally separated by thin plastic sheets [a] through which thermal energy flows, including the heat of absorption [i].
9. Water evaporates through the membranes and is transferred to the air stream [iii].
10. The secondary air stream is exhausted [4] to the outside as hot humid air.

The water-side membrane implementation of DEVap is part of the original concept, but is not a necessary component. Its advantages are:

- **Complete water containment:** It completely solves problems with sumps and water droplets entrained into the air stream.
- **Dry surfaces:** The surface of the membrane becomes a "dry to the touch" surface that is made completely of plastic and resists biological growth.

The water-side membrane may not be necessary in the DEVap configuration as wicked surfaces create successful evaporative coolers. Omitting this membrane would result in cost savings.

The desiccant-side membrane is necessary to guarantee complete containment of the desiccant droplets and create a closed circuit to prevent desiccant leaks. It should have the following properties:

- **Complete desiccant containment:** Breakthrough pressure (at which desiccant can be pushed through the micro-size pores) should be about 20 psi or greater.
- **Water vapor permeability:** The membrane should be thin (~25 μm) and have a pore size of about 0.1 μm. Its open area should exceed 70% to promote vapor transport.

The DEVap cooling core (Refer Figure 5) is an idealized implementation of the air flows. A higher performing air flow configuration (Refer Figure 6) shows the cooling device split into two distinct areas and depicts the air flow channels from the top vantage point. The mixed ventilation air and return air enter from the bottom and exit at the top. The location of the desiccant drying section is shown in green; the location of the evaporative post cooling is shown in blue. Using OA to cool the dehumidification section improves the design by enabling higher air flow rates to provide more cooling. Thus, the left half of the exhaust channel (Refer Figure 5) is replaced by an OA stream that flows into the page (Exhaust Airflow #1). The deep cooling of the indirect evaporative cooler section requires a dry cooling sink; thus, some dry supply air is siphoned off (5%–30% under maximum cooling load) to provide this exhaust air stream (Exhaust Airflow #2). This section is placed in a counterflow arrangement to maximize the use of this air stream. This is essential because it has been dried with desiccant, and thus, has a higher embodied energy than unconditioned air. The result is that

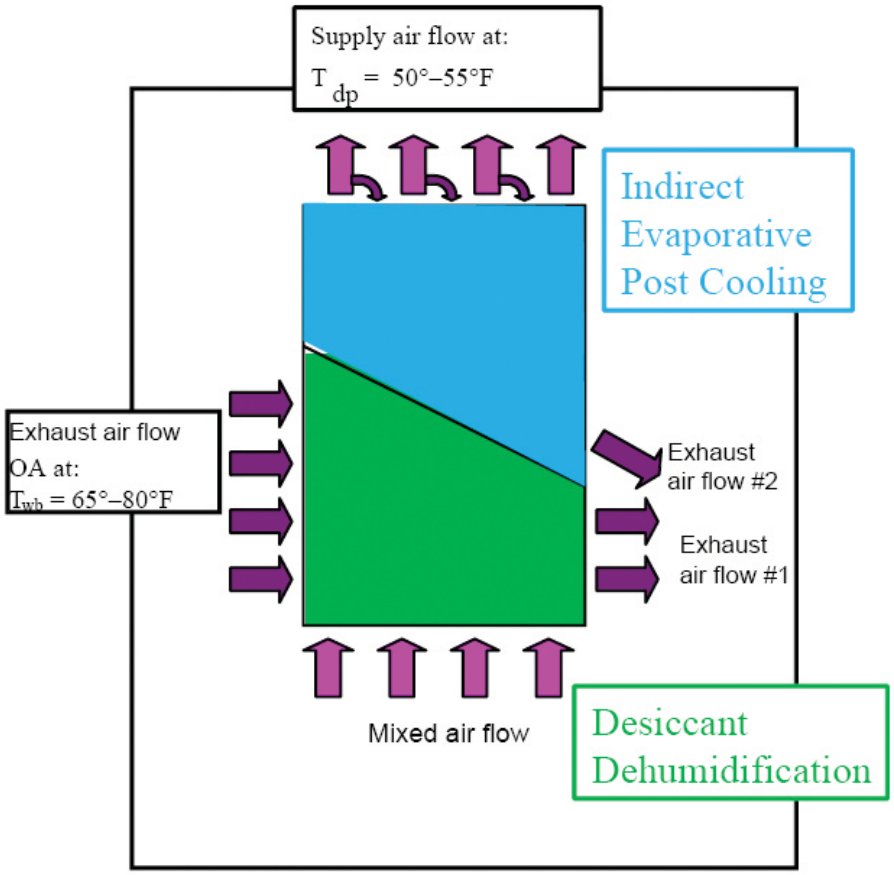

Figure 5: DEVap HMX air flows

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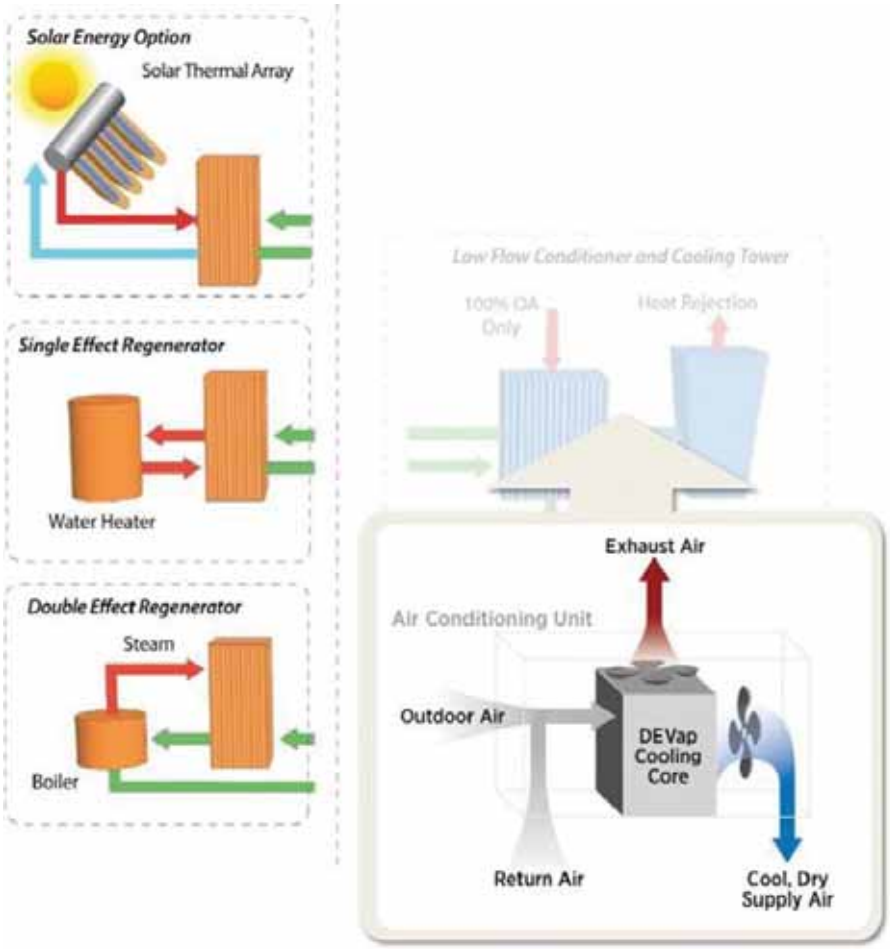

Figure 6: DEVap enhancement for LDAC

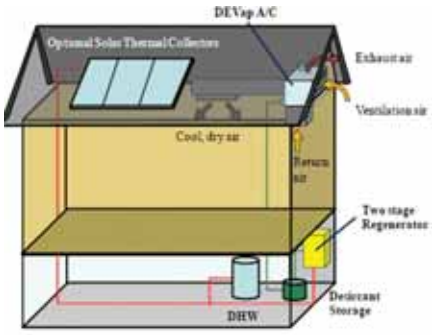

Figure 7: Example schematic for residential installation

the temperature of supply air is limited by its dew point and will come out between 55°–75°F depending on how much is siphoned off. Combined with the desiccant's variable drying ability, the DEVap A/C system controls sensible and latent cooling independently and thus has a variable SHR between <0 (latent cooling with some heating done) and 1.0.

The DEVap core is only half of a complete air conditioner. Figure 6 depicts how the DEVap cooling core enhances the already developed LDAC technology and

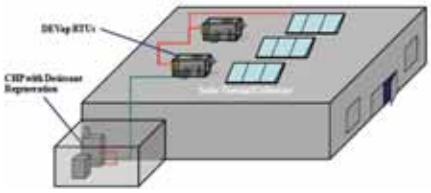

Figure 8: Example schematic for commercial installation with Packaged DEVap

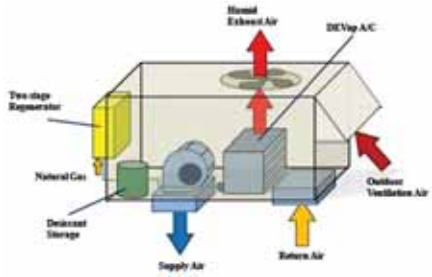

Figure 9: Packaged DEVap

converts it from a dedicated outdoor air system to an air conditioner that performs space temperature and humidity control and provides all the necessary ventilation air. In fact, DEVap can be configured to provide 30%– 100% ventilation air. Furthermore, DEVap does not require a cooling tower, which reduces its maintenance requirements.

Because the drying process creates sufficiently dry air, the evaporative process is no longer a function of climate. Therefore, DEVap will work in all climates.

Illustrations shown in figure 7 8 & 9 provide possible configuration of DEVap in different type of facilities,

Conclusion

DEVap is novel and disruptive, so bringing it into the entrenched conventional air conditioner market will create some market risk. Designing and installing a new DEVap system requires retraining. DEVap has unknown longevity and reliability compared to standard A/C. The availability of natural gas or other thermal energy sources may be an issue in certain places. However, DEVap does not require a large outdoor condenser, but instead uses a much smaller desiccant regenerator that can be placed inside or outside, and can be integrated with solar and waste heat. If these risks can be properly addressed, the DEVap air conditioner concept has strong potential to significantly reduce energy consumption and provide value to energy companies by reducing summer time electric power demand and resulting grid strain. Also, unlike most heating, ventilation, and air- conditioning systems, DEVap uses no environmentally harmful fluids, hydrofluorocarbons, or chlorofluorocarbons; instead, it uses water and concentrated salt water. ■

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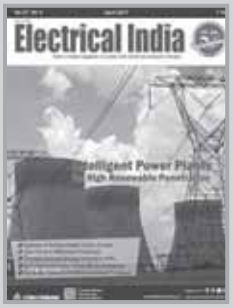
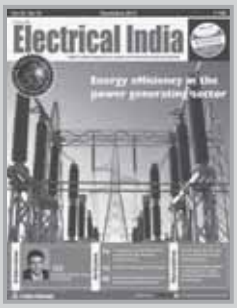
Ranga Vamshi
Energy Associate, GreenTree Building Energy Pvt Ltd, Noida





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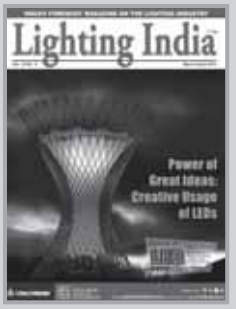

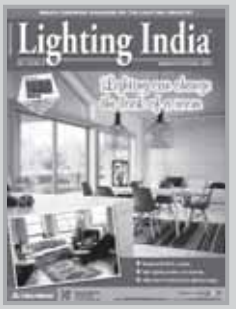

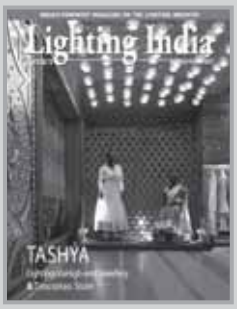

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Emerson's India Strikes A Hat-Trick

Emerson's winning streak continued at the Cold Chain Industry Summit 2017, Mumbai. The Digital Receiver Unit HLR was adjudged winner in the Best Refrigeration / Product of the Year category. It was the third win for Emerson this year, its earlier ones being at the ACREX Award of Excellence & the ASSOCHAM Award. With this win, Emerson has further cemented its position as the industry leader in offering innovative products and solutions for the HVACR (Heating, Ventilation, Air Conditioning & Refrigeration) industry.

Speaking on the occasion, Shirish Adi, vice president & managing director, India for Emerson's Commercial & Residential Solutions platform said "Our effort is to enhance food safety by offering transformational technology that protects the health of consumers while meeting our customer requirements of energy efficiency, reliability and value." He further added, "It is therefore a matter of immense pride for us to receive this honor, as it is recognition of our commitment towards bringing innovative solutions to our industry."

The award was presented at a grand ceremony at the Cold Chain Industry Summit 2017, Mumbai, that was organized to cover the challenges and showcase trends facing the temperature controlled supply chains in India and beyond.

Emerson offers the broadest, most reliable condensing unit product line. Leveraging the latest compressor technology, each platform provides the option to select the refrigerant, capacity, and application temperature combinations that meet customer requirements. Its award winning, Digital HLR is designed to meet the needs of Cold Storages, Quick Service Restaurants, and the Retail segment. Among its breakthrough features is its compact design that provides for a remote condenser and digital scroll™ technology, which combine to provide significant space and energy savings. ■

Cleaning Cleanrooms

Cleanroom cleaning requires many specialised products. This article addresses the importance of product selection and cleaning techniques in the pharmaceutical manufacturing environment...

Suitable disinfectants, such as this sterile spray, must be manufactured under clean conditions, with the quality assessed through appropriate manufacturing techniques and held in appropriate packaging

Pharmaceutical manufacturing takes place within a series of specially controlled environments – cleanrooms. On one level, a cleanroom or clean zone is simply an area that is clean in terms of both particle counts (as defined in the international cleanroom standard ISO14644) and microbial counts (as defined in a second cleanroom standard for bio contamination control, ISO14698.) In addition, regulatory requirements for cleanrooms are detailed by EU, GMP or the FDA guidelines. One important step towards achieving microbial control within a cleanroom is the use of defined cleaning techniques, together with the application of detergents and disinfectants. The detergents and disinfectants used in pharmaceutical grade cleanrooms need to be of a high quality and effective at killing micro-organisms. Both correct product selection and cleaning techniques are important, particularly, in relation to some of the newer cleanroom technologies.

Cleaning Agent Selection

The types of detergents and disinfectants used represent an important decision for the pharmaceutical manufacturer. There are various different types of disinfectant with different spectrums of activity and modes of action. Disinfectants have differing efficacies. Some are bacteriostatic, where the ability of the bacterial population to grow is halted. Here, the disinfectant can cause selective and reversible changes to cells by interacting with nucleic acids, inhibiting enzymes or permeating into the cell wall. Once the disinfectant is removed from contact with bacteria cells, the surviving bacterial population could potentially grow.

Other disinfectants are bactericidal in that they destroy bacterial cells through different mechanisms, including causing structural damage to the cell; autolysis; cell lysis and the leakage or coagulation of cytoplasm. Within these groupings the spectrum of activity varies, with some disinfectants being effective against vegetative Gram positive and Gram negative micro-organisms only, while others are effective against fungi. Some disinfectants are sporicidal in that they can cause the destruction of endospore forming bacteria.

Pharmaceutical manufacturers are

expected to use at least two disinfectants of different modes of activity in order to conform with current good manufacturing practices. The use of a sporicidal disinfectant is recommended for sterile areas on an occasional basis, even where such a disinfectant does not form part of the standard set. When selecting disinfectants, it is prudent to opt for manufacturers who offer a range of disinfectants of different modes of activity (which target and kill microbial cells in different ways).

For a disinfectant to work effectively, soil (such as grease and dust particles) must be removed first using a suitable cleanroom grade detergent. Detergents are, typically, either sterile, neutral solutions or have added cleaning chemicals, such as premium sterile non-ionic surfactants. When selecting a detergent a check should be made to determine that it is compatible with the disinfectant because some detergents, where there are residues, can neutralise the active ingredient in certain disinfectants. This can be overcome where detergents are purchased from the same manufacturer as the disinfectant.

It is important to understand the manufacturer of the disinfectant and to be assured that the cleaning agents purchased are of an appropriate quality. High quality disinfectants and detergents are manufactured under clean conditions with the quality assessed through appropriate manufacturing techniques and for the product to be held in appropriate packaging. With disinfectants, it is also important that the chemicals have been tested to the appropriate European standards.

Cleaning Techniques for Cleanrooms

The cleaning technique used for cleanrooms should be defined and standardised. It does not matter how effective the cleaning agents selected are if the cleaning technique practised by cleanroom operators is poor.

This relates partly to the techniques used and partly to the quality of the cleaning materials. With the techniques for the cleaning and disinfection of cleanroom floors, either the 'two-bucket' or the 'three-bucket' technique is recommended. Both of these techniques involve using a bucket of disinfectant and a bucket of water.

In the 'two-bucket' technique, there is a 'wringer' (for the mop) over the bucket of water. In the 'three-bucket' technique, there is a third bucket, empty except for having a wringer mounted over it. To illustrate this, the three-bucket technique involves:

1. Dipping the mop in disinfectant
2. Mopping the floor
3. Dipping the mop in the bucket of water
4. Rinsing the excess water off the mop head into the third (empty) bucket
5. Dipping the mop in disinfectant
6. Repeating

Such techniques do not achieve is the removal of disinfectant residue from the floors. To overcome this, the final stage in floor cleaning and disinfection is typically a rinse with sterile Water for Injection. For Grade A and B areas, careful consideration is required as any water used will need to be sterile.

Disinfectant should ideally be sprayed onto the surface rather than the wipe and left for the required contact time before wiping

Disinfectants can have different spectrums of activity and suitability: microbial filtered concentrated liquid, for example, is suitable for cleanroom surface disinfection

Use of Cleaning Products with New Cleanroom Technologies

In recent times there have been a number of advances in cleanroom technologies that have helped to reduce the risk of contamination and to streamline process operations. This includes the wider use of isolators and restricted access barrier systems (RABS), orientated towards the manufacturing of sterile products, particularly, aseptically filled products.

These 'clean air devices' are categorised as barrier technology and are situated inside cleanrooms. Isolators, by their design, are less prone to contamination than conventional cleanrooms. This protection is maintained by a barrier between the inside environment of the isolator (at Grade A) and the outside environment.

Some of the key criteria for the cleaning of cleanrooms and the appropriate use of disinfectants, detergents and cleaning apparatus in the pharmaceutical industry are elaborated. While selection of the right type of cleaning agent and materials is of utmost importance, controlled and careful cleaning techniques must be applied. This philosophy applies to both conventional cleanrooms and to the application of the more recent advanced cleanroom technologies.

The ultimate assessment of cleaning products and cleaning techniques is revealed through environmental monitoring programmes in terms of the numbers and types of micro-organisms recovered. Therefore, the construction of a cleanroom cleaning regime needs to be carefully planned and fit into an organisation's quality systems. To aid such decisions, important technical advice is provided by many of the leading manufacturers of cleaning products. ■

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M.E. Cryogenic
L. D. Engineering Ahmedabad
Zamil Air Conditioners India Pvt. Ltd. Ahmedabad

Star's Oldest Refrigeration Plant Still Going Strong

Star Refrigeration's oldest cooling plant might seem a relic from the past to the untrained eye, but the proud owners will tell you a different story. Built to last, each package consists of a single compressor, LPR, four way valve with patented reverse cycle defrost technology, an evaporator and twin circuit condenser...

The UK's largest industrial refrigeration engineering company Star Refrigeration is celebrating a long lasting relationship with its customer Associated Seafoods – after fitting its industrial cooling system in 1979. The plant has been running 24/7 with no cooling loss for almost 40 years, which is a huge achievement for both companies and a credit to Star's technology.

In 1979, Star Refrigeration provided the company with two refrigeration packages for their cold storage and production facilities located on the Moray Firth coast of Scotland, in Buckie. For Star Refrigeration, 1979 marks an era as this represents the oldest operational plant in Star's history. And to add a time perspective, here are a few things you might remember about that year: Margaret Thatcher was elected prime minister, Sony introduced the first 'Sony Walkman' and YMCA was in the UK music charts.

Star Refrigeration's oldest cooling plant might seem a relic from the past to the untrained eye, but the proud owners will tell you a different story. Built to last, each package consists of a single compressor, LPR, four way valve with patented reverse cycle defrost technology, an evaporator and twin circuit condenser. This industrial system is true Star quality through and through. "It's a great system, it still hits -25C in the cold store", says Roddy McDonald, Associated Seafoods Maintenance Manager in charge of routine checks to the system.

"I've been here for around 27 years, and the system was already in place when I started. It is always running – 24/7. We worked out that it's been running for 324,342hours non-stop" Roddy adds.

A leading supplier of some of the finest seafood caught right on its doorstep, Associated Seafoods has been in business since 1913. Experiencing steady growth over the years, the company now owns a specialist group of seafood companies comprising Moray Seafoods, Lossie Seafoods and GlenIsla Shellfish. The company is internationally recognised for the premium quality of their langoustines, prawns, crabs, scallops, shellfish, and the famous Scottish smoked salmon, The Pride of Scotland.

With such a long-standing relationship, the two companies have worked together effortlessly as they both grew substantially to become leaders in their respective markets. Calum McKenzie, said, "This is one of the first systems built using the low pressure receiver. During defrost, refrigerant flow is reversed, with hot gas flowing to the evaporator where the latent head of condensation is used to melt ice formation. This process has now been proven to be an exceptionally efficient way of defrosting and it is used in the most modern and energy-efficient refrigeration systems today."

The systems initially ran on ozone-depleting R502. Although very common in the 1970s and 1980s, it is now illegal to use HCFCs, and the system has since been converted to a non ozone-depleting and low global warming potential refrigerant. Reliable refrigeration over the past 38 years has enabled Associated Seafoods to focus solely on what they are best at, allowing it to grow to employ over 150 people in their factory in Buckie alone.

Despite running for almost 40 years, Roddy MacDonald is confident Star's system can keep going for another decade, "as long as it is kept as well looked after as it is now, it could keep going for another 10 years, easy."

"We are hoping to expand in the near future and continue our relation with Star Refrigeration. For me, there's never been anybody but Star to work with", said Stuart Gibson, Operations Director of Associated Seafoods. ■

‘Make in India will bring growth in Indian HVAC Sector’

Defence offset policy, rapid expansion of Metro network, increasing conversion of non AC coaches to AC coaches in railways, greater ‘green’ technology awareness, robust growth of the real estate, hospitality, health and education sectors are all likely to accelerate the growth for HVAC industry, informs **S S Sidhu, Managing Director, Sidwal Refrigeration Industries Pvt Ltd** in an interaction with **Cooling India**...

Please take us through the company’s journey.

Sidwal Refrigeration is an ISO 9001-2008 and IRIS (International Railways Industries Standards) certified company. We entered the air-conditioning and refrigeration industry in 1974. Through extensive in-house research and development, we have produced excellent products acclaimed for their distinguished quality for more than 40 years. The company pioneered the all-indigenous development of Roof Mounted Modular Compact Air Conditioner for Rail Coaches in 1991. Since then the company has supplied more than 16,000 such AC Units duly tested and approved by Research Design & Standards Organization (RDSO), Ministry of Railways, and Government of India for higher speed trains like Shatabdi Express, Rajdhani Express for Indian Railways.

We also supplied air-conditioners for the luxury prestigious tourist trains ‘Palace on Wheels’ for Rajasthan Tourism Development Corporation (RTDC), Deccan Odyssey and Maharaja Express.

What are the solutions and services offered by the company?

We have established niche in HVAC in the field of mobile applications (e.g. railways, metro, buses etc) and applications in defence, telecom shelters, telecom switch gear rooms and commercial establishments. We also pioneered position in the Indian Railways (Mainline as well as Metro) with solid past history with Indian Railways and Metro.

What are the trends in Indian HVACR market? How has the cooling market evolved in India as compared to the global market?

- Hugely potential business segments in upcoming 10-15 years for demand driven Railways, defence, telecom/IT, bus air conditioning, drinking water coolers. Each segment has huge potential for significant growth cycle.
- Huge demand for AC coaches for rising incomes and standard of living.
- Increase in coach production capacities to 5000 by year 2020, and to 10,000 in next few years – with higher (70%) proportion of AC coaches therein.
- New rail tracks and trains (including

double decker AC trains, larger number of AC coaches).

- Indian Railways HVAC business is expected to grow significantly from now.
- Special Focus on Railway in GOI's 'Make in India' policy.

The Government of India launched 100 Smart cities project. What opportunities do you look forward for your company?

- We are well positioned to grow with the industry 'Only Indian vendor approved by DMRC for supply of HVAC units for Metro Coaches'.
- Enhanced indigenization will prompt all coach OEMs to opt for DMRC approved experienced vendors.

The Government of India has launched 'Make in India' campaign in order to make the country as a manufacturing hub. How has it helped the company to expand its footprint in India? How many manufacturing plants do you have in India?

- Make in India policy of Government of India will bring growth in Indian HVAC Sector nearly 30% to over Rs 20,000 crore over the next two years, which will be much higher than 7-8% annual growth in past few years.
- Defence offset policy, rapid expansion of Metro network, increasing conversion of non ac coaches to ac coaches in railways, greater 'Green' technology awareness, robust growth of the real estate, hospitality, health and education sectors are all likely to accelerate the growth for HVAC industry.
- Our significant market share in each of the segments that it is operating in reiterates its international standard product quality, reliability and customer trust on us.
- It is one of the very few manufacturers in India for HVAC solutions that meet international quality standards. It is an approved supplier to most of the prestigious customers in the domestic market.
- Products, services and market penetration have evolved over time to meet the dynamics of customer demands over the past 40 years across diverse sectors from railways to defence, telecom &bus.
- We have two fully equipped and modern production facilities at Faridabad (Haryana, Near New Delhi) and KalaAmb (Sirmour, Himachal Pradesh).
- Manufacturing facilities are well designed to accommodate a wide variety of manufacturing processes, tests and R&D.

Defence offset policy, rapid expansion of Metro network, increasing conversion of non ac coaches to ac coaches in railways, greater 'Green' technology awareness, robust growth of the real estate, hospitality, health and education sectors are all likely to accelerate the growth for HVAC industry

What kind of technical innovation would you like to incorporate in your solutions or products to make them more energy efficient and cost efficient?

- Our products are already energy-efficient and cost-efficient and competing with the international products in the HVAC market.
- Product innovations are expected to further strengthen group's reputation as a leader in product quality.
- In house manufacturing of majority of components ensure efficient control mechanism on both quality & cost of the end products. Cooling coils, condenser coils, blowers, motors, PCB's, FRP moulding, electrical panels produced in-house provide the cutting edge benefit over the competition.

What are the growth drivers for your business?

- Capitalize on Leading Market Position: For defence HVAC, we have unique strength for its exclusive arrangement with BEL (Govt enterprise having almost 70% market share and preferential treatment by Ministry of Defence).
- Leverage Installed Base and Customer Relationship: Sidwal has decades old business relationship its principal customer base (e.g. railways, DMRC, MOD and DOT).
- Increased Operational Efficiency and Margin Improvement
- Leverage Strategic Advantage with Govt of India's Initiative: 'Make in India' will help in sustaining our market leadership and grow with huge demand curve in specialized HVAC segment.

What are the stumbling blocks faced by the company during providing your services? How do you overcome the same?

The only hurdle – perhaps we may face is the tendency of global operators to seek supplies from their own associated companies elsewhere; but with huge local support and pricing advantage, its best placed to even become preferred vendor for global operators for their Indian supplies.

What is your outlook for HVACR industry for 2017-18?

We look forward to a potential growth in the HVACR industry due to hugely buoyant Railway segment (both Mainline as well as Metro) for huge capital expenditure plans by Government, capacity expansion by Railways for coach manufacturing and drive to increase AC coaches, and upcoming new metro projects in other Indian cities. ■

Role of Refrigeration in Dairy Industry

The transportation of fresh milk from farms to cooling centres and processing units may take time. Consequently, cooling milk in time becomes major problem associated with raw fresh milk. The milk should be cooled within three to four hours of collecting it from the farm, which otherwise leads to spoilage. Thus, refrigeration plays a vital role in dairy industry...

Dairy is an indispensable part of the global food system and it plays a crucial role in the sustainability of rural areas in particular. It is a well-known fact that the dairy industry actively contributes to the economies of a number of countries. An increasing demand worldwide is noticeably emerging at present, and the industry is globalising. Milk and dairy products are very essential for human nutrition and development, especially, in children. Although milk is a highly nourishing food, raw fresh milk is highly liable to rot and can be easily spoiled by the growth of microorganisms. Fresh milk is collected from the farm, transported to cooling centres to prevent spoilage, then to processing units to produce other dairy products and finally delivered to the consumers in several ways, as shown in figure 1. The transportation of fresh milk from farms to cooling centres and processing units may take time. Consequently, cooling milk in time becomes major problem associated with raw fresh milk. The milk should be cooled within three to four hours of collecting it from the farm, which otherwise leads to spoilage. Thus, refrigeration plays a vital role in dairy industry.

Refrigeration of Fresh Milk

A variety of products are handled by dairy plants such as butter, ice cream, curd, condensed milk, butter milk, flavoured milk and cheese. The heating and cooling requirements for different dairy products and processes are shown in figure 2. In order to preserve quality and prevent spoilage, the warm and fresh milk should be cooled immediately after milking. The fresh milk should be rapidly cooled to 10°C within two hours of milking and to 4°C within three to four hours. In many temperate and tropical countries, where refrigerated cooling systems may not be available at the producer or milk collection point, the simple small scale methods for cooling milk to 10°C and below can be used. Some of such methods are as follows:

- Evaporative cooling using a charcoal cooler
- Cooling with natural water systems – mains, well or groundwater immersion cooling methods include placing the milk cans in a stream, river, lake or tank
- Surface milk coolers (open cooling systems)
- Refrigerated immersion cooler or cooling rings

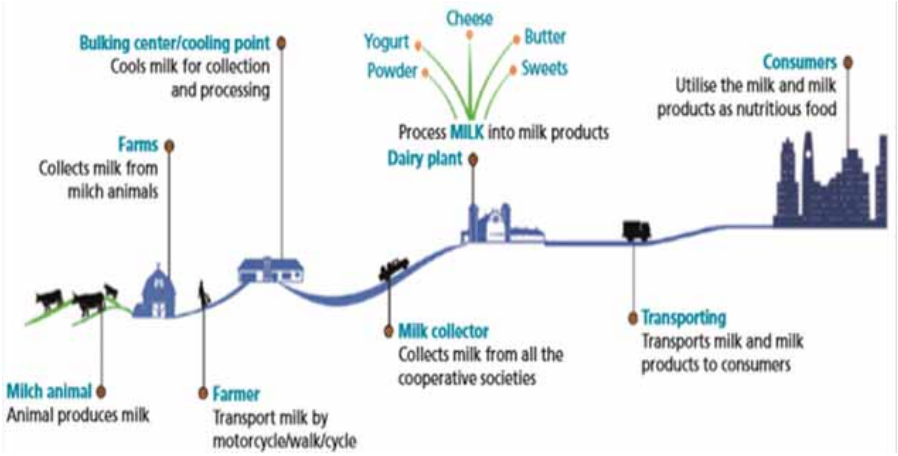


Figure 1: Rural dairy collection and dairy value chain

As soon as the fresh warm milk arrives at the milk cooling centres, it should be cooled to 4°C. This cooling requires considerable use of energy, suitable refrigeration equipment and insulated storage tanks designed specifically for milk. The most commonly used refrigeration system used in milk cooling equipment for milk cooling centres is vapour compression refrigeration system. The basic refrigeration system is made up of a refrigerated bulk tank, a refrigeration compressor unit and an air-cooled condenser unit. A typical bulk milk cooling tank is shown in figure 3. The bulk milk tanks are double-or-triple walled. The compacted polyurethane foam or expanded polystyrene is used for thorough insulation to keep the milk cool for at least 12 hours with a temperature rise of not more than 1°C at an ambient room temperature of 30°C.

The reciprocating type compressor is the most common, which can be open, semi-hermetically sealed or hermetically sealed. Now-a-days scroll compressor is being increasingly used as it is more efficient and uses up to 20 percent less electricity than reciprocating compressors. Condensers use natural or forced air, water or oil to cool the refrigerant. The naturally air-cooled condenser is the most commonly used condenser. The purpose of the condenser is to condense the refrigerant gas by removing the heat. Evaporators are commonly made from copper and located close to the source of the heat to be removed. The compressor and condenser assembly are mounted on the same support frame as the milk tank or on a separate frame adjacent to the tank. The room in which it is located must be well ventilated to ensure that the refrigeration system operates efficiently. In very hot countries, the compressor and condenser assembly can be mounted on an external wall of the milk cooling centre building which improves the efficiency of

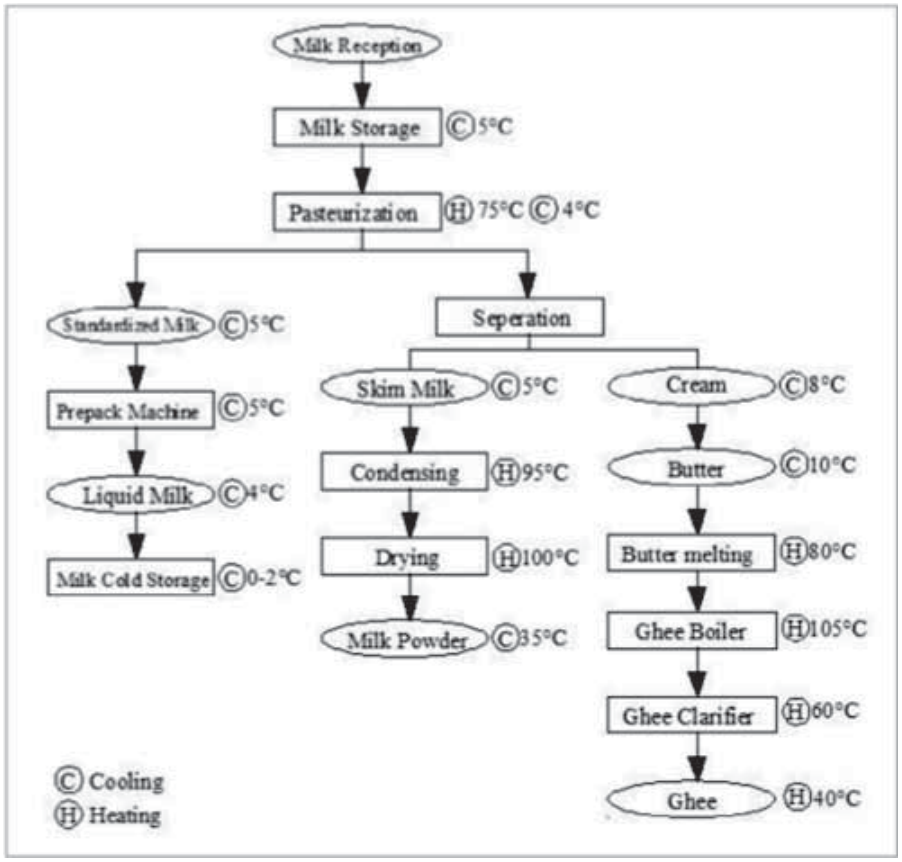


Figure 2: The heating and cooling requirements for different dairy products and processes

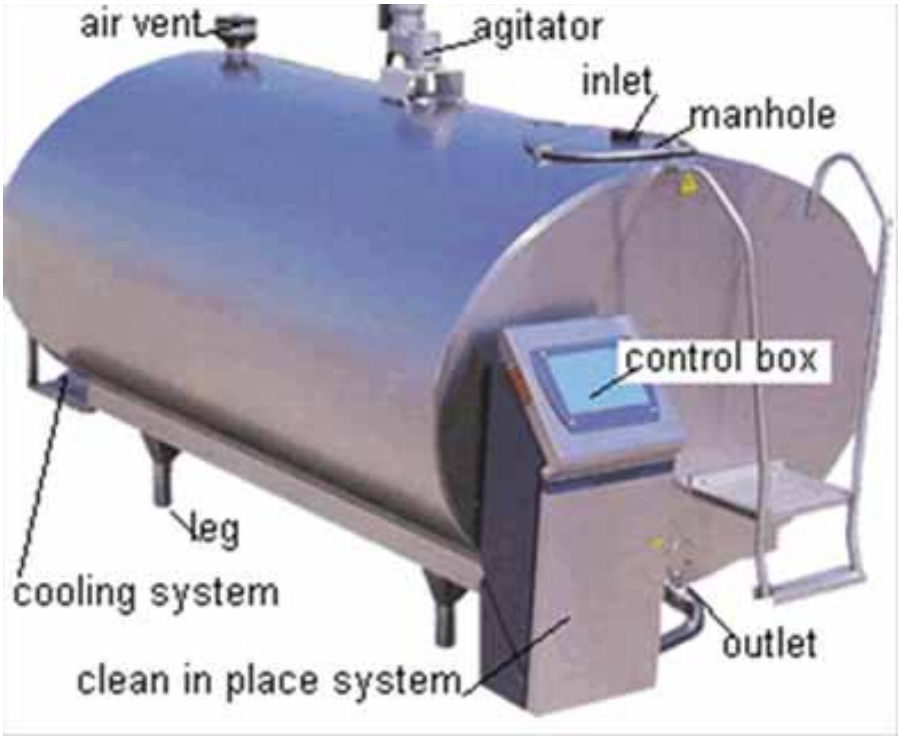


Figure 3: The bulk milk cooling tank

the system, ensure faster cooling of the milk and reduce energy consumption.

The refrigerants used for refrigeration in dairy industry should be in agreement with recent international agreements related to atmospheric pollution, by the gases that contribute to global warming and ozone layer depletion. Natural refrigerants are recognised to be potential permanent solution to phase out the use of synthetic refrigerants which are being restricted progressively. However, there are many challenges associated with the implementation of natural refrigerants. In India, ammonia based vapour compression refrigeration systems are the most preferred mode for cooling in milk processing plants. Ammonia based systems are low pressure systems with very less sophistication. They have good heat transfer properties, low cost and high efficiency. Leakage in ammonia system is easily detected due to pungent odour of ammonia. Ammonia also has zero ODP and low GWP. CO_2 is another natural refrigerant which is gaining prominence in the recent days. Compared to other refrigerants, the most remarkable property of CO2 is its low critical temperature (31.1 °C) and high critical pressure (7.1MPa).

Energy Requirement for Refrigeration

The dairy industry ranks fifth among the most energy-intensive industries after oil, chemical, pulp and paper mill, and iron and steel making industries. The industrialised countries have modern large-scale milk processing plants with about 100 tonne of milk intake. Even smaller plants with a daily intake of about 30 tonne of milk are generally equipped with modern machinery. The energy requirement in modern milk processing plants is shown in table 1. Also, the monthly electrical energy consumption (kWh) for 22 farms over 12 months (mo) for all major energy-consuming processes in the dairy industry is represented graphically in figure 4.The energy requirement in therefrigeration sector plays a very significant role in the overall energy requirements of a modern milk plant, often constituting above 40 percent of the total electric power consumption. This makes research on the reduction of energy required for refrigerating the dairy industries interesting and challenging.

Table 1: Electricity consumption per liter of milk produced, including cost of electrical energyconsumed and tariff distribution profile by percentage of day rate tariff usage

Item	Electricity consumed (Wh/L)	Cost of electricity (€/L)	% of day rate tariff usage
Milk cooling	13.02	0.0016	60
Water heating	9.83	0.0011	45
Milking	8.44	0.0011	71
Lighting	1.37	0.0002	89
Water pumping	2.13	0.0003	38
Other	7.54	0.0010	69

Methods to Reduce Energy Consumption

There are several methods identified that can be added to the milk cooling systems to reduce the refrigeration requirement and to capture waste heat:

- The condenser temperature should be as low as possible. For this, the correct size of the condenser should be ensured. A small condenser for the refrigeration indicates a small initial outlay, but running costs increase greatly. A condenser that is oversized, however, can sub-cool the refrigerant and affect the function of the expansion value.
- The evaporator temperature should be as high as possible. To achieve this, the evaporator should be of correct size. The evaporator should be kept clean and defrosted when necessary, especially, when cooling air to below 0°C, as ice can build up on the coil. Hot gas from the outlet of the compressor can be used to defrost freezers, but control must be accurate. The defrost water may then be used elsewhere in the plant.
- The compressor should match with the

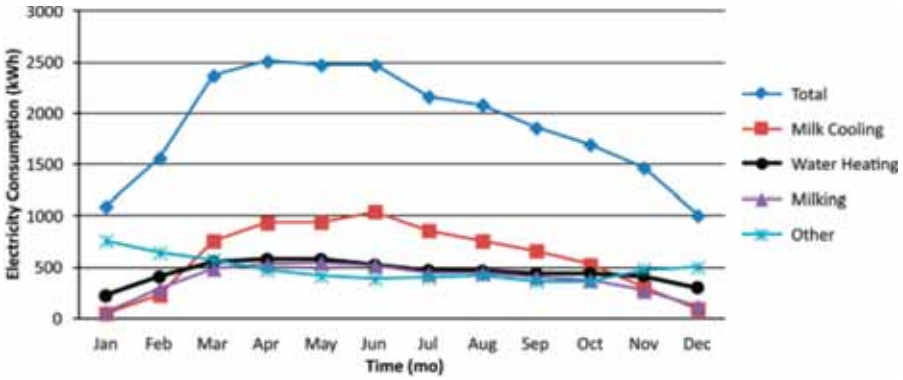


Figure 4: Monthly electrical energy consumption (kWh) for 22 farms over 12 months (mo) for all major energy-consuming processes.

load. If a compressor is oversized, it will operate at only partial load, and the energy efficiency may be reduced. A sequencing or capacity control system to match the compressor with the load could help to improve efficiency.

- The precooling of warm fresh milk using mains or well water will reduce the energy requirements of the refrigeration system to certain extent, thereby, reducing the cost of cooling. Precooling can be done by using both mains/well and chilled water in one operation. The chilled water alone increases the cooling rate and helps to maintain the milk quality.
- Refrigeration heat recovery (RHR) units are used to make a refrigeration system more efficient by collecting heat which is normally released into the air and using it for heating water which is used for various other purposes in the plant. The pre-coolers and RHR units are competing technologies. It is usually more cost effective to use a RHR than pre-cooler.
- The cleanliness of a farm's refrigeration system plays an important role in its maintenance. The coils that are dirty will reduce efficiency and increase operating costs. So, most of the systems are provided with a watch glass that can be used to determine if the refrigerant needs to be recharged.
- Leakages of refrigerant can reduce a system's efficiency by 40% and should be kept to less than 2% of the annual charge.

Some Case Studies

A few researchers studied the dairy refrigerating systems and implemented different methods in order to reduce the energy requirements and increase the efficiency of the system. The low grade heat which is available at the condenser side can be recovered and used for heating purposes. Various prominent options to recover the waste heat from the system are using heat pump system, regeneration system and tri-generation system. Heat pump option using a natural working fluid is considered as most viable, which can improve the overall COP of the plant. Singh et al. (2017) put forward an idea to integrate a trans-critical CO_2 heat pump system with internal heat exchanger (IHX) to utilize the rejected heat from the ammonia based refrigeration plant to preheat the boiler feed water and thereby, reduce the overall coal consumption. The boiler feed water used is ground water that is available round the year at almost constant temperature 27°C. The condenser of ammonia based refrigeration system was coupled with evaporator of the CO_2 based heat pump system in a way that the evaporative cooling system was eliminated which resulted in saving of some ground water. Figure 5 shows the CO_2 heat pump system with IHX working in a trans-critical mode, coupled with existing ammonia based refrigeration and boiler system.The

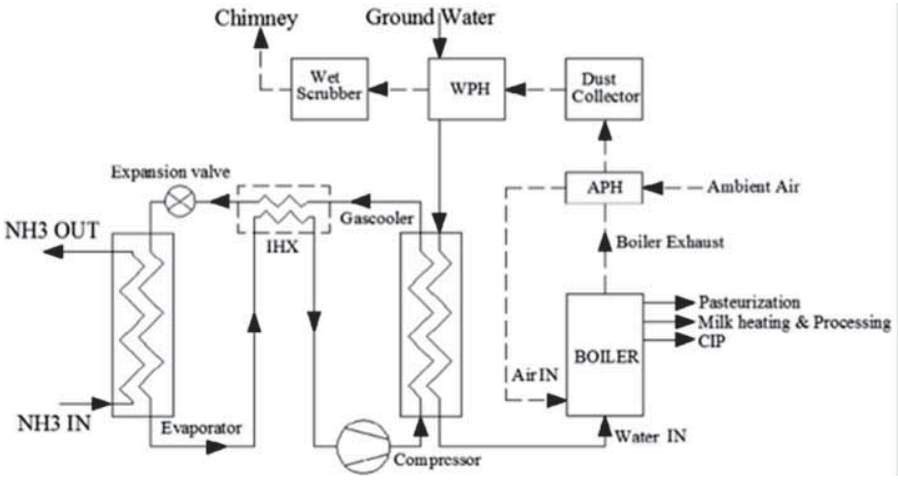
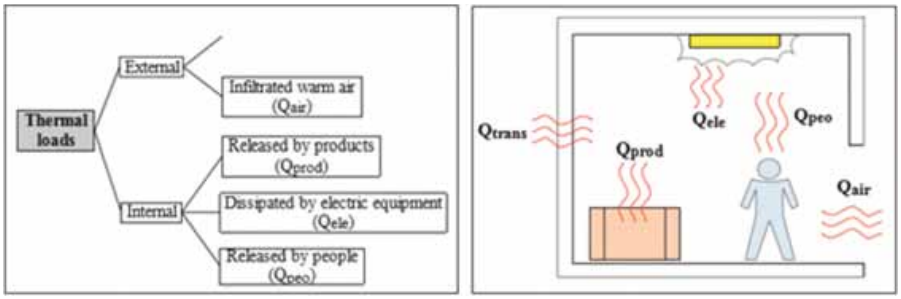


Figure 5: Schematic of the proposed trans-critical CO_2 heat pump system with IHX



(a) (b)

Figure 6: (a) Classification of penetrating thermal loads; (b) Sources of thermal loads

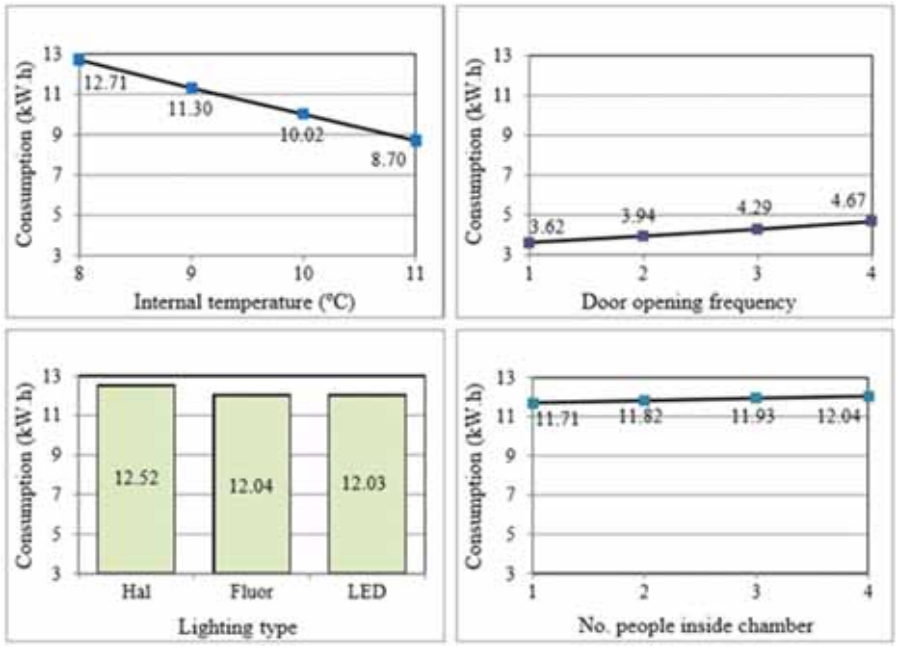


Figure 7: Sensitivity analysis for energy consumption by varying input parameters (a) internal temperature,(b) door openingfrequency, (c) lighting type and (d) number of people inside the chamber.

CO_2 heat pump with IHX meets simultaneous heating and cooling demands. The evaporator of the heat pump system takes up heat from the ammonia cycle and boiler feed water is preheated utilizing the heat rejected by the gas cooler. They carried out the analysis using the actual heating and cooling load and demand data from an ammonia based milk refrigeration plant situated at warm climatic condition in northern India where the annual temperature ranged varies between −2°C and 48°C. They observed resulting changes in primary operating cost and energy saving. Total payback period (PBP) of the proposed tans-critical CO_2 heat pump system was also computed using the total life cycle cost (LCC) approach. They found out that approximately 37 kW heat was recoverable by employing trans-critical heat pump system and about 5000 litres of ground water per week, consumed for evaporative cooling, was saved. They concluded that total reduction rate in CO_2 emission and cost of energy was approximately 45.7% and 33.8% respectively. Also, total PBP of the trans-critical CO_2 heat pump system with IHX was calculated to be approximately 40 months only.

Table 2: Inputs to vary in the sensitivity analysis

Input	Observations
Internal temperature	8°C -11°C
Opening door frequency	Period of time per door opening: 2 min.
Type and electric power of lighting	Lighting is on during door opening; total luminous flux: 20800 lm.
Number of employees inside the chamber per access	Total permanence time of employees in each access: 1 h.

Now, we know that existing refrigeration systems in the productive process employed to conserve the dairy products are largely responsible for high levels of energy consumption, and in some companies they consume about 60% of total energy used. In a study by Alves et al. (2014) the main causes that have been detected which contribute to such high spending were found to be deteriorated door junctions, poor insulation along the edges of cold chambers or lack of awareness of human resources for good behavioural practices. Many of these causes can be easily corrected with immediate results in terms of savings, estimating that these can be in the order of 20%.Thus, they intended to apply a mathematical methodology to estimate energy savings resulting from the application of energy efficiency measures in cold chambers from the dairy industry. The methodology developed was applied in real cold chambers from the dairy industry, more specifically in the cheese area of Nisa, Portugal. There was a moveable tight door to enter the interior which was usually opened for a long period of time to execute work tasks by 4 members of the staff.The total heat to be removed from the chamber was equivalent to the sum of all penetrating thermal loads with several origins. Figure 6 discriminates all those loads and the sources of origin. The identification of the most influent parameters in the global consumption was done by a sensitivity analysis, which consisted in a study of the variation ofsimulated consumption as a function of inputs defined in table 2.

For the sensitivity analysis, the variation in power consumption for varying internal temperature and door opening frequency are shown in figures 7(a) and 7(b) respectively. The consumption of power reduces with increase in internal temperature and increases with increase

in door opening frequency. The power consumption for halogenated light, fluorescent light and LED light has been shown in figure 7(c). The LED light and fluorescent light show similar consumption of power while the halogenated light consumes more power compared to the others. The number of staff inside the chamber generates the lowest weighted thermal load in final consumption (+0.11 kWh/person), among all inputs evaluatedas shown in figure 7(d).

It is observed that reducing the time of door opening and installing an air curtain device is really interesting due to the energy saving it could provide which is more than half of the original consumption. So, it is possible to reduce consumption by 67 % through the application of the proposed measures and a payback time of up to four years.

Energy Saving Potential of Future Technologies

A number of technologies are under development for use in the near future. Some of the most promising include:

- Absorption chillers allow cooling to be produced from heat sources such as fossil fuels, incinerated garbage, biofuels, low-grade steam, hot water, exhaust gas or even solar energy, generally, using a lithium bromide and water refrigerant. While the cost of absorption refrigeration is relatively low compared with compression refrigeration (1 kW of refrigeration for 1 kW of energy), absorption chillers can utilise a waste heat source, thus emitting less greenhouse gases than conventional vapour compression refrigeration systems
- Greater use of renewable energy sources such as solar electricity (PV), solar thermal, wind energy, biomass, geothermal heating and cooling.
- Greater system integration by use of heat pumps, Combined Heat and Power and Trigeneration. ■

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Italian City First Sign on to LEED for Cities in Europe

The US Green Building Council (USGBC), creators of the LEED green building rating system, and Green Business Certification Inc (GBCI), the organization that certifies all LEED projects globally, have announced that Savona, Italy, which is home to more than 62,000 people, is the first city in Europe registering for its LEED for Cities program. LEED for Cities combines sustainability, social equity and human experience with technology and analytics and is based on LEED – the world's most widely used program for green buildings and communities. "The city of Savona is committed to making measurable progress that we will share with others so that we can serve as a model for others cities that are looking to participate in LEED for Cities," Savona Mayor Ilaria Caprioglio said in a press release.

LEED for Cities provides cities with a framework for measuring and managing the performance of water consumption, energy use, human experience, waste and transportation. LEED for Cities is administered through GBCI's Arc performance platform.

"Cities face many challenges in this day and age – citizens are demanding more transparency and information about the places where they live, work, learn and play," said Kay Killmann, Managing Director of the new GBCI Europe office. "And now more than ever, local governments are laboratories of innovation and social problem solving."

Leaders, especially in growing cities, have enormous opportunity to initiate a dynamic dialogue with citizens and invite them to contribute to the city's progress. LEED for Cities is a framework that provides both citizens and their leaders with a detailed view of citywide performance.

Francesca Galati and Daniele Guglielmino, the LEED APs who advocated LEED for Cities to the city of Savona, said, "LEED for Cities represents a unique opportunity to grow awareness about health, wellness and sustainability at the urban scale, and Savona will become the case study for the European Region."

The European market has been a particular focus for USGBC and GBCI. In April 2017, GBCI Europe was launched to further facilitate the growth of a sustainable built environment locally and across the globe. ■

Role of Railways in Cold-Chain Logistics

National Centre for Cold-chain Development (NCCD): NCCD is an autonomous body set up by the Government of India with the aim to serve as a think tank, to facilitate cold chain development across all user segments through policy intervention, capacity building and standardisation. This NCCD report is prepared with intention to promote discussions and bring greater focus to the need for multi-modal (roadways, railways, airways, waterways) applications in cold-chain...

The country produces multiple crops across many states and production is increasingly developed in clusters so as to promote economy of scale at the farm-gate. This change is expected to grow with the formation of more Farmer Producer Organisations and through inherent impetus from cooperative or collaborative farming practices. Changed farming practices lead to the generation of large surplus of produce, regionally concentrated at the point of production. This local surplus is also since consumption is located in urban clusters, concentrated at a distance from producing areas.

In case of food grains, the surplus is captured by private sector (milling units) and through procurement by FCI and state government agencies. However, in case of perishable produce such as fruits and vegetables and other crops with lower holding life, the surplus is not procured and tends to go waste, causing loss of national resources. As per a study commissioned by MoFPI to CIPHET of ICAR in 2015, the post-harvest loss of agricultural produce is 5% to 16%, which was assessed along various handling stages in a market-linked supply chain. This report is observed not to have considered the losses suffered in long haul transport having taken only the first mile transport handling into assessments. More importantly, the instances when post-production surplus could not even enter the supply chain due to non-availability of logistics connectivity was not evaluated in this study. In such occurrences, unable to be directed towards a market, much of the surplus production is not evacuated from farms and this effects distress sale or is incurred as total food loss. Globally, the highest food loss and waste is reported in case of fruits and vegetables and is estimated upto 45%. There are frequent reports of sustained demand of certain vegetables in large cities while the same crop is

"Poor logistics connectivity is causing imbalance between demand and supply".

discarded alongside farms for want of market linkage. Coincidentally, most high perishable crops are also high nutrition foods and comprise the bulk of highvalue-agriculture (HVA).

To help in doubling farmers' income and to make agriculture more sustainable, there is a need to develop holistic market connectivity for perishable and semi-perishable produce. Such connectivity would require cross-geographical flow of fresh foods and preferably involve multi-modal transport connectivity.

Observations

Production is no longer the causal factor for demand-supply gaps. Instead, the need of the hour is to bridge episodic production with perpetual demand. A holistic logistics network for agricultural produce is essential, designed around key logistical activities so as to efficiently link

an Origin (farm-source) with Destination (consumer-market) - OD Pair.

An agri-logistics network design will require, at first instance, the establishing of logistics source points. These are also referred to as aggregation centres or pre-conditioning centres and normally developed at village or rural level. The most common example is milk chiller collection points and in case of fresh produce, these are called pack-houses.

This is the first step to value-realisation in a chain of market linked activities. The Ministry of Agriculture & Farmers' Welfare has rationalised its schemes to proactively promote modern pack-houses, where produce is collected, grouped and packed into market linked assortments. Where needed, such pack-houses also undertakes washing, trimming, waxing, packing, labelling and pre-cooling. These activities do not alter or undertake value addition to the produce, but only prepares for travel to markets. However, this set of activities brings value to the farmer as it makes the produce more marketable in its fresh whole format.

Services by way of pre-conditioning, pre-cooling, ripening, waxing, packing, labelling of fruits and vegetables which do not change or alter their essential characteristics have been exempted from service tax. As no direct value-addition to the product is done, there is no incidence of VAT either.

The next step is to evacuate the pre-conditioned produce to distant markets, thereby bridging the supply side with demand through providing transportation over roadways, railways, waterways and/or airways. The Ministry of Agriculture & Farmers' Welfare is actively promoting the infrastructure for market connectivity, such as reefer vehicles, multi-modal reefer containers, market infrastructure which includes cold stores and dry warehousing. The services of loading, unloading, packing, storage or warehousing and transport of agricultural produce is exempt from service tax. Logistics connectivity between an OD Pair requires that both locations use some basic food handling facilities, preferably to enable unit load handling systems such as pallet based material handling. This also minimises damage to the food items and mitigates handling losses, besides allowing for faster operations. Unitised load handling also permits the use of multi-modal containers as a future ready option. Various aspects of material handling equipment are supported by Ministry of Agriculture including automation, refrigerated containers, high reach lifts, etc.

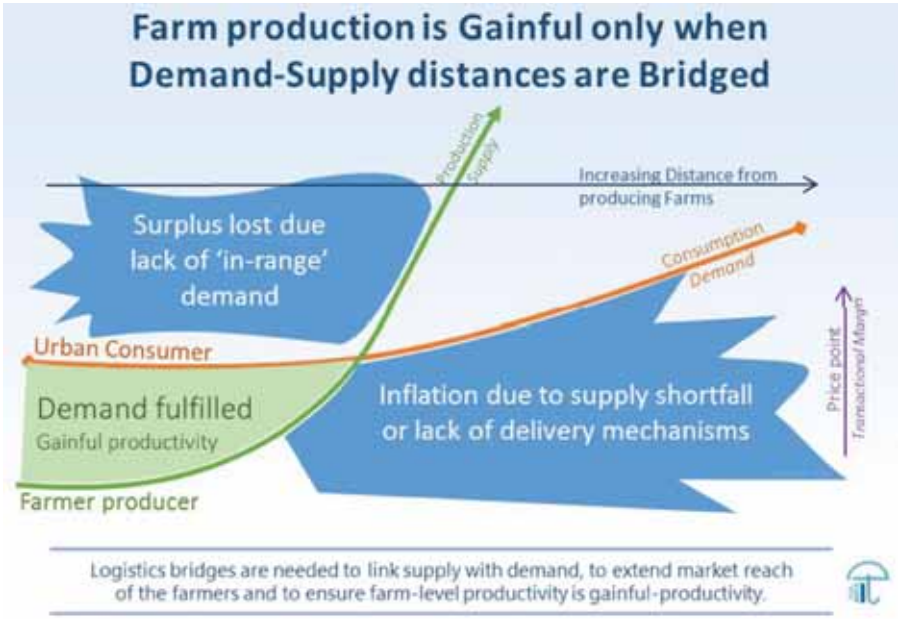
All above aspects indicate that Railways can play an important role in the coming second green revolution, wherein railheads can locate the modern produce collection centres (or be linked to the same), maintain certain floating stock of containers dedicated for food cargo and to be the backbone to the Unified National Agricultural Markets. Railways not only speeds up the logistics connectivity, which is important in case of perishables, it also covers larger distances which is key to achieving improved value realisation for farmers.

Need Assessment

The movement of food grains has regularly used railways wagons and is an ongoing intervention on freight trains. Since majority of shipments are undertaken by FCI, bulk handling is possible. To compete with roadways and to bring more idle rolling stock into use, railways also developed discounts and incentives for carriage of food grains.

Railways has an Automatic Freight Rebate Scheme to get freight in the traditional empty-flow direction. Yet, for perishables there is no evidence of similar positive focus. The agricultural trade, especially in case of perishable commodities, faces a perpetual shortage of time, once the produce is harvested. The agri-logistics of such produce has to resort to technologies such as precooling

"Railways can be a key player in bridging demand-supply & doubling farmers' income"



and cold-chain to enhance the marketable or holding life of the perishable goods because of lack of market access in the normal lifespan of the produce. On the other hand, assured connectivity to market centres is not possible until a certain economy of scale is generated from a single commercial entity.

However, on the demand side, the volumetric consumption is well ascertained from various surveys, including through multiple NSSO rounds. For example, on a monthly basis Delhi consumes 11600 tons of banana, 18600 tons of tomato, 23,500 tons of onion and 54,000 tons of potato. However, none of these items are produced in Delhi and they are transported from neighbouring and/or distant regions. The example is similar for all major metropolis and their fresh food intake is routed from multiple sources and states.

All major city centres also have modern rail terminals and freight handling yards. These cities are easily identified as the destination of agri-produce freight. The point of origin is also fixed for certain crop types which are produced perennially, or have a short harvest window with longer holding life – eg. banana, apples, potato, carrot, kiwi, peas, etc. In such cases, the supply side or origin can be said to have a comparatively steady throughput outflow.

In many other cases, the supply volumes will shift depending on seasonal variations or because of shorter production cycles and a shorter holding life (more perishable) – eg tomato, lettuce, mango, brinjal, okra, papaya, strawberry, pineapple, etc.

In both examples above, recent reports showcase that the surplus crops had to be discarded on the wayside, while unsated demand in faraway cities resulted in price inflation. This clearly indicates that effective logistics bridges were critical missing links between the points of surplus and demand.

Operational Requirements

This vision of technology affecting the food supply chain has following key aspects to consider:

1. Aggregation facilities with efficient transport linkage. The link provides a network as to bring the market within reach of the producer.
2. The logistics has to cater to the requirement of a rapid and trustworthy transport mode, and where required to provide ambient conditioning.
3. With most fresh perishables, the primary need is provision of transport, with storage at receiving front-end. Fresh perishables must not be stored at production centre, but moved to demand side while still young and firm to withstand rigours of transport.

Indian Railways with its pan-India network is the optimal and preferred choice for Hortiproduce movement. Yet, this burgeoning demand is not fully tapped or planned for in full. Most of proposed agri-hubs are remote from railways linkage or have difficult access to them. The railways itself has minimal options for servicing the thermally managed movement of fresh and frozen produce, leaving that growing service need to the road transport segment.

For Railways to tap into this growing transport demand from agri-logistics:

1. Upgrade logistics to facilitate the supply chain of fresh produce - agri-hubs or handling facility adjoining railway sidings for loading unloading.
2. Provide the use of railways communication network to aid price transparency to farmers & markets.
3. Create Receiving hubs from where local secondary or tertiary distribution can be handed over to road transport.
4. Provide links to export hubs including streamlining current export delays. This can be done in liaison with APEDA and MPEDA and other export promoting bodies.

Primary advantages to Indian Railways:

1. Assured income from logistics service from agri-hubs. Any producer with efficient and easy access to rail transport will rarely opt for long haul roadways transportation.
2. Income from railway land on which agri-hubs will be established. Land with railway sidings can be leased to proposed users under PPP mode or through outright sale.
3. Service to the nation with temperature controlled transportation, railways will have developed an enhanced ability to provide emergency services at times of disaster by serving as effective supply chain of fresh food including perishable medical supplies.
4. Upgradation of railways equipment and work-force. This will add value and fresh skills to both people and the railways service.

Agri-logistics, unified marketing and doubling farmers' income is a thrust area.

A scheduled, fixed route service will promote and spearhead the development large volumes along identified freight lanes".

Private Container Train Operators (PCTO) also do not service the domestic cold-chain. All aspects of technology aided agri-logistics is supported under schemes of the Ministry of Agriculture Cooperation and Farmers Welfare. These include pack-houses with pre-coolers and staging cold rooms, reefer vehicles, reefer containers (TEUs), refrigerated warehousing, material handling systems, storage and racking systems, etc. This provides railways and/or partner organisations the opportunity to build-to-suit facilities that can be designed to avoid capacity and cost over-runs.

Operating Models

Broadly two methodologies can be considered for establishing pan-India rail-based network for fresh produce supply chains. In one, the existing infrastructure can be utilised – first mile truck to rail-side à load onto wagons à long haul on rail à off load at destination à short haul to buffer storage by truck. This can be used for non-specialised movement of bagged and hardy vegetables such as onion and potato. For perishable produce, where delivery can be managed within 24 hours, enclosed carriage on VPNs can also be carried out. For specialised commodities, requiring temperature controlled carriage and storage, refrigerated containers are required. Since such movement will be on container trains additional handling facilities will be required at loading and offloading rail-siding (CRTs).

It is proposed that a predetermined schedule be run to induce volumetric throughput from users or buyers. A special consideration may be given to traders who have registered with eNAM and are intending to move the produce over more than 800 kms.

A detailed study is recommended for long term planning purposes. However, with purpose to spearhead the initial freight the following observations are to be considered. A north to south perennial flow of apple and potato is already established. Similarly, there is south to north perennial movement of bananas, chicken, lettuce, etc. Majority of this is occurring over trucks and reefer trucks and gives opportunity to convert this trade into rail-based containers.

On the West to East direction there is large movement of Amul products via trucks and return loads are not fully established. However, opening a fixed schedule of one or two containers will facilitate market linkage from North Eastern region. It is important to realise that unlike most of the bulk freight on railways, in case of fruits and vegetables large volume shipments impact market dynamics as receiving ends are not able to handle large supply. Hence, for the purpose of conceptualising horti-produce rail links, it may be necessary to consider piecemeal or partial rake loads. Therefore, this will require having compartmentalised wagons or containers, attached to existing rakes.

To assist the development of such trade, the ongoing scheme for fresh produce infrastructure will be targeted for freight forwarders who wish to scale up shipments through railways. As such, a system based approach would be promoted.

Two options can be considered for a predetermined time period:

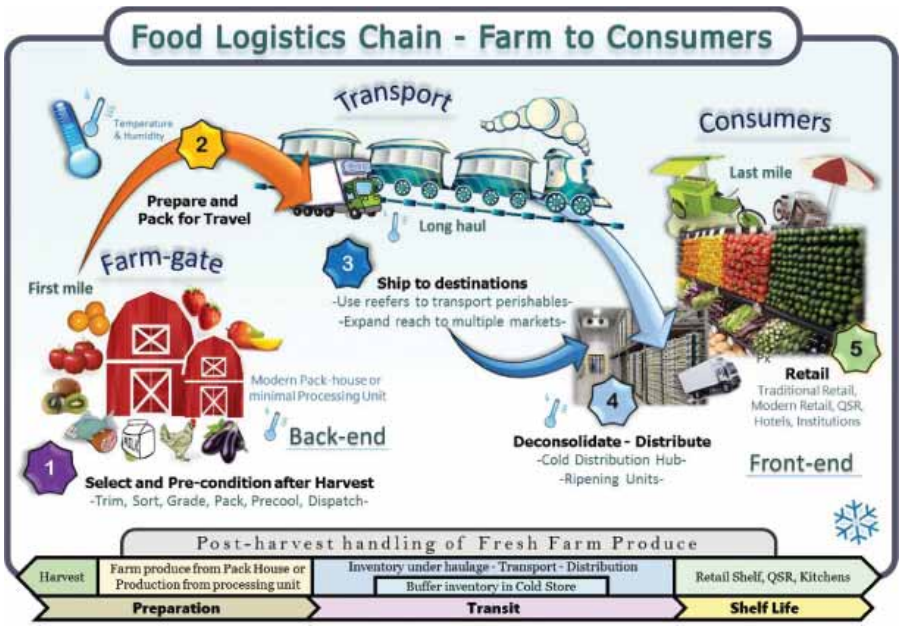
1. Use covered rail wagons or VPNs
2. Promote reefer container movement

For both options, a time table of available capacity can be published and publicised for freight forwarders and other stake holders to take advantage of. Once cargo volume is scaled up, other infrastructure development can be undertaken. The ability to use railways to cover longer distances in shorter times, empowers farmers by allowing them to expand their market reach. While existing trade into local markets will continue, the amount that is surplus to localised demand can be connected to consumers farther away, thereby, mitigating loss and increasing recovery from surplus. Otherwise the surplus produced is incurred as total waste.

Current status of Rail inked infrastructure with Indian Railways or with CONCOR (Container Corporation of India)

S. N.	Description	No.s	Remarks
1	Modern Pack-houses	Zero	Used for aggregation or collecting of produce from farms. Produce is pre-conditioned for travel by sort and packaging before precooling. These can be outsourced to off-site locations or established at railways land adjoining railheads.
2	Reefer transport	Zero	Used to link pack-houses with next chain of distribution. Can be outsourced to transporters. For certain produce like potato, ordinary trucking will suffice.
3	Distribution Hub (Cold warehousing)	1	Used for transient warehousing for produce while waiting rail connectivity. Can be used for stuffing containers in advance for container trains and destuffing service. 1 of 1430 tons created in Bengal near Singur railway stn.
4	Containers	98	Insulated but Ventilated containers with CONCOR and were earlier in use for onion and banana movement. Procured with funds provided from NHB. Currently not used for any trade.
5	Reefer Containers	Zero	No refrigerated containers are available for domestic users – hence mutli-modal refrigerated transport is not possible.
6	Refrig. Parcel Vans (VPN)	10	These were reported in partial use (2016).

Private Container Train Operators (PCTO) also do not service the domestic cold-chain.



Previous Reports

The report of the National Transport Development Policy Committee (Planning Commission - 2014) had also stated that most of thinking on transport in India had been project-centric done in single-mode silos. The recommendation is to have a system based approach, cutting across modes of transport and geographies. The report also mentioned relative transport isolation by region, in specific North East Region (NER). In this concept, it is felt that sector-wise there is relative transport isolation in the agriculture sector, especially, for horticulture. As a first step to total multi-modal transport system for horticulture, the integration between railways and roadways modes for perishable goods is conceivable in the short term. The Planning Commission's 'Total Transport System Study on Traffic Flows and Modal Costs' by RITES, published in March 2008, highlights certain key aspects such as average lead time and share of various products on railways and road.

In case of fruits and vegetables, 97.4% of volume moves on roadways. It is to be noted that this fruit and vegetables have the lowest share with railways among the top 21 commodities.

Top 21 Commodities By Volume Moved By Rail And Comparative Road Share

Sr. No.	Commodity Name	Total (All Modes) Million Tonnes	Modal Share			
			Rail		Road	
			Million Tonnes	% Of Total	Million Tonnes	% Of Total
1	Coal	415.37	331.77	79.87	68.35	16.46
2	Iron Ore	154.69	121.80	78.74	23.30	15.06
3	Cement & cement structures	157.86	78.83	49.94	75.98	48.13
4	Chemical manures & fertilizers	54.57	36.38	66.67	18.19	33.33
5	POL products (liquid)	189.56	35.13	18.53	128.14	67.60
6	Iron & steel (all types)	134.49	27.31	20.31	107.18	79.69
7	Containers (loaded & empty)	85.44	27.10	31.71	56.60	66.25
8	Rice (all types)	69.54	22.43	32.25	47.12	67.75
9	Parcels, miscellaneous & others	227.17	22.29	9.81	201.50	88.70
10	Limestone & dolomite	19.85	13.69	69.00	6.15	31.00
11	Wheat and wheat flour	41.67	12.31	29.54	29.36	70.46
12	Granite, marbles & other stones	31.97	6.79	21.24	25.18	78.76
13	Sugar and khandsari	24.84	5.98	24.08	18.86	75.92
14	Ores other than iron	14.68	5.49	37.40	9.19	62.60
15	Building materials	121.13	5.05	4.17	116.08	95.83
16	Salt	11.06	4.62	41.77	6.44	58.23
17	Other food grains	15.29	2.29	14.98	13.00	85.02
18	Fruits and vegetables	71.81	1.89	2.63	69.93	97.38
19	Wood, timber, plywood, etc.	33.91	1.14	3.36	32.77	96.64
20	Chemicals (Powder & liquid types)	34.90	1.11	3.18	33.79	96.82
21	Edible oils	26.36	1.09	4.14	25.26	95.83
Sub-Total		**1936.16**	**764.49**	**39.48**	**1112.37**	**57.45**
TOTAL ALL COMMODITIES		**2386.97**		**32.03**		**46.60**

Planning Commission Total Transport System Study

Mode-Wise Average Leads Of 52 Commodities

Sr. No.	Commodity	Modewise Avg. Lead (Kms)				Avg - All Modes (Kms)
		Rail	Road	Coastal Shipping	Airways	
1	Rice (All Types)	1294	327			639
2	Wheat and Wheat Flour	1375	437			714
3	Other Food grains	895	370			448
4	Grams & Pulses	1261	607			619
5	Sugar and Khandsari	997	462			591
6	Sugar Cane	88	136			133
7	Oil Seeds (All Types)	1155	576			598
8	Cotton (Raw & Mfd)	1633	576			583
9	Jute and Coir (Raw & Mfd)	1585	697			758
10	Rubber (Raw & Products)	1888	574			574
11	Fodder	1742	415			452
12	Fruits and Vegetables	1653	522			552
13	Tea and Coffee	478	750			750
14	Tobacco & Products	250	645			645
15	Wood, Timber, Plywood, etc.	737	450			460
16	Iron Ore	437	304	2965		574
17	Ores other than Iron	478	350			398
18	Coal	581	463	1271		587
19	POL Products (Liquid)	658	272	1163		467
20	Coal tar and Bitumen	1204	399			521
21	Limestone & Dolomite	676	438			602
22	Salt	1452	480			886
23	Granite, Marbles & other stones	331	551			504
24	Cement and Structures	557	358	552		461
25	Building materials	327	153			160
26	Chemical Manures & Fertilizers	834	373			680
27	Iron & Steel (All Types)	936	525			609
28	Metals other than Iron & Steel	575	477			479
29	Edible Oils	1519	538			579
30	Chemicals (All Types)	943	611			622
31	Paints & Dyes	758	627			627
32	Electricals (Incl. Wires)	810	614			614
33	Cloths Raw & Manufactured	1629	601			601
34	Leather & Goods (Incl. Bones)	564	545			545
35	Gas Cylinder - All Types		151			151
36	Paper & Paper Products	2044	545			571
37	Plastic & Plastic Goods	2070	611			612
38	Car, Vans, etc.	2025	810			868
39	Cycle & Cycle Parts		729			729
40	Heavy Machinery (Agr. Equp.)	1345	595			596
41	Three Wheelers		739			739
42	Two Wheelers		728			728
43	Tyre and Tubes	2489	673			673
44	Spare Parts (All Types)	1763	568			569
45	Empty Tins, Bottes, Drums, etc.	311	374			374
46	Provisions & Household Goods	2095	535			539
47	Containers (Loaded & Empty)	1250	306	664		613
48	Fish/Egg/Meat	476	600			600

Sr. No.	Commodity	Modewise Avg. Lead (Kms)				Avg - All Modes (Kms)
		Rail	Road	Coastal Shipping	Airways	
49	Livestock	1529	215			234
50	Milk & Products	2223	160			165
51	Scrap (All Metals)	1188	455			465
52	Parcels, Misc, Others, etc.	720	628	1408	1027	648
	AVERAGE OF ALL MODES	661	453	1450	1027	545

Planning Commission Total Transport System Study

Among the top 52 commodities, the average lead time or travel time is about 500 kms, mostly (97%) by road. It is reiterated that long haul movement can be greatly facilitated by scaling up rail based movement of fruits and vegetables, which will help farmers capture more markets and therefore, become more productive in gainful terms.

Above data is from 2007-08 but it is expected that the status is similar in 2016. It is, therefore, inferred that in case of perishable crops, which can benefit greatly with market linage from reduced transit time and improved travel conditions on rail modes, is not able to take advantage of current rail system. The reason can be because of lack of suitable handling facilities but mostly from there being no special focus to capturing such freight.

- Currently, majority of food grains and certain quantum of tea, potato, onion moves on railways wagons. These wagons are not designed for sensitive or temperature controlled transport.
- Very small quantum of fruits & vegetables avails rail transport, as the past approach has been to evaluate full train loads, instead of breaking down into smaller unit loads.
- Container trains allow the opportunity to consider a smaller unit load of container, instead of full train loads only – a container train can load multiple commodities types and stuffing can happen in advance to train arrival.
- A floating stock of containers, for on demand use can be located across terminals and carried on empty slots of existing routes. Such individual containers can be used for multiple loads types interchangeable along a series of freight lanes, promoting multi-modal format for agri-logistics.
- Two types of freight systems are expected – 1) for hardy produce such as potato, tea, ginger, spices, etc where long distance connectivity is more of essence. In such cases, the receiving end is also not expected to be specialised. 2) for more perishable produce such as mangos, bananas, pineapple, brinjal, tomato, etc. where time is of essence and requires temperature controlled handling facilities to stud and destuff the containers.In the first instance, railways system would only be used to freight the aggregated crops for an offsite wholesale yard or receiving facility.
- Railways wagons (covered type) could also be used.
- In second case, special refrigerated containers would be the unit load for transport and the receiving facility may require refrigerated cross-dock or storage options – offsite or at railhead.
- To spearhead use of railways for movement of horticulture produce, partial or piecemeal movement will have to be started. This may manifest, preferably, in form of reserved parcel van freight or single container freight on existing lanes. The pre-reserved option can be opened on select routes for a fixed time window of two years.
- As a full unit load is achieved, with reverse logistics, the opportunity can be passed on to other service providers such as PCTOs (Private Container Train Operators).
- Fixed lanes between North to/fro South and West to/fro East are possible. It is envisaged that a regular freight service will promote the use of railway mode for horticulture transport and develop the appropriate eco-system of freight forwards/aggregators.
- DAC&FW is already promoting the setting up of modern pack-houses as aggregation points, reefer transport including rail containers and warehousing for distribution purposes with material handling equipment.

Conclusion

- There is definite advantage to use rail-based long-haul of fruits and vegetables.
- There appears to be ample scope to promote rail mode of domestic transport for fruits and vegetables and other perishable food items.
- Initially, a weekly schedule on fixed lanes can be spearheaded for perishable fruits and vegetables.
- These lanes can be initiated on railways wagons or on container trains (CONCOR or Private Operators) in north-south and east-west direction.
- The initial freight volume is expected to be piecemeal or less than rake load.
- Freight forwarders can expect to initially book less than a container or VPN load on predetermined scheduled runs.
- As volumes are scaled up, necessary development in terms of other associated handling infrastructure can be subsequently planned.
- Publicity can be given to a two year window of rail-based service offering to promote users, while scheme based support for agri-logistics infrastructure to private sector can be used to drive entrepreneurial interest.
- A focused study to assess the scope and infrastructure requirement could be undertaken for long term development of multi-modal carriage of perishable goods. ■

Pawanexh Kohli
Chief Advisor & CEO, NCCD,
New Delhi

World's First Eco-friendly CO_2 Refrigerant Compressor for Cars

In accordance with environmental policies, the European directive on mobile air conditioning systems (MACs) introduced a ban for the use of refrigerant gas with a global warming potential (GWP) higher than 150 applicable for all new cars sold on the EU market since 1 January 2017...

Sanden Automotive Components Corporation, a wholly owned subsidiary of Sanden Holdings Corporation, announced that it has recently completed the development and industrialization of compressors for automotive air conditioning applying CO_2 refrigerant. The company started supplying Daimler AG with the world's first CO_2 compressor for mass-produced passenger cars in May 2017 on a full scale.

Environmental regulations such as for prevention of ozone layer depletion or global warming are evolving rapidly around the world in order to cope with recent environmental problems occurring on a global scale. In accordance with these environmental policies, the European directive on mobile air conditioning systems (MACs) introduced a ban for the use of refrigerant gas with a global warming potential (GWP) higher than 150 applicable for all new cars sold on the EU market since 1 January 2017.

Advantages of the natural CO_2 refrigerant

Features \ Refrigerant	CO_2 (Natural Refrigerant)	HFO - 1234yf	HFC - 134a (alternative fluorocarbon)
Global Warming Potential (GWP)	1	4	1410
Ozone Depletion Potential (ODP)	0	0	0
Atmospheric Lifetime	absorbed and incorporated into natural circulation system	11 days generates oxidants during decomposition	14 years
Flammability	non-flammable	flammable	non-flammable

"Daimler chose Sanden for the development of the R744 compressor because of their extensive experience with this refrigerant and pioneering spirit towards new technologies. It has been quite a challenging project also for Daimler to get the R744 AC system launched in such short period. Therefore, the strategic partnership with Sanden has been very important and we are pleased about this successful launch," said Dr Ralf Theurer, Project Leader R744, Daimler AG.

"This project truly represents the policy of Sanden Management; Create corporate value based on 'environment' utilizing our global strength and quality capabilities. We are contributing to the health of our planet by bringing to the market a robust product, which has been designed by a global team. I am proud of this launch and very grateful for the co-operation with Daimler. Serving our customer whilst engaging in environmentally friendly activities is a privilege," said Tsuguo Ito, President of Sanden Automotive Components Corporation. "My target is to expand this technology and use the knowledge gained throughout the development to grow in a sustainable manner in the world market."

Advanced technological skills regarding high pressure resistance and airtightness structure are required in commercializing the CO_2 compressor, because operating pressure for CO_2 refrigerant is 5 times greater than that of HFC-134a. For several years, the Sanden group has actively pursued adoption of CO_2 refrigerant in a wide range of products including freezing and refrigerating showcases, and vending machines, all of which are receiving high praise from customers around the world. For the development of the new automotive compressor, in 2014 Sanden established a project team reporting directly to the president of Sanden Holdings Corporation (formerly Sanden Corporation). The joint Japan-Germany based team completed the development of this product. The product development was accomplished in record time by adapting CO_2 refrigerant technology incorporated in various other products to enhance the basic performance of this new compressor. The compressors are produced at Yattajima plant, Gunma prefecture in Japan.

CO_2 Refrigerant Compressor

Product Features

- Cooling performance and function exceeding conventional compressors with one fifth of capacity (31cc)
- Packaging and weight equivalent to conventional compressors
- High pressure resistance to enable performance at 5 times high operating pressure
- Noise reduction structure with new internal design feature Improved stability and safety achieved by new control method

With environmentally-friendly vehicles becoming popular worldwide, attention is being focused on CO_2 refrigerant combined with electric compressor and heat pump system, for their abilities to deliver lower energy consumption. The Sanden Group continues to contribute to global environmental conservation and the innovation of the automotive industry worldwide, by offering advanced technology and high quality compressors. ■

Value Chain for Vegetables & Fruits

Due to perishable nature and improper post-harvest handling, 25- 30% of the produce is rendered unfit for consumption. This increases cost of production with reduced returns. In this article, prospects of value chain for vegetables and fruits are explored, limitation identified and solutions to address the problems have been suggested...

Agriculture in India, especially, in the north Indian plains, is passing through a critical stage. Current farming systems are difficult to sustain. Alternate options are being explored for their economic viability. Being high value crops and suitable for multiple cropping systems, vegetable crops cultivation offer viable option to diversify agriculture in Punjab. However, due to perishable nature and improper post-harvest handling 25-30% of the produce is rendered unfit for consumption. This increases cost of production with reduced returns. In this article, prospects of value chain for vegetables and fruits are explored, limitation identified and solutions to address the problems have been suggested.

Prospects of Vegetable & Fruits Cultivation in Punjab

Potato is the major leading vegetable crop of Punjab having an area of 87.2 thousand ha with 55 % of the vegetable production. There is scope to increase area under processing potatoes since most of the raw material for processing in Punjab is imported from outside the state. Similarly, other than potatoes, pea, cucurbits, chilies, capsicum, onion, cauliflower, tomato, brinjal and carrot etc are major vegetables grown in the state. Turmeric, ginger and garlic production is also gradually picking up. Onion is another important crop for domestic use and export and can be promoted as an alternative crop in the state. Pea is the third important vegetable

crop and is consumed as fresh and processed into frozen. It is available in the state from November to March.

Among fruits, the Punjab state leads in citrus production with the highest production of Kinnow, which occupies an area of 47.1 thousand ha contributing 67% of the total fruits produced in Punjab. Other important fruit crops are guava, mango, pear and peach which occupy considerable area in the state. Protected cultivation is another area which can boost the economy of Punjab state and can generate employment and entrepreneurship in the rural youth. The farmers are enrolling in vocational training course being conducted by Precision Farming Development Centre, PAU Ludhiana for honing their skills. Protected cultivation increases productivity of the land manifold, thus, improves the income levels of the farmers substantially. Precision farming practices are scaling new heights in Punjab with poly net house farming of vegetables picking up not only amongst the small and the marginal farmers but also among the farmers with large holdings. About 1200 poly net houses were built in Punjab occupying total area about 51 hectares. The high value crops viz. capsicum (coloured and green), seedless cucumber, tomato (both table and cherry), gerbera, lilium etc are being cultivated throughout the year. Both progressive and small/marginal farmers are adopting the technology to cultivate vegetables the year round. The Punjab Horticulture Department is reaching out to more and more farmers.

Status of Vegetable & Fruit Processing

Despite being the leading agrarian state of country, Punjab is way behind in food processing or value addition industry. A very few low capacity multi-commodity processing units are being managed by some self-help groups. Some self-help groups have also started supply chain of fresh vegetables directly to retailers and consumers. Establishment of processing industry for bulk consumption of the produce will help to stabilize vegetable marketing and sustain the fruit and vegetable production. Crop cultivars and agronomic practices should ensure good quality raw material availability for longer periods. Some of the processable varieties of different fruits and vegetables grown in Punjab are as under:

Vegetable	Cultivars
Tomato	Punjab Ratta
Pea	Punjab 89
Onion	Punjab White
Chilli	CH 1, CH 27, Punjab Sindhuri
Turmeric	Punjab Haldi- 1, Punjab Haldi- 2
Carrot	Punjab Black Beauty
Chinese sarson	Chinese Sarson 1, Chinese Sarson 2, Saag Sarson
Potato	Kufri Chipsona- 1, Kufri Chipsona- 3, Kufri Frysona
Ashgourd	PAG 3
Fruits	
Mandarin	Kinnow
Guava	Punjab Pink
Grapes	Punjab Purple
Litchi	Dehradun, Calcuttia
Mango	Dashehri
Pear	Punjab Nectar, Punjab Soft and Punjab Gold
Peach	Shan-i-Punjab
Plum	Satluj Purple and Kala Amrtitsari

Establishment of Food Parks

To enable small and medium scale units to attain viability by defraying cost of major facilities such as R & D lab, cold storage, warehousing, pack house etc at present, one food park project at Sirhind, district Fatehgah Sahib is being implemented by PAGREXCO. Another food park has been approved by the Ministry of Food Processing Industries (MoFPI) which is being implemented by International Mega Food Park Ltd at village Dhabwala Kalan district Fazilka. Recently, one more food park has been approved by MOFPI at Ludhiana (Ladhowal).

For value addition and preservation infrastructure, MoFPI has approved two cold chain projects in the state. One project at village Rajaur, dist Kapurthala is complete and has started commercial operations. Another project at village Channo District Sangrur is at an advanced stage of completions.

Establishment of Cold Chain

Cold chain is a logistic system that provides a series of facilities for maintaining ideal storage conditions for perishables from the point of origin to the point of consumption in the entire supply chain. The chain needs to start at the farm level (e.g. harvest methods, pre-cooling) and cover up to the consumer level or at least to the retail level. A well-organized cold chain reduces spoilage, retains the quality of the harvested produce and guarantees a cost-efficient delivery to the consumer given adequate attention for customer service.

Benefits of Cold Chain

Benefits to farmers or producers

- Increasing income to the farmers
- Helping in price stability
- Checks the glut like situation

Benefits to the consumers

- Price stability
- Year round availability
- Ensured quality

The main feature of the chain is that if any of the links is missing or is weak, the whole system fails. The Cold Chain Logistics Infrastructure generally consists of:

- Pre-cooling facilities
- Cold Storages
- Refrigerated Carriers
- Packaging
- Warehousing
- Information Management Systems (Traceability and Tracking etc.)

The cold chain operations start right from the field and ends until the commodities reach to the consumers in good quality. The main steps involved during cold chain are:

Existing post-harvest and cold chain infrastructure for vegetables and fruits in the state:

i) Cold Storages:

At present, a total of 550 cold storages are available in the state, which are mostly

used for storage of potato. Punjab Mandi Board has also established state-of-the-art post-harvest infrastructure in 12 fruit and vegetable markets of Punjab comprising of 16 multi-chamber cold storages each having capacity of 50 MT and 52 ripening chambers with 10 MT capacity each.

ii) Mechanical Washing & Grading Lines:

At present, there are five mechanical washing, grading and waxing plants established by Punjab Agro Industries Corporation (PAIC). These washing and waxing plants are established at Chhauni Kalan and Kang Mai in Hoshiarpur district, Abohar, Jattan Tahliwala in Ferozepur district and Badal in Muktsar district. Besides, many progressive growers (more than 100) have also installed such facilities privately at their own farms.

iii) Processing plants:

The Punjab Government through its agency Punjab Agro Juices Limited (PAJL) has established two pilot scale processing units at Hoshiarpur and Abohar. Plants have capacities to handle 20 MT per hour citrus fruits and 10 MT per hour of other fruits and vegetables with cold storage as well as deep freezer capacity of 1000 MT each at both the plants. The machinery for the plants has been procured from CFTSPA Italy, a leading international food engineering company. The plants are designed to process Kinnow and debitter the juice and have the capacity to process other fruits and vegetables such as tomato, carrot, pomegranate, papaya, guava, pear, pumpkin, melons, chilly, jamun, mango, strawberry, litchis, amla, aloe-vera etc. The processing plants can handle pulp and store all the concentrates and single strength juices at one facility. PAJL has also been doing job work for large domestic and multi-national companies.

iv) Centre of Excellence:

In a bid to enhance skills of the farmers by providing training in latest agriculture techniques, the Punjab Government has established three centres of excellence one each for vegetables at Kartarpur (Jalandhar), for fruits at Khanaura (Hoshiarpur) and for potato at Dhogri (Jalandhar). The center at Kartarpur has been established in sync with the Indo-Israel agreement. It is aimed at to make the Punjab farmers aware of the latest technological and scientific advancements in cultivation of vegetables. The center of excellence at Dhogri is being established in joint collaboration with Indo-Dutch joint agriculture work group with a focus on quality of seed potato, suitable farm mechanization and proper disease management technologies etc.

v) High-tech Pack Houses:

Five pack houses with cold storage and grading or sorting lines have been established by PAGREXCO at Mushkabad (Ludhiana), Saholi and Lalgarh (Patiala), Kangmai (Hoshiarpur) and Babri (Gurdaspur).

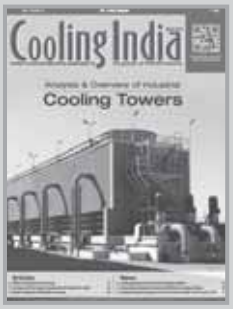
vi) Self-help groups:

At present, few cooperative societies like FAPRO, Unati, KAFRO etc are proving role model for development of rural entrepreneurs and income as well as employment generation.

vii) Establishment of private sectors in Punjab

- **Field Fresh Foods Private Ltd:** It is a joint venture between Bharti Enterprises and Del Monte Pacific Limited. For fresh vegetables, Field Fresh Foods has an Agriculture Centre of Excellence (ACE) at Ladhowal, Ludhiana in Punjab, which is one of the largest agricultural R&D facilities of its kind and is spread over 300 acres with a state of the art protected and open field cultivation for value added vegetables. At ACE, the advanced technologies and agricultural best practices are showcased to partner farmers in order to help them in enhancing their agricultural productivity and farm income in an environmentally sustainable manner. Field Fresh Foods is engaged with over 4000 partner farmers across 5000 acres in Punjab and Maharashtra, who are Global GAP compliant and grow vegetables for export to Europe. The company offers processed food and beverage products in India under the brand Del Monte and fresh vegetables in its export markets under the brand Field fresh.
- **Namdhari Farm Fresh:** Namdhari's Fresh handles more than thousand tons of fresh vegetables and fruits at domestic and international market. The produces are mainly destined to Europe, Australia and the Middle East. After the success in seed world, Namdharis have diversified into production, distribution and export of fresh vegetables and fruits under the name "Namdhari's Fresh" To ensure the freshness of the vegetables till it reaches the consumer, the company is having a continuous cold chain network right from the point from where the produce is harvested. The harvested vegetables are transported in refrigerated trucks which also help in the removal of the field heat. From the refrigerated trucks, the vegetables are transferred to the pre-cooling room. The certification is done by the Dutch accredited certifying agency SKAL, with a symbol EKO which is recognized in most of the Europe and the north American countries. It has become India's first vegetables growing and exporting firm, which has received GLOBAL-GAP Certificate. The pack house is under implementation of BRC and HACCP, however all the norms, essential for the same are practiced.
- **PAGRO Frozen Foods Private Ltd:** It is the largest private integrated vegetable processing plant incorporated in 2007 in Punjab. The major product is frozen green peas but it also processes potato, onion, carrot, sweet corn etc. With daily processing capacity of 550 tons (50000 tons vegetables / year), PAGRO in fact is the largest plant in South East Asia. The plant runs for 280 days a year. It receives about 90% of the raw material from outside the state.
  - **List of some processing units in Punjab**

Processing unit	Location
JP Co	Khadoor Sahib
Cremica	Hoshiarpur
Palca	Jalandhar
Harnaj and Nijjar Agro foods	Amritsar



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- Surgeons
- Paramedical Professionals
- Hospital Administrators
- Pathologists
- Radiologists
- Physiotherapists

Several Others…

Punjab Agro Juices limited processing facility at Hoshiarpur

State-of-the-art pack-house, cold store and ripening facility at fruit and vegetable market, Ludhiana

PAGRO plant at Fatehgarh Sahib (Punjab)

Pre-cooling of fresh produce at Namdhari pack house, Ludhiana

Indian fresh produce from Punjab in UK

Baby corn being handled at low temperature at field fresh facility, Ludhiana

Tomato Processing & its scope

According to the World Processing Tomato Council (WPTC), an estimated 41.37 million tonnes (MT) of tomato (26% of global production) worldwide were processed into value-added products in 2015. By comparison, less than 1% of India's tomato production currently gets processed into such products. An estimated 130,000 tonnes of tomato were processed in India in 2015, which is 0.3% of the global tomato processing market. Tomato paste is an important product because it is used as the base for a wide range of other products. A wide range of value-added products are produced from tomato including tomato juice, paste, diced/peeled tomatoes, strained tomato pulp, ketchup, pasta, pickles and pizza sauces, salsa, gravies, ready-to-eat (RTE) curries and tomato-based powder products. Processed tomato products have wide application in the household, food processing industry, snack foods,

hotels, restaurants and fast food retail chains. The process involves washing and grading tomatoes and then boiling them in steam jacked kettles before pulping in a continuous pulper, where skin and seeds are separated from the pulp. The filtered extracted pulp is the basic material from which other products are made. The recovery of pulp varies from 40% to 50% depending upon the quality of tomatoes. A recent survey by ASSOCHAM (the Associated Chambers of Commerce of India) conducted in leading Indian cities indicated that the demand for tomato puree and ketchup has surged by 40% in just the month of June 2016 due to surging fresh tomato prices and a trend towards easier-to-cook meals. India's

Table 1: Recommended Storage Conditions for Fruits & Vegetables

Commodity	Temperature (ºC)	Relative Humidity (%)	Approx. storage life
Fruits			
Bananas	13-15	85-90	1-4 weeks
Ber	7-8	90-95	2 weeks
Grapes	0-2	90-95	1-6 months
Guava	6-8	90-95	2-3 weeks
Kiwifruit	0-2	90-95	3-5 months
Lemon	10-13	85-90	1-6 months
Lime	9-10	85-90	6-8 weeks
Kinnow	4-6	90-95	1.5 months
Mango	12-15	85-90	2-3 weeks
Peach	0-2	90-95	2-4 weeks
Pear	0-2	90-95	2 months
Plum	0-2	90-95	3-4 weeks
Vegetables			
Asparagus	0-2	90-95	2-3 weeks
Beans, green	4-7	90-95	7-10 days
Beets	0-2	90-95	10-14 days
Broccoli	0-2	90-95	10-14 days
Brussels sprout	0-2	90-95	3-5 weeks
Cabbage	0-2	90-95	3-6 weeks
Carrots	0-2	90-95	4-6 weeks
Cauliflower	0-2	90-95	3-4 weeks
Celery	0-2	90-95	2-3 months
Cucumbers	10-12	90-95	10-14 days
Eggplant	8-10	90-95	2-3 week
Garlic	0-2	65-70	6-7 months
Ginger	13-15	65-70	6 months
Greens, leafy	0-2	90-95	10-14 days
Lettuce	0-2	90-95	2-3 weeks
Cantaloupe	0-2	90-95	1-2 weeks
Watermelons	10-15	90-95	2-3 weeks
Mushrooms	0-2	90-95	3-4 days
Okra	8-10	90-95	7-10 days
Onion, green	0-2	95-100	3-4 weeks
Onion, dry	0-2	65-70	1-8 months
Peas, green	0-2	90-95	1-2 weeks
Chilli, green	8-10	90-95	2-3 weeks
Potato (seed)	0-2	90-95	5-6months
Pumpkins	10-13	60-70	2-3 months
Radish	0-2	90-95	2-3 weeks
Spinach	0-2	90-95	1-2 weeks
Sweet potato	13-16	85-90	4-7 months
Tomato (green)	13-15	90-95	3 -4 weeks
Tomato (Red)	8-10	90-95	1 week

annual ketchup consumption is estimated at 13,000 tonnes with a market valuation of Rs 1.8 billion (USD 28 million). Nestle's Maggi dominates the ketchup market with a 37% market share followed by Unilever's Kissan (29%) and Heinz (10%). Tomato paste production appears to be commercially viable when processing facilities are based in and around key Indian tomato growing areas. Though the market for processed tomato products is expanding, the processing industry is often confronted with the problem of limited supply of processing tomatoes. Quality parameters for processing include color, total soluble solids, sugar content and firmness for which existing Indian tomato varieties currently available in India are considered unsuitable. The most popular market type for the fresh market is acidic, and highly suitable for curries and other common dishes. Processors are required to neutralize this acidity with increased dosage of sugar resulting in higher production costs. Despite the high potential for growing tomatoes, low yields increase the cost and the risk of growing tomatoes resulting in depressed farmer incomes.

Leading Indian Tomato Paste Makers & Product Manufacturers

Hindustan Unilever: HUL's Kissan brand is India's second-most popular ketchup brand with a market share of 25%. HUL was one of the first processing firms to institutionalize farm-gate sourcing of tomatoes from small holder farmers in Nasik district in 2011. Kissan partnered with smallholder farmers, a local tomato paste processor named Varun Agro and agri-input supply companies to establish a supply chain aimed at producing tomato paste locally that could be used as an input into its ketchup production process. Unilever sourced 40,000 tonnes of tomato from India in 2011, some 60% of its requirement for ketchup production.

Field Fresh Foods or Del Monte: India's third largest processed tomato products maker, Field Fresh manufactures ketchup, pasta and pizza sauce under the Del Monte brand at its factory is located in Krishnagiri. It has established a 120 ha R&D farm at Ladhowal, near Ludhiana where it is undertaking tomato production trials including specialized cultivars for the processing industry and the application of mechanization for tomato cultivation and harvesting.

Nestle India: Nestle is India's leading ketchup maker with a market share of 37% through its Maggi brand. Nestle also produces tomato soup mixes competing against Knorr and other leading brands. Nestlé India collaborates with suppliers to source raw materials locally under its Supplier Development Program though it also uses its global supply chain to import raw material for ketchup production in India.

Global Green: This Bangalore-based processor and exporter commenced large scale contract farming of hybrid tomatoes in 2012 to meet the growing demand for tomato paste and tomato paste based sauces in India. It has promoted the use of processing hybrid varieties from United Genetics USA like UG-37, UG-157, UG-52, amongst farmers which have high lycopene content. It established farmer groups and small cooperatives to enable production volumes for its processing needs and to improve quality compliance through a cluster-based approach. Global Green sources tomatoes over the two peak seasons annually from farmers in Andhra Pradesh as well as from Kolar and adjoining areas of Karnataka which are processed at the facilities of Srini Food Park in Chitoor, Andhra Pradesh. Global Green processes over 20,000 tonnes of fresh tomato each year. Using paste produced at the Srini Food Park, it produces value-added tomato based products under the Tify brand including ketchup, pasta sauce, and tomato blend and pizza sauce.

Indira Foods: Established in 2008, Indira Foods produces tomato ketchup for the retail and institutional segments with a focus on the southern Indian market. With capacity to process 30 tonnes/day it has a 70% market share of sales to hotels, restaurants and airlines in Karnataka apart from supplies to Global Green and Namdhari Group. The company procures tomatoes from Kolar district in Karnataka.

Cremica Group: It produces tomato ketchup, puree, pasta sauce, dips and Indian gravies at its production facilities in Ludhiana (Punjab) and Noida, near Delhi. Apart from its retail products, the company supplies to food chains like McDonald's, Barista, Café Coffee Day, Pizza Hut, Domino's and Papa John's as well as to institutional partners and private labels like Big Bazaar, Spencer's, Taj Group, ITC, Jet Airways and Air India.

Dabur India: It is a leading producer of tomato puree, tomato juice, soups and chutneys under its 'Homemade' retail brand. Tomato processing operations commenced in 2011 at its processing plant in Siliguri (West Bengal) while juices are produced at its factory in Nepal.

Capricorn Food Products: Capricorn is one of India's largest independent tomato paste makers supplying paste and puree to leading processors and private labels including Hindustan Unilever, Nestle and Field Fresh. It has processing facilities for paste making in Nashik (Maharashtra) and puree production in Koyna (Maharashtra), Krishnagiri (Tamil Nadu), Chitoor (Andhra Pradesh). In 2013, Capricorn established a plant in Nashik, Maharashtra with the capacity to produce 100 MT of tomato paste every day. During off season from April to July, Capricorn's paste making units process mango pulp to maintain round-the-year operations.

Nijjer Agro Foods: An Amritsar-based tomato paste manufacturer supplies the product to Nestle, Del Monte and other processed food makers in the northern Indian region.

GD Foods: Produces both tomato paste and processed products like ketchup under its 'Tops' brand at its plant operations in Tarn Taran (Punjab). It currently operates plant facilities producing 42,000 tonnes per annum and supplements tomato processing with chilli and apple products. For tomatoes, it undertakes contract farming over 400 ha with farmers in Punjab.

Mother Dairy: The company produces tomato paste and its Safal brand of tomato ketchup at its 23,000 tonnes per annum pulp and concentrate unit near Bengaluru

in Karnataka. Mother Dairy partnered with Bayer Crop Science to improve tomato production amongst farmers in Chickballapur and Tumkur districts of Karnataka for its processing needs. Bayer Crop Science identified tomato varieties suitable for processing and scientifically raised seedlings of the short listed varieties. These were then provided to some 361 farmers for further cultivation on 280 hectares under its supervision and improved crop production practices including crop protection techniques were applied as well as the internalization of traceability processes. As a result, tomato yields of farmers are reported to have increased from 35 tonnes/ha to 45 tonnes/ha. The company also announced in February 2016 plans to develop a new puree production and processing unit in Ranchi in Eastern India. Mother Dairy also sells frozen tomatoes in the Delhi-National Capital Region which it processes at its facility in West Delhi.

Godrej Beverages and Foods: Godrej targets the home cooking segment with its Smart Cook tomato puree range of products.

GRG Foods: Bangalore-based food products company manufactures its Spego brand of tomato ketchup and Revathi brand of tomato-based powders and mixes for the Southern India market.

National Agriculture Co-operative Marketing Federation: NAFED operates a tomato paste and ketchup production facility in Vellore (Tamil Nadu).

ITC Group: ITC produces a range of ready-to-eat (RTE) products for the Indian and export market under its kitchens of India brand. This includes curry pastes, sauces and chutneys which include tomato as an important ingredient.

Griffith Laboratories: Griffith is a US-based specialized condiments producer which manufactures Indian paste and powder mixes at its Bengaluru facility for food services institutional clients including hotels and restaurant chains in India and overseas.

Chordia Food Products: Chordia produces tomato ketchup, paste and mixes at its factories in Shirwal close to Pune (Maharashtra) and Chennai and Dharwad (Karnataka) for both the domestic retail market and supplies to institutional clients. With an installed capacity of 2.5 tonnes per day it previously supplied tomato paste to Nestle but now consumes most of its processed paste.

Constraints

Following are constraints that why farmers are not interested in growing vegetables/fruit for processing:

- The quality of fruits and vegetables is not uniform
- Lack of processing units in crop production areas
- Costly seed of private companies
- The domestic demand for processed products is quite low due to seasonal availability of most fresh fruits or vegetables almost throughout the year
- At all stages, manpower involved in logistics and marketing is not fully aware of produce requirements, leading to loss in quality and value
- Lack of contract farming
- Delay in payment to growers by processing units
- Lack of good behaviour of processing units towards farmers
- Lack of mechanization in crop cultivation and handling
- Lack of varieties suitable for processing purpose
- Diseases and insect-pest problem
- Erratic and costly power supply
- Inadequate pricing by processors
- Poor rural infrastructure affecting transport
- Viability of processing to remain a question mark for many reasons,

Probable solutions

- Increasing area and productivity of vegetables is not the answer to Punjab's diversification and thereby value chain issues, unless all farmers are a part of a modern value chain structure.
- There is periodic glut of particular fruit and vegetable, which can be managed if proper post-harvest infrastructure including cold chain is created both at farm and market levels
- If middle men are present in the chain, they should act as facilitators to add value to the produce by way of consolidation, wholesale activities, processing, storage, packaging and transportation.
- There is need to strengthen linkages between farmers and food processors
- Innovative practices like contract farming needs to be encouraged. Contract farming can fill up this gap by providing the farmers with quality inputs, technical guidance and management skills
- Additional skills and expertise required for high-value markets need to be developed.
- In order to push diversification in agriculture sector, Punjab must focus on research & development, extension and training services in post-harvest management, distribution and marketing of horticultural crops. ■

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Engineers Find Way to Evaluate Green Roofs

A good-for-the-environment solution to mitigating storm water runoff may seem like a no-brainer, but a common concern regarding green roofs is the variability of their performance. One challenge is figuring out how well the buildings that hold them up will respond to the increased and highly variable weight between wet and dry conditions...

Graduate student Reshmina William, left, and civil and environmental engineering professor Ashlynn Stillwell pause on the green roof over the Business Instructional Facility at the University of Illinois. Their research is helping to simultaneously evaluate the performance of green roofs and communicate their findings with urban planners, policymakers and the general public.

Green infrastructure is an attractive concept, but there is concern surrounding its effectiveness. Researchers at the University of Illinois at Urbana-Champaign are using a mathematical technique traditionally used in earthquake engineering to determine how well green infrastructure works and to communicate with urban planners, policymakers and developers.

Green roofs are flat, vegetated surfaces on the tops of buildings that are designed to capture and retain rainwater and filter any that is released back into the environment. "The retention helps ease the strain that large amounts of rain put on municipal sewer systems, and filtration helps remove any possible contaminants found in the stormwater," said Reshmina William, a civil and environmental engineering graduate student who conducted the study with civil and environmental engineering professor Ashlynn Stillwell.

A good-for-the-environment solution to mitigating storm water runoff may seem like a no-brainer, but a common concern regarding green roofs is the variability of their performance. One challenge is figuring out how well the buildings that hold them up will respond to the increased and highly variable weight between wet and dry conditions. Another challenge is determining how well they retain and process water given storms of different intensity, duration and frequency, William said. While studying reliability analysis in one of her courses, William came up with the idea to use a seemingly unrelated mathematical concept called fragility curves to confront this problem.

"Earthquake engineering has a similar problem because it is tough to predict what an earthquake is going to do to a building," William said. "Green infrastructure has a lot more variability, but that is what makes fragility curves ideal for capturing and defining the sort of dynamics involved."

William and Stillwell chose to study green roofs over other forms of green infrastructure for a very simple reason: There was one on campus fitted with the instrumentation needed to measure soil moisture, rainfall amount, temperature, humidity and many other variables that are plugged into their fragility curve model.

"This is a unique situation because most green roofs don't have monitoring equipment, so it is difficult for scientists to study what is going on," Stillwell said. "We are very fortunate in that respect." William said the primary goal of this research is to facilitate communication between scientists, policymakers, developers and the general public about the financial risk and environmental benefit of taking on such an expense.

"One of the biggest barriers to the acceptance of green infrastructures is the perception of financial risk," William said. "People want to know if the benefit of a green roof is going to justify the cost, but that risk is mitigated by knowing when an installation will be most effective, and that is where our model comes in."

The results of their model and risk analysis, which appear in the Journal of Sustainable Water in the Built Environment, provide a snapshot of green infrastructure performance for this particular green roof. The results from a single model do not yield a one-size-fits-all approach to green infrastructure evaluation, and William and Stillwell said that is one of the strengths of their technique. Adaptability across different technologies and environments is essential to any green infrastructure analysis. The University of Illinois department of civil and environmental engineering and the Ravindar K and Kavita Kinra Fellowship in Civil and Environmental Engineering supported this work. ■

Air Master: Leaders in HVAC Air Distribution Products

Air Master is a group of companies established in UAE in the year 1987 by Indian entrepreneurs, and started operations in India in 1988. Since then, Air Master has been delivering the best quality air distribution products with a proven record of on time delivery and distinct quality. We have been operating in the Middle East and Indian Sub-Continent ever since and currently operate eight manufacturing facilities in Middle East and four in India with a highly skilled workforce, headed by a team of business professionals and experienced engineers and managers, thus, ensuring delivery of quality engineered products to meet the dynamic needs of our customers in a scheduled time. We are the first Indian company to have introduced world class quality aluminium air distribution products in India.

Products

Over the decades we have engaged in manufacturing wide range of air terminal outlets such as Grilles, Registers, Louvers, Diffusers, Jet nozzles and ducting accessories such as volume control dampers, fire dampers, sound attenuators, VAVs and access doors. We also manufacture UL classified fire and smoke dampers and fire doors. The flexible ducts and adhesive tapes amongst others products in UAE.

This year has been another important milestone for Air Master with the launch of UL Classified Fire and Smoke Dampers in India. A new state-of-the-art manufacturing plant was opened in Bangalore dedicated to manufacturing UL products to meet the growing demand in the industry. Our factory in Bengaluru has been approved by Underwriter Laboratory USA with multiple listing code to produce the above dampers. Our central location facilitates easy reach and logistic support throughout India for timely delivery to our esteemed customers.

Quality

Air Master products are tested by ETL testing laboratory in accordance with the ASHRAE, ANSI, and AMCA standards by testing facilities in USA and UK to guarantee its performance and efficiency. Air Master Fire Dampers (vertical and horizontal installation) are UL555 & UL555S classified for 1½-hour and 3-hour fire rating to ensure its performance and reliability in times of need. Air Master Fire Doors (Single Swing Type Doors) are UL 10B classified for 2-hour fire rating. In addition to this, all products undergo multiple quality inspections before delivery to ensure quality, excellence and customer satisfaction.

Facility

Our factories are one of the largest of its kind in this line both in UAE and in India, specially dedicated to the manufacturing of air outlet products and ducting accessories. We boast state-of-the-art manufacturing facilities in Bangalore apart from eight in Middle East. Our plants are equipped with highly sophisticated machines and technology imported from across the world. We are increasingly making use of automated technology which has enabled faster deliveries to its customers with higher precision in quality. Totally, Air Master employs over 500 skilled workforce resulting in a smooth and unstoppable production output. Air Master's prime focus remains on quality of the product delivered which we do not compromise at any cost. With sales and business

operations across India and all GCC countries and manufacturing facilities in Bangalore and Chennai in India, Air Master does its best to meet the growing demands of the region.

Projects

We have been a part of many prestigious projects and carried out various challenging projects in sectors such as Business Parks, leading IT software Parks, 7 & 5 star Hotels like Abu Dhabi Palace Hotel, Oman Palace Hotel apart from The Atlantis in the Palm Jumerah, hospitals, airport terminals, power stations, oil and gas, manufacturing plants, shopping malls, universities etc. We have supplied to almost all major airports in South India and many 5 Star hotels such as Leela Palace Marriott, Hilton, Sheraton, Shangri La, Taj Group etc. Other projects to name a few are Bosch, Toyota, Prestige Golfshire, Embassy Boulevard, Bangalore World Trade Center, Shantiniketan, Kingfisher Towers, ANZ, IBM, Wipro, Infosys, Cognizant, Accenture, Amazon, ISRO, BEL, BARC and many more.

The tallest tower in the world, Burj Khalifa, is definitely amongst one of our most prestigious projects. Air Master brand was selected by the project consultant with toughest competitions among the leading world suppliers due its reliability and undoubtable commitments to deliver on time by maintaining quality at all stages. It was a challenging project with non-negotiable deadlines. In addition to specially designed Grills and Diffusers, we also supplied large volumes of Volume Control Dampers and Access Doors. We procured the design and spare parts in Germany and assembled the products in our specially established workshops. All air ventilation products in Burj Khalifa were supplied by Air Master. Special services were also provided to meet the aesthetic requirements of the project.

Challenges

We face different challenges for each project due to varying project requirements during the completion of the project. Every construction project is unique in its own way encompassing various features such as performance, sustainability, reliability, safety, security, maintainability, beauty, etc. Our products are designed to meet each of these demands as we accommodate these changing needs and the aesthetic needs of the architects, consultants and government agencies. We are committed to quality and prompt deliveries.

Finishing a project within a given deadline is a difficult task for the contractors, which Air Master understands. We ensure that the project is completed by offering our full support and we carry out this efficiently and with complete dedication. The requirement for our products arises at the 11th hour since our products are required at the final stages of the project.

Our unique talent and capability has contributed to our fame as a reliable supplier. Our trademark values of honesty and reliability and cooperation's have enabled us to emerge as a market leader and have kept us ahead of any changes in the business environment.

It is our privilege to work with the best consultants around the world to their fullest satisfaction with constant research and development fulfilling the gaps between manufacturers and end users. We also manufacture custom made products to suit their design requirement keeping in mind the increasing demand for new innovative products.

Burj Khalifa, Dubai

Growth

We have steadily grown with more than 25 years of excellence in this field and the knowledge of air outlet products and their design has increased over the years. Now there are various types of air distribution products that have vastly improved the air quality and air distribution systems. As projects costs have been on the rise, awareness of sustainability and its subsequent implementation has also increased. Products are expected to be environment friendly and energy-efficient while adding more focus on the aesthetic aspect of the product. At Air Master we strive to make all our products and processes sustainable and energy efficient by constant research and developments. Our operations are less energy consuming, including our powder coating methods which are automated and environment-friendly.

Our progressive growth over the years is the result of strong attention of our consultants and clients due to our commitment to delivery of quality products and an invariable passion for continuous improvement and the dedication of our employees. Air Master started as a family business, and continues to thrive today as the second generation well qualified with Post Graduations as stepped in to add further dedication to Air Master's spirit, and vigorously expanding and improving operations.

Future

We at Air Master believe in having a global approach towards serving customers. We strive to serve all regions of India, GCC countries, Africa, Europe and some parts South Asia. We believe we can expand this further by introducing new products and services in the present day dynamic environment. Our achievements in the past loyalty of our customers to whom we brand as life time customers stand as a testimony to our growth. We are always in search of new business opportunities and products to further expand our wings of innovation to serve our customers in the best possible way we can. "Air is the basic need of every individual, and we ensure it is delivered to you for your comfort, health and safety." ■

Gubba Cold Storage Uses Thermal Imaging To Guarantee Best Cold Storage Conditions

Gubba Cold Storage offers its customers high-quality cold storage services for a wide range of products. In order to guarantee the best conditions for the stored goods, Gubba Cold Storage makes sure that its infrastructure is in an impeccable state. That is why the company recently invested in thermal imaging technology from FLIR. Thanks to FLIR, no insulation leakage or bad electrical wiring goes unnoticed.

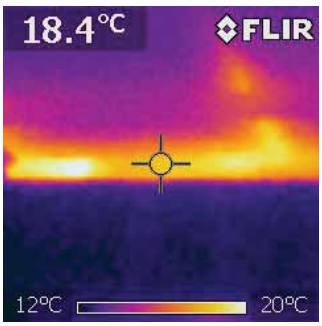
Since 1987, Gubba Group Ltd. has been offering cold storage services out of Hyderabad, Telangana, India. Gubba Cold Storage's eleven cold storage units are operational on a 24/7 basis and offer infrastructure for stocking seeds, pharmaceuticals products as well as agricultural products. Every stored product in the cold storage facilities has its own set of prescribed temperature settings. Understandably, with the continuous operation of Gubba Cold Storage's facilities lead to high energy consumption.

"At Gubba, we provide a host of value added services to our customers that helps build their trust," says Gubba Prashant, Director at Gubba Group Ltd. "As customer satisfaction is our main priority, we will do everything in our capacity to ensure that our customers' stocks are preserved perfectly."

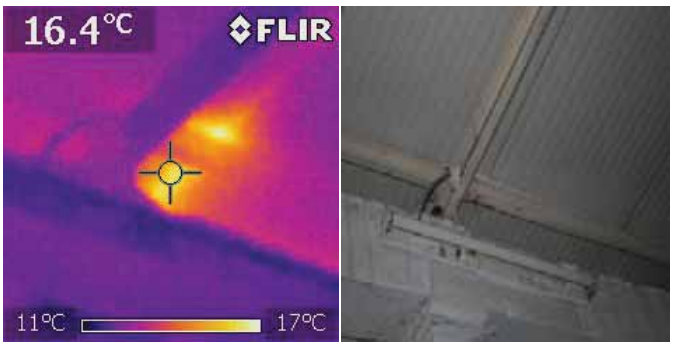
Insulation Leaks And Humidity

To preserve the temperature in the cold storage units, the quality of insulation is of course of utmost importance. Leaks in the insulation material covering the cold storage unit can be a

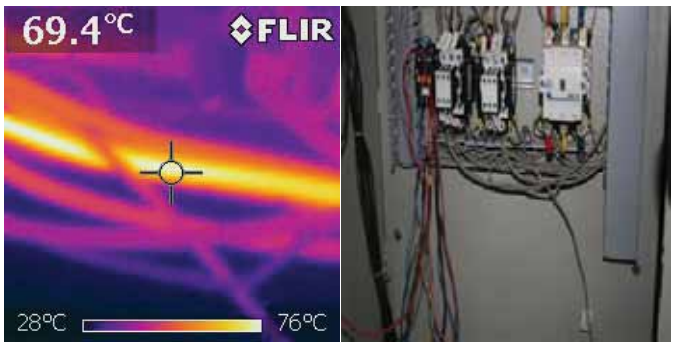
The FLIR i3 is the smallest, lightest and most affordable thermal imaging camera on the market.



Leaks in the insulation material covering the cold storage unit can be a threat to the temperature uniformity inside the unit.



Small insulation leakages can easily be detected before they escalate into something worse.



Gubba Group uses the FLIR i3 camera extensively for safety checks in electrical panels and chiller rooms across its various cold storage buildings.

threat to the temperature uniformity inside the unit. However, insulation leaks used to be discovered in a rather random fashion and repaired on the fl. What's more, insulation leaks can also allow moisture to enter the unit, which can also disturb the required relative humidity. The moisture that enters the building will condense and freeze. Eventually, the build-up of ice can also affect the insulation properties of the cold store wall and weaken the structure of the wall or building.

"I did not know about the power of thermal imaging, until I saw one of these cameras at work at a FLIR exhibition booth in India," says Gubba Prashant. "There, I discovered that you can quickly scan large areas to look for insulation problems, find moisure beneath the insulation surface and much more. We decided to invest in one of FLIR's handheld thermal imaging cameras and we haven't regretted it ever since."

Easy And Timely Detection

At Gubba Cold Storage , Gubba Prashant is now frequently using a FLIR i3 point-and –shoot camera to monitor the cold storage units and to detect possible leakages. One of the many advantages of this new approach is that inspections can now be scheduled in advance and on a regular basis. Small leakages can easily be detected before it escalates into something worse. And more importantly, by blocking these leakages in time, uniformity in temperature and relative humidity is maintained in the unit. This helps Gubba Cold Storage to save its customers' stocks from perishing.

The FLIR i3 is the smallest, lightest and most affordable thermal imaging camera on the market from FLIR. It is incredibly easy to use and requires no former experience. It really is a matter of "point-shoot-detect" to obtain high-quality thermal images that will immediately give you the thermal information you need. It only weighs 365 g and is easy to store in a belt pouch.

Soft and Hard Benefits"

Again, next to safeguarding our facilities, doing regular inspections with our FLIR thermal imaging camera and sharing these thermal images with our customers also allows us to build trust," says Gubba Prashant. "After performing a thermal audit with our FLIR i3 camera, we provide our customers with a report that certifies perfection in temperature and relative humidity maintenance.""But next to these intangible benefits , such as enormous power savings and reduced energy bills, as a result of repairs we were able to do based on information from our thermal imaging camera."


Nagesh,: "After performing a thermal audit with our FLIR i3 camera, we provide our customers with a report that certifies perfection in temperature and relative humidity maintenance."

Electrical Inspections

Aside from detecting heat and energy loss in cold unit storage structures, FLIR's thermal imaging camera has proved to be an accurate & effective tool in Gubba Cold Storage's facilities predictive maintenance programs. In electrical installations, hot spots in the thermal image usually point to emerging problems. With the FLIR i3 camera, Gubba Prashant's team can now scan electrical cabinets and components and survey multiple wires and connections to get an instant picture of potential trouble.

"We use the FLIR i3 camera extensively for safety checks in electrical panels and chiller rooms across our various cold storage buildings," says Gubba Prashant. "When the thermal imaging camera clearly shows you an electrical cable that is much hotter than its environment, you know you have to intervene. This is how we can prevent bigger problems from happening." ■

For more information about thermal imaging cameras, email: flir@flir.com

Huge Escalation in Dairy Supplies & Demands

Intercontinental companies to join in DairyTech India 2017. Dairy farming has progressed in the way of becoming an organized industry that covers increased production of milk products, and the breeding of higher yielding cattle, scientific rearing of animals and feed production...

7th Edition DairyTech India 2017

Dairy activities have by tradition been connected to India's rural economy and the country ranks as the world's largest producer and consumer of dairy products. An estimated eight crore rural families across India are engaged in dairy production and the rural market consumes over half of the total milk produce. Dairy farming in India is currently evolving from just an agrarian way of life to a professionally managed industry - the Indian dairy industry.

Over the past two decades, dairy farming has progressed in the way of becoming an organized industry that covers increased production of milk products, and the breeding of higher yielding cattle, scientific rearing of animals and feed production. Transformation of this sector is being persuaded by many helpful factors like newfound attention on the part of the organized sector, new markets, easy credit facilities, dairy friendly policies by the government, etc.

National Policy

The recent Union Budget by Government of India brought cheers for the entire dairy industry this year (2017) with its announcement to allocate Rs 8,000 crore (Approx Euros 106666) for three years for the development of this sector. This is the first time since the White Revolution that the government has focused on the dairy industry. The decision would enable India to produce 500,000 liters per day of additional milk with an estimated Rs 50,000 crore cash flow to the farmers' hand.

Challenges

Though India may boast of one of the world's largest cattle population, the average output of an Indian cow is significantly lower compared to its American counterpart. Moreover, the sector is plagued with various other impediments like shortage of fodder, its poor quality, dismal transportation facilities and a poor development of cold chain infrastructure. As a result, the supply side lacks in elasticity that is expected of it.

Practice to Commerce

Commercialization of dairy farming as a business activity is the need of the hour. There is enormous scope for the industry in the field of value-added products including desserts, beverages, yoghurt and so on. It is expected that the demand for processed and packaged dairy produce will witness a phenomenal growth in urban centres due to growing population with higher disposable income and greater health consciousness. Realizing the growing importance of commercialization, this is the best place to become part of the emerging Indian Dairy Industry and promote it further.

Emergence of Commercial Dairy Farming

It is important to introduce efficient feeding methods and feeds, encourage commercialization and mechanization of dairy farms, develop networks to endorse processed food and beverages based on milk, have well managed cold chain facilities to reduce wastage and organize the sector. The government and other stakeholders are increasingly coming forward to help the growth of the sector. Ministry of Agriculture and Farmers' Welfare as well as Ministry of Food Processing Industries initiated several steps to encourage organized growth of dairy farming and production of dairy products.

Always willing to contribute and

promote the objectives of these initiatives by ensuring the all-round development of the Indian dairy industry, Media Today Group is organizing DairyTech India 2017 exhibition (7th edition) at BIEC, Bangalore from 28-30 August 2017. The Group received an overwhelming response in the last edition. This will surely strengthen the bonding among various stakeholders of this segment.

It is India's largest international exhibition on dairy products, processing and packaging machineries and related technologies. The highlights of the exhibition will be the presence of many national and international exhibitors with the participation of various companies for joint venture opportunities and technical tie-ups.

The exhibition will be a great opportunity for meeting the industry experts and entrepreneurs apart from the established players who will participate to showcase their variety of products and services to heighten the industry's future scenario. It will be an ideal platform for interaction among manufacturers, retailers, cattle and farming consultants, quality-certification agencies, veterinary health care products manufacturers, various dairy services providers and exporters of dairy-based food, packaging machinery, value-added milk products and storage system.

In view of the above scenario, it would be a good opportunity for the business community from all segments of Dairy sector from all over the world to take part in this event to provide further momentum to their business. The Punjab Farmers Commission in association with Dairy Development Department, cooperatives like Amul and private sector dairy players are giving an impetus to setting up Hi-tech commercial dairy farms leading to clean milk production.

The event will have its co-located shows, 9th AgriTech India and India Foodex as well as 6th International Poultry & Livestock Expo and 4th MeatTech Asia. It has been actively supported, sponsored and guided by Union Ministry of Agriculture, National Meat & Poultry Processing Board, National Agricultural Cooperative Marketing Federation of India Ltd. (NAFED), Agricultural & Processed Food Products Export Development Authority (APEDA), National Small Industries Corporation (NSIC) and Food Processing and Packaging Machinery Industry Association (FPPMIA). ■

Thermax Closes Q1- FY 2017-18 with Improved Order Balance

For the first quarter of FY 2017-18, at the consolidated level, Thermax posted revenue of Rs 917 crore, 10.5% lower compared to Rs 1,025 crore in the corresponding quarter, last year. Profit after tax for the quarter was down 11.3% at Rs 47 crore (Rs 53 crore). Consolidated net profit after company's share of loss in joint ventures and associate company stood at Rs 40 crore (Rs 49 crore), down by 18.4 %.

As on June 30, 2017, Thermax group had an order balance of Rs 4,944 crore (Rs 4,040 crore) up 22.4%. Order booking for the quarter, at the consolidated level, was Rs 1,919 crore, up 134.9% compared to Rs 817 crore, last year. (These figures don't include those of the joint venture companies).

The reduction in revenues is because of the lower order carry forward at the start of FY 2017-18. The improved order balance position is on account of a single large order booked during the quarter from an African business conglomerate. Thermax continues to grapple with the challenges in the core sectors of the domestic economy and the sluggish growth in the overseas markets in which the group operates.

On a standalone basis, Thermax posted a total revenue of Rs756 crore during the quarter, 9.6% lower compared to Rs 836 crore in the previous year. Profit after tax for the quarter was Rs 32.4 crore, down 28.3% from last year's Rs 45.2 crore. Order balance on June 30, 2017 stood at Rs 4,530 crore (Rs 3,653 crore), up 24%. Order booking for the quarter improved to Rs 1,742 crore (Rs 698 crore), up 149.6%.

The company's efforts to expand its footprint in international markets received a fillip when its new manufacturing facility in Indonesia was inaugurated during the quarter. The facility, situated in the industrial area of Krakatau at Cilegon, around 100 kms from Jakarta, will support the customers of PT Thermax International Indonesia (PT TII) in ASEAN markets. Meher Pudumjee,

Chairperson of the Thermax Group, says, "We established PT Thermax International Indonesia in 2014 to focus on Indonesia and other South East Asian markets. The new facility will provide indigenous manufacturing muscle and services to our customers in the region."

The Indonesia facility will produce a wide range of the company's standard products – packaged boilers, heaters, steam accessories, water and waste water treatment along with pollution control equipment such as electrostatic precipitators (ESPs) and bag filters. Thermax subsidiaries and sales-service network in Malaysia, Thailand and Philippines will assist PT TII's business initiatives.

Thermax Limited, a leading energy and environment solutions Provider, is one of the few companies in the world that offers integrated innovative solutions in the areas of heating, cooling, power, water and waste management, air pollution control and chemicals. The sustainable solutions Thermax develops for client companies are Environment-friendly and enable efficient deployment of energy and water resources. ■

Three Year Export Statement of Apeda Products

PRODUCT	2014-15		2015-16		2016-17	
	Qty (in MT)	Rs. (in Lacs)	Qty (in MT)	Rs. (in Lacs)	Qty (in MT)	Rs. (in Lacs)
FLORICULTURE						
Floriculture	22947.27	46077.23	22518.58	47942.04	22086.1	54873.96
Fruits & Vegetables Seeds	12499.31	42703.8	10925.75	49354.45	11638.46	52741.88
Total	35446.58	88781.03	33444.33	97296.49	33724.56	107615.84
FRESH FRUITS & VEGETABLES						
Fresh Onions	1238102.6	230054.14	1201245.3	274741.05	2415757.1	310650.09
Other Fresh Vegetables	835501.2	240223.6	699600.34	211949.8	1002396.9	281537.74
Walnuts	2665.85	13645.24	3291.71	11791.54	2191.19	5527.26
Fresh Mangoes	42998.33	30253.66	36329.01	31710.03	53177.26	44554.54
Fresh Grapes	107257.81	108648.99	156218.34	155131.67	232940.76	208834.98
Other Fresh Fruits	274436.09	124588.02	308261.23	153815.57	409939	185890.63
Total	2500961.9	747413.65	2404945.9	839139.66	4116402.2	1036995.2
PROCESSED FRUITS AND VEGETABLES						
Cucumber and Gherkins (Prepd. & Presvd)	251183.01	120242.24	202926.91	99917.2	180820.87	94271.78
Dried & Preserved Vegetables	63701.77	84713.55	66189.61	91420.9	87279.99	108854.99
Mango Pulp	154820.66	84138.54	128866.01	79616.93	135621.22	86497.48
Other Processed Fruits & Vegetables	316059.42	256991.89	320732.58	290033.31	351834.58	311607.87
Pulses	220914.58	120949.67	251644.32	160321.88	124883.94	114013.46
Total	1006679.4	667035.89	970359.43	721310.22	880440.6	715245.58
ANIMAL PRODUCTS						
Buffalo Meat	1476309.8	2928915.7	1314473.1	2668541.3	1330660.5	2630793.2
Sheep/Goat Meat	22827.77	82153.84	21635.69	83389.82	22060.15	87108.27
Other Meat	261.92	267.17	0.1	0.25	78.51	91.35
Processed Meat	406.11	1419.71	280.92	618.18	140.9	457.83
Animal Casings	260.15	1933.25	206.36	1702.45	173.24	1383.69
Poultry Products	556698.81	65119.18	659304.15	76871.61	449527.49	53164.74
Dairy Products	66424.37	120539.56	33377.16	75420.27	39397.62	91044.05
Casein	8168.05	42853.42	5897.99	21594.03	6214.85	24108.12
Natural Honey	29578.56	53509.97	38177.08	70586.99	45537.99	56320.7
Albumin (Eggs & Milk)	2125.02	16118.53	1934.12	14982.69	1705.82	8793.49
Total	2163060.5	3312830.3	2075286.6	3013707.6	1895497.1	2953265.4
OTHER PROCESSED FOODS						
Groundnuts	708386.26	467536.9	537888.26	404605.21	726535.91	545671.95
Guargum	665177.71	947993.57	325250.71	323387.42	423285.66	313174.23
Jaggery & Confectionery	258252.73	116181.13	292212.03	128925.82	298075.64	147163.91
Cocoa Products	20877.7	84865.67	32633.58	126699.37	25700.17	108998.74
Cereal Preparations	306328.81	303875.5	314644.59	334130.63	340872.17	357261.49
Milled Products	415984.45	101909.43	416079.29	107843.72	256604.63	81768.4
Alcoholic Beverages	264625.53	223162.15	239127.51	200513.41	231332.48	200062.59
Miscellaneous Preparations	372998.36	243781.07	354905.14	259348.88	283265.21	257048.23
Total	3012631.6	2489305.4	2512741.1	1885454.5	2585671.9	2011149.5
CEREALS						
Basmati Rice	3702260.1	2759789.2	4045796.3	2271843.5	4000471.6	2160453.7
Non Basmati Rice	8274046	2042854.3	6366585.5	1512909	6820773.1	1714536.2
Wheat	2924070.2	499183.94	618020.01	97859.25	265909.26	44839.97
Maize	2825610.6	403750.82	650103.38	108989.66	569296.93	103033.45
Other Cereals	688199.92	122401.73	264974.25	51721.69	168641.79	39582.87
Total	18414187	5827979.9	11945479	4043323.1	11825093	4062446.2
Grand Total	**27132967**	**13133346**	**19942257**	**10600232**	**21336829**	**10886718**

Source: DGCIS Annual Data (APEDA.gov.in)

Ensavior: Addressing Energy Efficiency & Indoor Air Quality

Ensavior Technologies Private Limited, is engineering solutions provider company engaged in design, engineering, sales, marketing and servicing of the following systems or services:

Pumping System: Pumps for HVAC, Plumbing, Fire

Hydronic Balancing: Automatic Balancing / PICV Valves for HVAC System

Ventilation & IAQ Systems: Ultra Violet Germicidal Irradiation (UVGI) System / LS Fans Electrostatic Precipitator System

TES Systems: Chilled Water Thermal Energy Storage System

We promote concepts and products that to a significant extent address the issue of energy efficiency and indoor air quality. Our strategic tie ups with Xylem, Flowcon International – Denmark, Aeropure, Espair and FTENE – Korea, form a well mix of products that cater to the need of the hour. The company's strength lies in its unique offerings of the above products and services. Our success is an outcome of strategic focus on the HVAC industry, moving up the value chain for products and services.

Pumping Systems: We represent Xylem for pumping solutions, which are constantly developing and fielding new HVAC systems that work efficiently, making buildings more comfortable, productive and healthy.

Hydronic Balancing: It is the process of optimizing the distribution of water in a building's heating or cooling system to provide the intended indoor climate at optimum energy efficiency and minimal operating cost.

UVGI System: UVGI systems irradiate the AHU coils with UV-C rays, destroying the ability of the organisms to reproduce and multiply, thus, maintaining the indoor air quality of the air-conditioned spaces. It leads to energy savings by improving heat transfer efficiency of AHU cooling coil.

HVLS Fans: High Volume Low Speed (HVLS) Fans circulate the air and improve the comfort, productivity and the health of people. Elevated temperatures and humidity make people uncomfortable and decrease productivity.

Electrostatic Precipitation Systems: ESPAIR™ has developed the most sophisticated technology based on Electrostatic Precipitation for filtration and elimination of pollutants like mist, dust, smoke, grease, oil, fumes, microbes, etc to ensure environment healthy surroundings.

Thermal Energy Storage System: We have a tie up with FTENE, Korea for Stratified Thermal Energy Storage. It helps lower Operational Costs by enabling the shifting of energy consumption of chillers from high cost hours to low cost hours by storing cool energy during low cost periods.

We engage on the project right from the conceptualization stage and thereby help in right selection, optimum design and implementation of most energy efficient products. Besides that, we ensure on site job trainings to project managers, facility managers and operators so that the systems are operated in most efficient and simplest manner. Based on need of the project, we also undertake operation and maintenance of the system for which we have back up in terms of spare parts and manpower.

We view every project as a fresh opportunity for continuous improvement. This results in maximum cost effectiveness, efficiency, and productivity for our customers. We firmly believe that, the more you engage with customers, the things become clearer, and it is easier to co-relate to their requirements. It is our constant endeavour to make every aspect of the customer requirement a little bit better, since we know ***when a customer comes first, the customer lasts.....*** ■

Oventrop: Leading Manufacturers of Valves & Controls

Oventrop is one of the leading European manufacturers of valves and controls for the building services industry since its inception in year 1851. The company is an expert partner to the stockists, consultants, contractors and industry. Oventrop offers its partners a long term beneficial relationship. Oventrop has two well established manufacturing facilities at Olsberg and Brilon in Germany.

Oventrop is operating in India since 2006 and currently Oventrop is headed by Milind Pawar who is based out of Mumbai. Oventrop operates through sales network of business partners across India, Nepal and Bangladesh. After sales service is provided directly by Oventrop across India through its own service Engineers.

Oventrop serves various industry segment with its flagship products like Pressure Independent Balancing and control Valve (PIBCV), 2/3 way control valves , Manual Balancing Valves, Solar thermal products, Potable water hygiene systems etc. Oventrop serves major 5 star hotels, Hospitals, pharmaceutical companies and other premium industry customers across country. Customer retention and in-house service support remains key factor for successful run of Oventrop in India. ■

Commercial Programmable Thermostat from Venstar

School Stat commercial programmable thermostats from Venstar are designed to help schools reduce energy costs while maintaining indoor comfort. They feature a setpoint-limiting security function, separate weekday/weekend programs, and the company's "One for All" technology, which ensures the product works with virtually all equipment.

Standard Features

- Commercial programmable
- Specialty thermostat series
- Features energy saving operation
- Programmable override
- Unoccupied until button press
- Setpoint limiting security
- Separate weekend/weekday programs
- Morning warm-up period
- Soft start capability
- "One for all™" works with virtually all equipment
- Non-volatile memory
- Keypad lockout
- 3 security levels
- Remote sensor ready
- 48 hour clock backup and economizer op

Model T2900SCH

All of the above features plus:

- Works with EZ Programmer ACC0432
- Compatible with wallplate ACC0422
- Compatible with lock ring ACC0620 ■

Website: www.venstar.com/thermostats

Enfinity® Vertical Floor Mounted Water Source Heat Pumps

More than 40 years ago, Daikin designed the first complete line of water source heat pumps for high efficiency, individually zoned comfort control in offices, schools, assisted living facilities, manufacturing facilities and other commercial buildings. Our reputation for outstanding reliability and quiet operation has been reinforced in thousands of successful installations.

Enfinity water source heat pumps incorporate the best of our past and the best of what's new. Using feedback from building owners, consulting engineers, contractors and service engineers, we designed Enfinity products to give you maximum flexibility to design, install, operate and maintain the ideal water source heat pump system for your building project.

- Standard or geothermal application flexibility
- High efficiency reduces energy consumption/operating costs and can contribute to earning LEED® points and rebates
- Superior indoor air quality and quiet operation
- MicroTech® III unit controls with Open Choices® feature allows standalone or easy, low cost network integration using LonWorks® or BACnet® communication options
- Multiple factory-installed features/options - including desuperheater, hot gas reheat, auxiliary electric heat, ECM fan motor, two-way motorized valve and compressor sound blanket, allow you to closely match application requirements and lower installation costs
- Performance rated with ISO Standard 13256-1 ■

Website: www.daikinapplied.com

Haier's FlexFit Pro Series Light Commercial Ductless AC Line

Haier Ductless is launching a new ductless series designed for light commercial installation as well as large residential applications. The FlexFit Pro series offers a number of options to make installation easy. "Available from 24,000 BTU to 48,000 BTU, the FlexFit Pro Series is the next evolution of our product assortment for North America," said Nick Shin, vice president and business unit leader, Haier Ductless.

Outdoor

- Flexible installation with long piping length up to 230ft., and 100ft. drop
- 100% cooling Capacity at 0°F
- Low standby power at 4W
- Outdoor unit quiet operating mode reduces noise below 45dB(A)

Cassette Indoor

- Unique round-corner air outlet to eliminate blind spot
- Individual airflow control of the 4 louvers
- Optional intelligent eye for continuous monitoring and control for improved efficiency

High Duct Indoor

- DC fan motor
- Consistent airflow in wide range of ESP up to 0.6in.
- Rear and bottom air return

High wall Indoor

- Sleek design with hidden LED temperature display
- Up to 60ft. air throw distance
- Quadruple-action pathogen filter

Haier is one of the leading producers of HVAC products with capacity to produce 20 million units per year and with 10 percent of global market share. ■

Email:www.haier.com

Forthcoming Events At A Glance

DairyTech India 2017
Venue: BIEC, Bengaluru
Date: 2tth to 30th August 2017
Website: www.dairytechindia.in

FoodPro 2017
Venue: Chennai Trade Centre, Chennai
Date: 7th to 9th September 2017
Website: www.ciifoodpro.in

Green Building Congress 2017
Venue: Chennai Trade Centre, Chennai
Date: 3rd to 7th October 2017
Website: www.cii.in

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

2018 AHR Expo
Venue: Chicago
Date: 22nd to 24th January 2018
Website: ashrae.org/AHRExpo2018

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

index to advertisers

Amity University Gets LEED Platinum Certification

Amity University Haryana has become the first university in India and Asia's second one to be awarded with the coveted 'LEED Green Platinum Certification (EB), USA' which is the highest Green Building Standard for its green building design, operation and maintenance by US Green Building Council.

The LEED is the most widely used third party verification for green buildings. The Platinum category certification ensures that the buildings and the campus are designed complying with the highest levels of green parameters in use of materials, construction technology, use of natural light and are also operated and maintained with highest standards of energy efficiency.

The Green Honour Platinum category Certificate was presented to Dr Aseem Chauhan, Chancellor, Amity University Gurugram (AUG) by Gopalakrishnan Padmanabhan, Director GBCI (Green Business Certification Inc) during a glittering ceremony at Amity University Gurgaon (AUG).

Expressing his elation over the historic accomplishment, the Chancellor of Amity University Gurugram, Dr Aseem Chauhan said, "It is a proud moment for Amity to receive the LEED Platinum Certification, USA for AUG, which speaks volumes about Amity's commitment to safe and cleaner planet for present and future generations.110 acres lush green campus of Amity University Gurugram has been meticulously designed to ensure optimum utilization of resources." ■

Future Home: HouseZero

The Harvard Center for Green Buildings and Cities (CGBC) will retrofit its headquarters, a pre-1940s house in Cambridge, MA, into an ultra-efficient, healthy, positive energy structure. Targeting the most rigorous efficiency standards ever achieved by a building retrofit, HouseZero has the following performance goals:

Almost zero energy required for heating and cooling, 100% natural ventilation, 100% daylight autonomy, Zero carbon emissions, including embodied energy in materials. HouseZero will model a healthy indoor environment with natural light, pleasing acoustics, and zero off gassing materials. Designed to be durable, functional, flexible, comfortable, and connected to its natural environment, the house will promote well-being and worker productivity. This demonstration project attempts to

address the global environmental challenge of climate change by focusing on inefficient existing buildings, which account for vast amounts of energy use and carbon pollution worldwide. While numerous new buildings have achieved net-zero or positive-energy performance goals, the retrofit potential of the current US building stock has not been thoroughly explored. ■

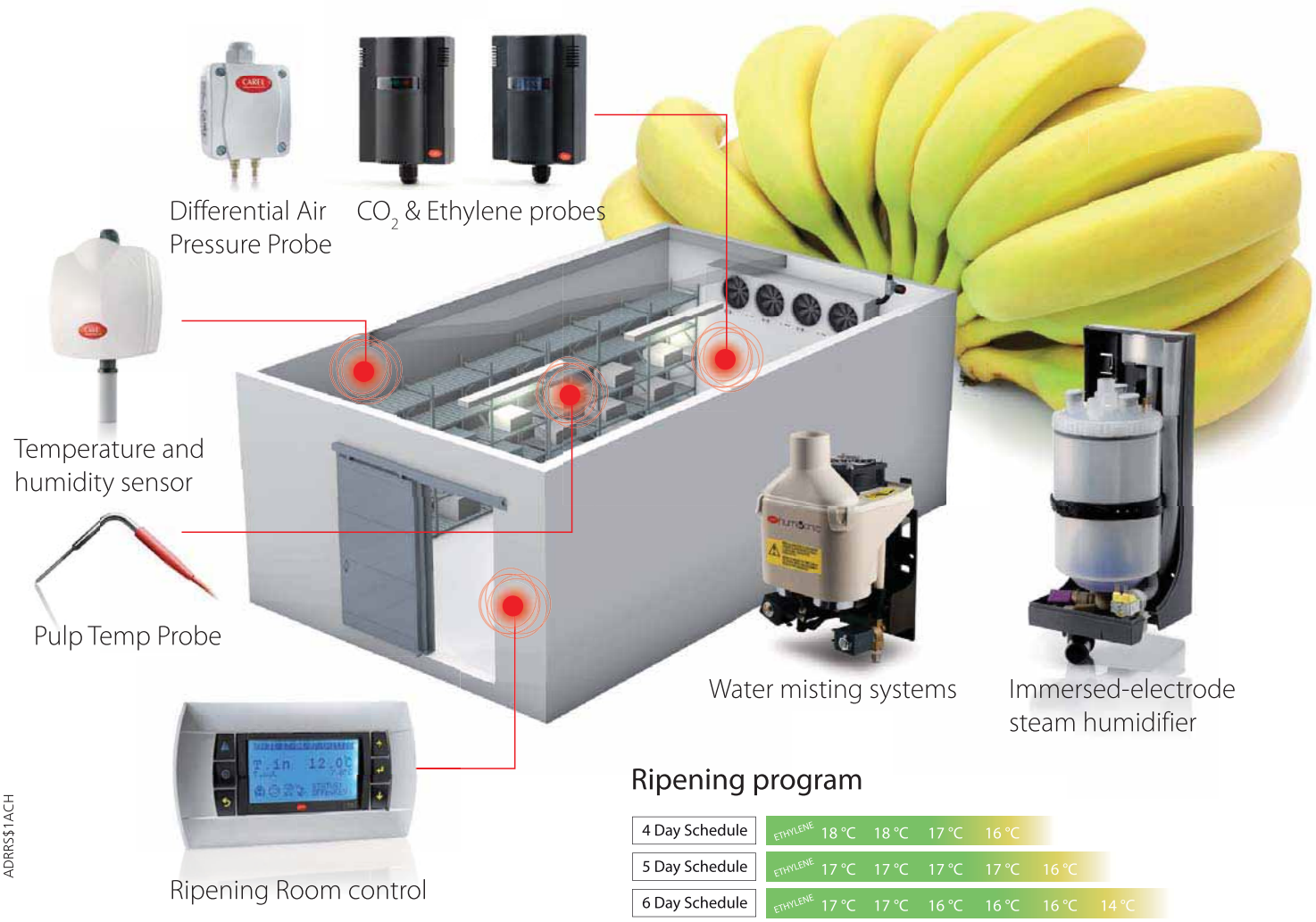
Nottingham Leads the Way On Clean Public Transport

UK Covenant of Mayors signatory Nottingham is taking the lead on e-mobility in Europe through an ambitious electric bus project. The city council of Nottingham launched in 2012 a six-year project to convert its entire tendered bus fleet ('Linkbus') to electric buses. The €17 million project, implemented in partnership with the city's urban transport company (Nottingham Community Transport), is mainly funded through the city's workplace parking levy and a UK Green Bus funding scheme. Furthermore, some funding has come from the EU Horizon 2020 REMOURBAN project, a Smart Cities and Communities (SCC) project where Nottingham is involved in as frontrunner city ('Lighthouse city').

Nottingham's electric bus project has three objectives: reduce air pollution, decrease noise levels and cut operating costs. Between 2012 - 2017, it has already delivered carbon emission cuts worth 1050 tons, and decreased fuel costs by €340,000. Upon completion of the project in 2018, Nottingham will be able to save over €225,000 per year in the operation of its bus fleet. These generated savings are critical for the city, especially in light of strained public budgets. ■

High Efficiency Solutions.

CAREL



ADRRS$1ACH

Ripening program

4 Day Schedule	ETHYLENE	18 °C	18 °C	17 °C	16 °C			
5 Day Schedule	ETHYLENE	17 °C	17 °C	17 °C	17 °C	16 °C		
6 Day Schedule	ETHYLENE	17 °C	17 °C	16 °C	16 °C	16 °C	14 °C	
7 Day Schedule	ETHYLENE	16 °C	16 °C	16 °C	16 °C	16 °C	14 °C	14 °C
8 Day Schedule	ETHYLENE	14 °C	14 °C	14 °C	14 °C	14 °C	14 °C	14 °C	14 °C

Integrated solutions for ripening

- Flexible Control System for Fruit Ripening
- Set parameters within a program (Temperature, rH%, time, Ethylene ppm, CO_2 ppm)
- Ethylene dosing through electrically operated valve/generator, select one-shot or trickle dose
- Cooling control based on Air or Pulp temperature
- Control of reversible air-flow systems
- CO_2 extraction by door or by Fan/dampers
- Control for pressurised ripening

CAREL ACR Systems India Pvt. Ltd.
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Chennai: Office No. 728 , 'AMARA SRI", situated at Old No. 313, New No. 455, Block No.75, 7th Floor, Anna Salai, Teynampet, Chennai 600018. | Phone +91 44 4904 8300

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... A Green Approach To Energy Efficiency & Sustainability In HVAC Systems

ensavior

xylem
Let's Solve Water

Xylem Water Solutions
Pumps & Package Pumping System on Variable & Constant Speed

- **Bell & Gossett:** HVAC (Primary - Secondary, Tertiary, Condenser Water Variable Speed Pumping).
- **Lowara:** Water & Waste water pumps (Hydro-pneumatic Booster, Submersible, Drainage Pumps).
- **Flygt:** Submersible Pumps, Mixers and Mechanical Aeration equipment.
- **AC Fire Pump:** UL/FM approved Fire Pumps and skids.
- **Goulds:** Centrifugal and Turbine pumps

FlowCon international

Key Features
- Continuous Display of Flow Rate
- LCD Display
- Optional Fail-Safe Power Storage Feature
- Communication with BMS thru RS- 485
- BACnet Compatible
- 51 Different Maximum Flow Rate Settings
- 100% Valve Authority

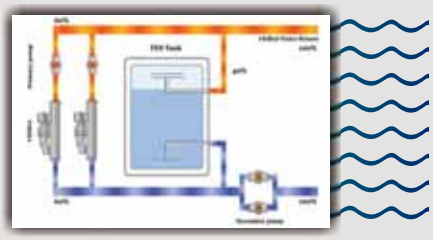
- Pressure Independent Control Valves
- Adjustable Cartridge Automatic Balancing Valves
- Pre-set Automatic Balancing Valves
- Temperature Control Valves
- Differential Pressure Controller
- 3 Way By-Pass Modules
- Actuators
- Automatically Balanced Temperature Control Valves
- Externally Adjustable Automatic Balancing Valves
- Pre-set Automatic Balancing Valves
- Thermostatic Control Valves

ESPAIR™

Electrostatic Precipitation System

Key Features
- Removal of grease and smoke from commercial kitchens
- Removal of smoke, fumes and oil/coolant mist from industrial processes
- Higher efficiency, upward of 90-95% in single stage, more than 99% in multi stage
- Very low pressure drop in comparison to media and cartridge filters
- Durable, Compact, Modular Cabinetry
- Performance Tested as per ASHRAE Std 52 and EN779

FT EnE, Inc.



Chilled Water Thermal Energy Storage System

Utilizes only the sensible heat of water for cooling energy storage in a chilled water storage tank and discharges the stored coldness for air-conditioning during on peak time. This operation scheme reduces the total energy consumption and operation cost.

Ideally suitable for District Cooling and backup of chilled water for mission critical facilities like Data Centers and High Tech Manufacturing.

aeropure™

Aeropure UV Systems

Ultra Violet Germicidal Irradiation (UVGI) For cooling coil in HVAC System
- Energy Savings
- Maintenance Savings
- Improved Indoor Air Quality
- Extended food shelf life
- Faster Return on investment
- Green Building Contribution

Ensavior Technologies Pvt. Ltd.

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E-mail : info@ensavior.com **Web : www.ensavior.com**