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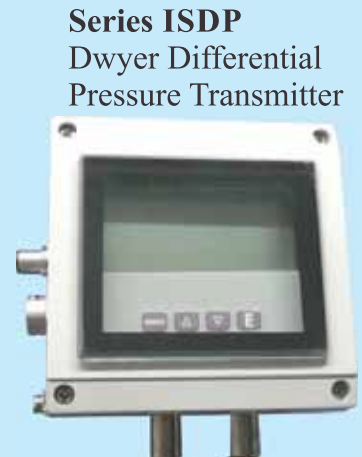
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Publisher's Letter



Publisher's Letter

A Digital Platform To Boost Sales Of Complete Product Manufacturers

With the changing socio-economic conditions in India, the so-called middle class people are nowadays spending much more money than they ever did earlier on elevating their lifestyle. Almost every family from the average-income group buys at least one home appliance on an average each year. Global warming has made 'air conditioners' essential for each and every home in the urban areas. Today's busy life, nuclear family structure etc., have made fridges a commonplace in almost every Indian home. Diwali or Deepavali, the festival of lights is coming, and this is the prime time when most of the buyers buy new gadgets for their homes.

Although today's Indian buyers are well aware of the availability of the new gadgets, their utilities and price levels, when it comes to the technicalities, an average Indian buyer is still unaware of the ins and outs that he/she should know to select a product, especially, in connection with power consumption and electrical safety, which are two vital areas where the elementary knowledge is very essential when finalizing any product for purchase.

In our country, most of the buyers' decisions are influenced more by their own or family sentiments than logical evaluation of the merits and demerits of the products. Suggestions from friends and relatives are given high priority. Also, price often stands as a vital decision making factor. So, even if the knowledge is (theoretically) present in the society, often purchase decisions are not logic driven. It often has an adverse effect, for example: the purchased gadget is either insufficient to cater to the actual need of the buyer or his/her family or redundant in the home. Thus, after some time the buyer either gives away the gadget to some known person or looks at opportunities to sell out the same.

Advent and growth of online purchase is adding to the number of such instances. As in this process, the buyer has no alternative but to depend on the revealed facts about the gadget by the manufacturer or the seller, here again the chance of optimum level of satisfaction is not cent percent.

Thus, the complete gadget manufacturers have to be more close to the users. An advertisement in electronic entertainment media for two or three seconds may kindle the interest among the users, but does not satisfy their queries with elaborate explanation. The digital platform is the best solution for that. Cooling India has created a good platform for this purpose. Why don't you give a try?

Please send your comments at pravita@charypublications.in

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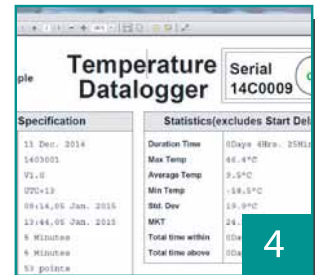
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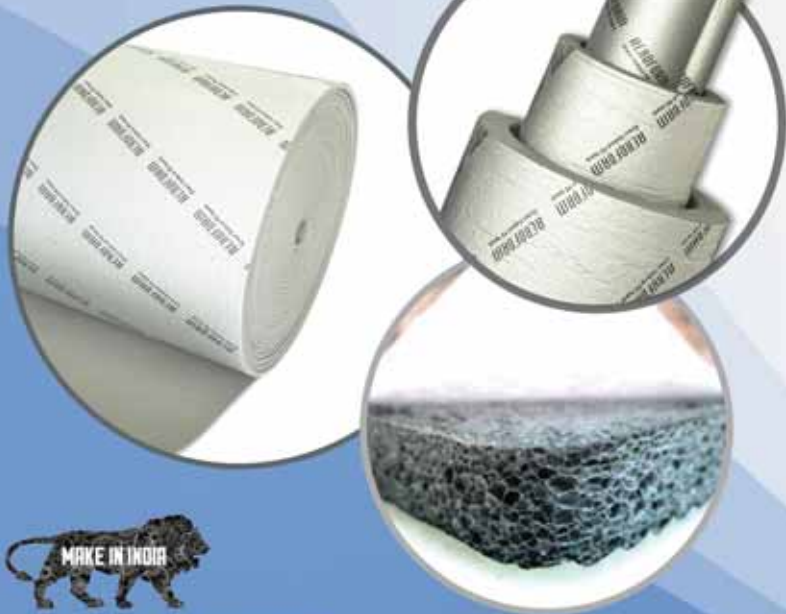
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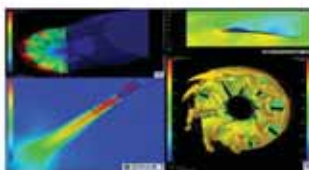


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FROM THE EDITOR



Are You Going To Buy An AC Or A Fridge?

On the eve of India's biggest festival of lights, Deepawali, first of all let me take this opportunity to greet you all. Well, as this is the biggest buying season throughout our country, schemes, discounts and other offers are going on in every market for almost all electrical and electronic gadgets and home appliances. Many of you must be buying one or more such gadgets or appliances. Therefore, I feel this is the right time to talk about some important facts that will help you in deciding which air conditioner or fridge to buy.

Whether you are buying an air conditioner or a fridge, beside the one-time capital investment, its running cost also need to be given due importance. Generally, fridges keep on running 24X7 throughout the year, but air-conditioners have intermittent gaps. However, for both the gadgets, a buyer's priority should be maximum cooling or comfort at the minimum cost.

Some simple considerations will help you go for the optimum air conditioners to suit your purpose within your budget. Please remember that for the same tonnage, the cooling capacity may vary from model to model. Also, under-sized or over-sized devices create problems. More clearly, installation of an over-sized air conditioner makes the room dank – whereas the under-sized one increases power consumption.

It is always better to take an expert's advice before finalizing the buying decision. In this field, the inverter technology has brought in a big change. Instead of running the compressor motor at a constant speed, this technology helps in running that at variable speed depending on the requirement, which considerably reduces power consumption. Although the initial investment goes up slightly, it is always better to adopt this technology, and generally its payback period is as low as two years.

Similarly, for fridges, whether to go for a double door refrigerator or a product having single door – is a challenge that involves decision making. Please remember for a small family of (say up to four members), a single door device is quite ok. But for a large family, double door mechanism helps. Also, electrically double door fridges draw more current, form factor-wise they need more space. So, considering all these you should decide what to buy.

Once again, Happy Deepawali!

Pl. send your views at pkchatterjee@charypublications.in

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Danfoss Hall of Fame spreads awareness on energy efficiency in Mumbai

Hall of Fame roadshow, an initiative by Danfoss India, was held recently in Mumbai. The roadshow was aimed at increasing participation for Hall of Fame 2017, which is a joint initiative with Indian Society of Heating, Refrigeration and Air-Conditioning Engineers (ISHRAE) to recognise excellence achieved in conserving energy by commercial buildings in the country.

About 70% of Maharashtra's industrial revenue is generated from Mumbai, Pune, Nashik and Aurangabad districts. Previously, Mumbai International Airport Limited (MIAL) project received the honour of being the first organisation to be inducted into the Hall of Fame at ACREX 2016, one of India's largest industry exhibitions.

Based on selection criteria that include Energy Performance Index, Indoor Environment Quality initiatives, Energy Saving Initiatives including Renewable Energy, Building Management System and one-year operational data, the inductee/s will be announced in February 2017 at ACREX, New Delhi.

Ravichandran Purushothaman, President, Danfoss India, said, "As a financial capital that is in need of electricity at all times, it is imperative that Mumbai looks at alternatives to manage the huge energy demand. Hall of fame encourages cities to compete on energy efficiency and raises the bar for energy efficient commercial buildings nationwide. Mumbai International Airport was inducted into the ACREX Hall of Fame last year and that has set precedence for strong contenders for the recognition from Mumbai this year."

"ACREX Hall of Fame recognises cutting edge energy efficient interventions that organisations have adopted to meet their objectives, setting an example for others to replicate the same sustainable solutions," he further added. ■



Ravichandran Purushothaman

Cooltech Applications partners with Carrefour

Cooltech Applications, (Cooltech), a magnetic refrigeration company, has implemented a fully equipped magneto-caloric display cabinet at Carrefour's head office restaurant for a 4-week period, a world premiere. The Magnetic Cooling System (MRS) utilises a water coolant instead of a refrigerant gas – a major contributor to climate changes – resulting in an eco-friendly solution. The technology totally eliminates the need for refrigerant gases, cuts energy consumption by up to 50%, reduces noise and boosts reliability and safety.

Jean Michel Fleury, Project Director, International support at Carrefour, said, "Our employees really enjoyed drinking fresh beverages from the innovative cabinet. Our intention is now to test several magnetic refrigerated display cabinets in stores. In addition to the environmental performance with no gas emission, magnetic cooling will bring significant energy savings to our stores." ■



Elanpro launches its First Experience Centre

Elanpro, a commercial refrigeration company in India, recently launched its first Experience Centre in Bhopal.



Ish Arora at the ribbon cutting ceremony...

The centre will showcase complete range of commercial refrigeration products apart from providing end-to-end implementation and consulting services to customers seeking ease of use in further leveraging the products.

Ish Arora, MD, Rajsons Dairy Products and Owner, Khajuraho Dairy & Amour Ice Cream; Sanjay Jain, Director, Elanpro; Shashank Joshi, VP, Elanpro; were present at the ribbon cutting ceremony. The company aims to open 50 Experience Centres by 2017. It also plans to initiate more display centres in other major cities of India like Indore, Jabalpur amongst the others.

Sanjay Jain, Director, Elanpro, said, "We are extremely delighted to announce the launch of our first Experience Centre in Bhopal. With a constantly increasing demand of technologically advanced products, we wanted our valued customers to gain first-hand experience before making investment." ■

Hunt's foodservice opts for Carrier Transicold Supra system

Hunt's Foodservice, a catering wholesaler of frozen, chilled and ambient goods operating across the South-West, updated its delivery fleet with 12 Carrier Transicold Supra units. Carrier Transicold, which operates in the UK as Carrier Transicold UK, is a part of UTC Climate, Controls & Security, a unit of United Technologies Corp.

Hunt's selected the supra units due to the range's flexibility, specifying eight Supra 1250 MT (multi-temperature) units for its new 18-tonne DAF LF250 rigids, and the Supra 850 MT system for four DAF LF220 12-tonne trucks.

Central to the order is the Supra MT range's suitability for intensive distribution environments with multiple door openings.

"The Supra system's quick pull-down time and ease of operation makes it ideal for our intense delivery schedule," said William Harvey, Operations Manager, Hunt's Foodservice. "Our fleet operates around the clock, keeping our customers throughout the South-West stocked with chilled and frozen goods. We required cooling systems that work fast, maintain temperatures at the desired set point reliably, and can handle the frequent, stop-start nature of our delivery cycle."

The Supra systems are mounted to twin-compartment Jackson Coachworks bodies, and the 12 vehicles will be used intensively at Hunt's Foodservice, working up to six days a week in peak season.

Harvey added: "The Supra system's fuel economy has helped us keep our overheads down, and we've had nothing but positive feedback from the drivers, who find the systems easy to operate and consistently reliable." ■



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Climaveneta introduces new high efficiency heat recovery system

HRD2 is the new heat recovery unit designed by Climaveneta to filter and treat air in the building – creating a fresh and healthier living and working place while ensuring large energy savings.



At the core of HRD2 is the high efficiency air-to-air heat recovery system that allows the unit to extract the energy contained in the exhaust and re-use it to cool or heat the renewed air. As the counter-flow system is made of sealed aluminium heat exchanger plates, the unit ensures a perfect air flow separation and releases a constant flow of fresh air inside the environment.

The result is an outstanding efficiency, up to 86%, which is even above the standards set by the Eco-design regulation. If one considers that the unit will work at maximum air flow, for example, the HRD2 results will be more efficient all year long than the two traditional solutions of recovery + electrical heater and recovery + battery. It is especially in the winter season that this is particularly evident, as the efficiency values of HRD2 are three times higher than those of the other two solutions.

Another premium feature of HRD2 is the bypass system with a motorised damper for the free cooling and free heating working modes. When the outdoor temperature is higher or lower than the indoor temperature in addition to the free heating (or free cooling) ratio, the motorised damper opens, enabling HRD2 to use the cooling or heating capacity contained in the outside air. This precious thermal or cooling energy is fully harnessed and the unit can work with zero energy expended. ■

Faiveley Transport to supply HVAC system to Stadler Pankow

Faiveley Transport has signed an agreement with Stadler Pankow to supply Heating, Ventilation and Air-Conditioning (HVAC) systems for the new Berlin S-Bahn trains that will operate in the German capital. This agreement was signed at InnoTrans, the world's leading trade fair for transport technology, which took place in Berlin between 20 and 23 September 2016.

As part of a framework contract for up to 1,380 electric multiple unit cars, 106 new Berlin S-Bahn trains were initially ordered in December 2015 by DB Regio subsidiary S-Bahn Berlin to Stadler Pankow in consortium with Siemens. These trains, which comprise 10 pre-serial and 96 serial trains, consist of 85 four-car and 21 two-car sets. They will be used on the Ringbahn (circular railway) and southeastern lines of Berlin, and will be equipped with air conditioning, new to the city.

Under the terms of the agreement, Faiveley Transport will be in charge of the design, engineering, manufacturing and extensive testing of the HVAC systems for passenger compartments and driver cabs. ■

BITZER delivers 2.5 millionth product to Oy Combi Cool Ab

The compressor specialist BITZER delivered its 2.5 millionth product, which was made at Schkeuditz near Leipzig in Germany, to one of its longest-standing customers, Oy Combi Cool Ab from Finland. Two and a half million compressors and condensing units and a quarter of a century on a course of constant economic growth that is the successful result, which the BITZER Group has achieved from 25 years at Schkeuditz.

Frank Fuhlbrück, Factory Manager at BITZER Schkeuditz;

Erik Bucher, Director Sales Refrigeration; Ralf Gasper, Director Sales Northern Europe and Baltic States; from BITZER handed over the anniversary product to its Finnish customer of many years, Oy



Combi Cool Ab. For this event, Klaus Nyström (Managing Director) and Markus Antikainen (Product Manager) travelled from Helsinki to Schkeuditz, to accept the ECOSTAR condensing unit from the new LHVE series together with the corresponding certificate. ■

Klaus Nyström (Managing Director, 2nd from right) and Markus Antikainen (Product Manager, centre) travelled to Schkeuditz to accept the ECOSTAR condensing unit from the new LHVE series as well as the corresponding certificate...

Two rules to reduce use and emissions of potent GHGs

The U.S. Environmental Protection Agency (EPA) has finalised two rules that will reduce the projected growth and emissions of Hydrofluorocarbons (HFCs) – a class of chemicals commonly used in refrigeration and air conditioning that are potent greenhouse gases and can be hundreds to thousands of times more powerful than carbon dioxide.

These rules demonstrate continued commitment by the United States to reduce emissions of climate-damaging HFCs at home, while working with other countries to amend the Montreal Protocol to address HFCs globally.

Under Section 612 of the Clean Air Act, EPA's Significant New Alternatives Policy (SNAP) program is adding to the list of safer and more climate-friendly chemicals for use in the refrigeration and air conditioning and fire suppression sectors; listing several new substitutes as unacceptable in specific end-uses in the refrigeration and air conditioning sector; and changing the status of a number of substitutes that were previously listed as acceptable in the refrigeration and air conditioning and foam blowing sectors. Foam products that contain unacceptable foam blowing agents are also listed as unacceptable.

In each instance where EPA is listing a substitute as unacceptable or changing the status of a substitute from acceptable to unacceptable, EPA has determined that there are other alternatives that pose lower risk overall to human health, the environment, or both. This rule results in environmental benefits from avoided HFC emissions of up to 7 million metric tons of CO₂-equivalent (MMTCO₂eq) in 2025, equal to the greenhouse gas emissions from 1.5 million cars in one year.

Secondly, EPA is strengthening the refrigerant management program under Section 608 of the Clean Air Act and extending the regulations to non-ozone depleting substitutes such as HFCs and other substitutes. This action will lead to reductions in emissions by lowering the leak rate at which large air conditioning and refrigeration appliances must be repaired and incorporating industry best practices such as verifying repairs and conducting regular leak inspections on leaking appliances. In addition to the benefits for the ozone layer, EPA estimates the refrigerant emissions avoided from this rule will be more than 7 MMTCO₂eq annually. ■



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Fujitsu General, Rheem are into strategic collaboration

Fujitsu General and Rheem recently revealed their strategic collaboration, which will expand the heating and cooling product portfolios for both companies.

According to Air Conditioning, Heating, and Refrigeration Institute (AHRI), ducted central air conditioning systems account for approximately 90% of the U.S. residential HVAC market. However, in recent years, the demand for ductless cooling systems – pioneered by Japanese manufacturers – has grown in the United States. The growth has been due to consumers' interests in systems that provide comfort and energy savings, and meet special add-on installation requirements, such as sites where duct-work is not feasible.

As part of this agreement, Rheem will begin offering ductless mini-split systems manufactured by Fujitsu General to its U.S. customers under the Rheem and Ruud brands. The relationship will expand to other product categories in the future and will further include joint development of products, as well as collaborative operational opportunities. Additionally, Fujitsu General will introduce a portfolio of ducted HVAC products, manufactured by Rheem, in its channel.

Mike Branson, Vice President and General Manager, Rheem Air Conditioning Division, said, "In recent years, the demand for ductless mini-split and commercial VRF systems, has risen dramatically in North America. Rheem is pleased to partner with Fujitsu General a global leader in these categories."

"Our businesses are extremely complementary. We are excited about the potential of this relationship to develop and deliver new and expand HVAC solutions to the market," he further added. ■



Mike Branson

Fortiline signs a definitive agreement to join MORSCO family

Fortiline Waterworks (Fortiline), a portfolio company of CHS Capital LLC and a well known waterworks distributor in the United States, recently revealed it has signed a definitive agreement to be acquired by MORSCO of Fort Worth, Texas, as its waterworks distribution platform.

MORSCO, a portfolio company of global private equity firm Advent International (Advent), is a well known U.S. distributor of commercial and residential plumbing and HVAC supplies. Advent will make a significant new equity investment to support the acquisition.

The closing of the Transaction, which is expected to occur by October 31, 2016, is subject to various conditions, including the expiration or termination of the applicable waiting period under the Hart-Scott-Rodino Act. Mike Swedick, Fortiline President and CEO, said, "On behalf of all the employees at Fortiline, we are extremely proud and excited to have signed an agreement to join the MORSCO family." ■



Mike Swedick

Hanon Systems receives NET certificate

Hanon Systems, a well known provider of automotive thermal solutions, has received a New Excellent Technology (NET) certificate from the Korean Ministry of Trade, Industry and Energy. The company received this recognition for its deodorizing air conditioning technology that incorporates an Ultraviolet (UV) Light Emitting Diode (LED) with a photocatalyst.

The NET certificate aims to facilitate the commercialisation of new technologies by confirming their superiority and the likelihood they will contribute positively to the Korean economy.

The deodorizing air conditioning technology eliminates nearly all microorganisms and odour-causing substances from the Heating, Ventilation and Air Conditioning (HVAC) unit.

Positioned between the blower and the evaporator, the LED-based UV light source shines onto a light absorbing photocatalyst, which produces oxygen containing free radicals in the air stream that possess unique antimicrobial and odour neutralising properties.

In-Young Lee, President and Chief Executive Officer of Hanon Systems, said, "We are honoured to be recognised for our research and development efforts to provide a comfortable environment for vehicle occupants." ■

Mitsubishi Electric Cooling & Heating donates comfort solutions to VCP

The Cooling & Heating Division of Mitsubishi Electric US has donated 50 Zoned Comfort Solutions to the Veterans Community Project (VCP). The VCP is a non-profit organisation serving homeless veterans in Kansas City, Missouri.

Founders and veterans launched the program in 2015 with the goal of creating a holistic support system for men and women – who have served in the United States military. The VCP's services include housing of veterans in the Veterans Village community, as well as offering food, utilities, counselling and employment opportunities.

In support of this project, Mitsubishi Electric donated 50 MSZ-SH09 indoor units and MUZ-SH09 outdoor units to the tiny homes in the Veterans Village, and plans to donate a Zoned Comfort Solution to the 6,000 square foot community centre. The compact systems sit comfortably within each 240-square-foot house, providing the organisation with an efficient utility saving system.

Kevin Jamison, Co-Founder, Veterans Community Project, said, "Mitsubishi Electric's efforts opened the doors for other companies to follow in their footsteps. They were the first company to step up and donate, helping to lower the overall cost of our Veterans Village. We are grateful for their help in making this project possible." ■



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Optimum Energy introduces HVAC optimisation solution

Optimum Energy recently released OptimumEDGE, a patented, quick-start HVAC optimisation solution that shaves chiller-plant energy use by 13% on average – and cuts water use as well – without affecting building operations or occupant comfort. OptimumEDGE gives commercial building operators affordable access to patented technology in OptimumLOOP, which is Optimum Energy's advanced chiller-plant optimisation solution for large commercial facilities. It is engineered for buildings that have up to three chillers with a combined cooling capacity of 400 to 2,000 tons.

"We're excited to make our true optimization technology available to a large category of facilities that have not been able to achieve maximum efficiency because products designed for larger facilities just didn't make sense for them," said Ben Erpelding, Optimum Energy's Chief Technology Officer. "OptimumEDGE is an opportunity for small to midsize office buildings, healthcare facilities and other commercial sites to save resources and money—painlessly."

It uses relational control algorithms to optimise chiller system components in relation to one another in response to real-time building loads and changing ambient and occupancy conditions. Most conventional control technologies optimise components individually to fixed set points – which results in some savings but does not achieve peak efficiency.

OptimumEDGE's benefits go beyond energy and water savings. It prevents performance drift and provides valuable insights into plant operations. It also provides anywhere, anytime access to operational data via Optimum Energy's secure, cloud-hosted OptiCx platform.

Optimum Energy enables campuses, healthcare facilities, pharmaceutical plants, data centers and other commercial buildings to cut energy costs and meet sustainability goals by optimizing HVAC systems, the largest consumer of energy in buildings. The company's cloud-based OptiCx Platform and its associated modules reduce an HVAC system's energy usage and resulting costs by up to 50%. The technology also reduces water use in chiller plants, tracks and reports on savings, provides detailed insights into building system operations, and efficiently scales across entire building portfolios. Optimum Energy technology has enabled current customers to save about 500 million kilowatt-hours of electricity, reduce carbon emissions by nearly 290,000 metric tons and save over 100 million gallons of water. ■

Lloyd Electric & Engineering bags contract from GE Transportation

GE Transportation has signed a US \$18m contract with Lloyd Electric & Engineering to supply custom designed air-conditioning units for the Indian Railways Marhowra Locomotive project.

The contract is to design, manufacture, test and supply air-conditioning units to be manufactured in Lloyd's factory in Bhiwadi, Rajasthan over a period of 11 years. Design of the equipment will be a collaborative effort within the Lloyd group of companies and led by Lloyd's recently acquired subsidiary Noske-Kaesar Rail & Vehicle New Zealand, based in Palmerston North, New Zealand.

This project is a significant win for Lloyd Electric & Engineering and builds on existing business between GE Transportation and Noske-Kaesar Rail & Vehicle New Zealand.

The air-conditioning units to be manufactured by Lloyd are to provide driver comfort for

1000 diesel locomotives to be manufactured in a new plant being built by GE Transportation in Marhowa, Bihar. This project advances the 'Make in India' initiative and reinforces India's position as ~ global manufacturing destination. ■

VDL Bus & Coach opts for Thermo King's product

VDL Bus & Coach, a popular bus producer in Europe, chose Athenia MkII heat pump air-conditioning systems from Thermo King, a manufacturer of transport temperature control solutions for a variety of mobile applications and a brand of Ingersoll Rand, for its electric bus fleet now operating in Germany and Netherlands.

VDL was looking for the most efficient way of providing heating and cooling in their electric bus fleet to allow for optimum passenger comfort in combination with the lowest possible energy consumption. Thermo King Athenia MkII Electric Heat Pump range answered this request.

The units offer the most efficient way of heating and cooling performances in electric buses due to its reversible refrigeration circuit. It offers maximum passenger comfort not only during the summer months when cooling is required but also during the winter months when heating is needed. These units have been popular worldwide since their introduction in 2014. ■



Red Robin rolls out new energy management system

Burgers are not the only thing Red Robin does well. In an effort to strengthen its environmentally conscious use of energy, Red Robin Gourmet Burgers and Brews, famous for serving more than two dozen high-quality and innovative burgers with Bottomless Steak Fries, is rolling out new energy management systems in its restaurants.

The project is on track for completion by early 2017 and will enable Red Robin to further protect, recycle and reduce the natural resources necessary to fuel the company's 449 corporate-owned locations across the U.S. and Canada.

Energy management systems underwent significant testing in select restaurants prior to the system wide rollout that began in May 2016. The end result will give Red Robin increased ability to control HVAC set points and exterior lighting, as well as monitor both HVAC and water heater performance and efficiency in its restaurants. The new systems will also provide Red Robin with visibility into HVAC unit performance and streamline the maintenance process.

Amanda McAllister, Director of Capital Purchasing at Red Robin, said, "Red Robin is committed to offering our guests an unparalleled dining experience from our high-quality food and service, down to how we buy and use energy to power our restaurants."

"Installation of the new energy management systems is a testament to Red Robin's environmental stewardship as we continue to manage our energy usage and carbon footprint through prudent sustainability practices," she further added.

Contextually, Red Robin Gourmet Burgers, Inc., a casual dining restaurant chain founded in 1969 that operates through its wholly-owned subsidiary, Red Robin International, Inc., and under the trade name, Red Robin Gourmet Burgers and Brews, is the Gourmet Burger Authority, famous for serving more than two dozen craveable, high-quality burgers with Bottomless Steak Fries in a fun environment welcoming to guests of all ages. Whether a family dining with kids, adults grabbing a drink at the bar or teens enjoying a meal, Red Robin offers an unparalleled experience for its guests. In addition to its many burger offerings, Red Robin serves a wide variety of salads, soups, appetizers, entrees, desserts and signature beverages. ■

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Max H Mitchell

He is a President and Chief Executive Officer of Crane Co...

Lennox International appoints a new member in its Board of Directors

Lennox International has recently appointed Max H. Mitchell as a member of its Board of Directors, which has been effective from September 16, 2016. He is a President and Chief Executive Officer of Crane Co.

He joined Crane Co. in 2004 and before being named President and Chief Executive Officer, he served roles of increasing responsibility, including Group President of the company's largest business segment and President and Chief Operating Officer. Prior to joining Crane Co., he held senior operational roles at Pentair Corporation and Danaher Corporation.

He holds a Bachelor of Arts degree from Tulane University and an MBA in finance and strategic planning from the University of Pittsburgh.

Todd Bluedorn, Lennox International's Chairman and Chief Executive Officer, said, "We're excited to welcome Max as a Member of the Board of Directors of Lennox International."

"He brings significant experience and expertise in the design, manufacturing, and multiple channel distribution of industrial products. We expect him to make valuable contributions to our Board," he further added. ■



Norbert Schmidt

He was General Manager of Whirlpool's NAR Refrigeration Business Team...

Norbert Schmidt becomes VP Products & Brands at Whirlpool EMEA

Norbert Schmidt has been appointed Vice President (VP) Products & Brands of Whirlpool Europe, Middle East and Africa (EMEA). In his role, he will directly report to Esther Berrozpe Galindo, President of Whirlpool EMEA and Executive Vice President of Whirlpool Corporation.

Prior to this role, he was General Manager of the North America Region's (NAR) Refrigeration Business Team, a position he held since late 2014. Over his 13 years with Whirlpool, he has gained leadership experiences in cooking, refrigeration and laundry product development, merchandising, marketing, plant operations, supply chain and engineering.

He graduated in mechanical engineering at Purdue University. He holds a Master's degree in Industrial

and Operations Engineering from the University of Michigan and an MBA from Northwestern's Kellogg School of Business.

He expressed his thoughts by saying, "I am thrilled to take on this new challenge and I look forward to working with the team to further develop Whirlpool's marketing approach across products and brands to help reinforce and establish our product and brand leadership and to expand our expertise in the Internet of Things (IoT). This is an exciting time for our company and I look forward to continuing Whirlpool's pioneering role in creating products and solutions that offer true value to our consumers and giving them the chance to live real moments that matter." ■



Steve Scarbrough

He has been at Mitsubishi Electric since 2010 and has more than 10 years...

Mitsubishi Electric US promotes Steve Scarbrough

Mitsubishi Electric US, Cooling & Heating Division, which is a well known manufacturer of Zoned Comfort Solutions and Variable Refrigerant Flow (VRF) cooling and heating systems, has promoted Steve Scarbrough to Director, Strategic Programs.

In this role, Scarbrough is responsible for providing leadership and oversight of multiple strategic initiatives, including the high performance construction program and strategic direction for e-commerce tactics.

He is also in charge of national wholesaler programs and managing private label activities for residential business. Based out of the Cooling & Heating Division's office in Suwanee, Georgia, he also develops and communicates policies and

procedures to the Mitsubishi Electric sales team, distributors and contractors.

He has been at Mitsubishi Electric since 2010 and has more than 10 years of experience in the industry. Previously based out of Tallahassee, Florida, he served as Business Unit Sales Manager, South Business Unit, where he created and implemented strategic partnerships to grow the VRF and Zoned Comfort Solutions market share in key vertical sectors. He was also responsible for significantly increasing CITY MULTI sales in Florida while serving as Commercial Sales Manager.

Scarbrough is an active member in the ASHRAE, Atlanta, Georgia; the Air Conditioning Contractors of America, Arlington, Virginia; and the U. S. Green Building Council, Washington, D.C. ■

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You Still can't beat the System when it's all FRICK INDIA

Students receive BASF science competition awards

Students from Northwestern University's chemistry and mechanical engineering departments won the second annual BASF science competition with a proposal for high performance lubricant base fluid via targeted functionalization of alpha olefins. The team presented new technology that may improve oil performance and engine life.

BASF hosted the science competition at its research and development location in Tarrytown, NY.

The goal of the competition was to solve the following challenge: What chemistries can be used to develop a synthetic fluid to meet the needs of tomorrow's high performance, high-efficiency engines and transmissions.



Standing with their BASF coach, Lauren Cafiero in the middle, the students from Northwestern University are (L2R) Michael Desanker, Blake Johnson, David Pickens III and Jie Lu.

"The novel idea presented by the Northwestern "Woildcats" team clearly demonstrated the challenge objectives of collaboration, business attractiveness, and technical feasibility of their multifunctional additive," said Mike Costello, Ph.D., BASF Global Technology Lead, Manual Transmission Fluids. "Their solution incorporated the properties of a viscosity improver, friction modifier and anti-wear additive in one molecule." Three teams of students presented proposals to a panel of BASF executive judges. The proposed ideas will be shared with many of the BASF business units for possible further development. The two other finalist teams represented Clemson University and the University of California – Merced. All three presenting teams received cash awards. ■

EuroSite Power makes it to the finale of ADE awards

EuroSite Power, a well known on-site utility solutions provider, offering clean electricity, heat, hot water and cooling solutions to healthcare, hospitality, housing and leisure centres in the United Kingdom (UK) and Europe, has been selected as a finalist in two categories at the prestigious Association for Decentralised Energy Awards (ADE) 2016.

The ADE awards aim to showcase innovation, best practice and achievements across combined heat and power, district heating and demand response and energy services, in the UK.

EuroSite Power has been shortlisted for the Commercial / Public Sector Project of the Year for its solution for Kingfisher Leisure



Paul Hamblyn

Centre, Sudbury, UK, and for the Customer Engagement Award for its solution for Haverhill Leisure Centre, Haverhill, UK.

Paul Hamblyn, Managing Director of EuroSite Power, said, "We are delighted to have been shortlisted in two categories at this year's ADE Awards. We hope these selections provide unbiased recognition of how our solutions represent a pioneering way to help customers access the benefits of Combined Heat and Power (CHP) in a way that is demonstrably superior to other methods of sale."

The final award winners will be announced at a ceremony on 23rd November 2016 at The Natural History Museum, London. ■

Johnson Controls receives Science and Technology Award

Johnson Controls was recently recognised for breakthrough in waste heat recovery technology again. Its large-scale steam-driven centrifugal heat pumps received the prestigious Science and Technology Award from the Architectural Society of China.

Among the 93 organisations honoured, it was the only one awarded for a facility – this demonstrates the proven, effective application of its heat pumps in a real-world setting. The award underscores the company's technology leadership as well as commitment to improving China's sustainability and air quality.

Moreover, the company is committed in promoting the waste heat recovery technology, to meet China's energy restructuring goals. According to the "Implementation Plan of Providing Residential Heating by Waste Heat," coal-fired boilers in heating systems exceeding two billion square meters will be replaced with low-grade waste heat recovery solutions by the end of 2020, reducing coal consumption by more than 50 million tons. Energy restructuring and



A view of the award giving ceremony...

reducing coal consumption are key to improving China's air quality.

Johnson Controls was one of the first Energy-Saving Service Companies (ESCO) certified by the State Council of China in 2009, and was honoured with the Special Contribution Award for Innovation (HVAC) and Technology & Innovation Award (HVAC) from the China Association of Building Energy Efficiency in 2015. ■

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Veolia Brings In New Technology

The automated technology boasts of '5Cs' – collect, calculate, correct, communicate and control – and it offers manufacturers several key benefits...



With cooling systems, operators have to continuously adapt the chemical dosing in the water to mitigate fluctuating make-up and cooling water parameters. The Aquavista 5C is Veolia's automated technology to diagnose cooling systems conditions for appropriate chemical response solution, and according to the company – it provides users with key features and functions of top-of-the-line cooling monitoring and controlling systems. This solution can prevent adverse effects like corrosion, deposits, fouling and microbiological growth in cooling towers.

The new technology boasts of '5Cs' – collect, calculate, correct, communicate and control – and it offers manufacturers key benefits such as minimising risk concerning scale and corrosion, maximising water usage, optimising blow-down water and related discharges, facilitating reports and operating conditions, and achieving the

highest water treatment systems performance.

Specially designed for integrated management of water treatment systems, Aquavista 5C also excels in remote monitoring, which allows access of information through the Aquavista 5C portal on a smart phone or tablet. This enables manufacturers to retrieve equipment status performance and data from any location instantly, and it facilitates fast reaction times when readings deviate from standard parameters.

A space-saving technology due to its compact design, the Aquavista 5C features five levels of optimisation:

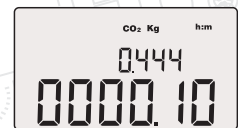
- Reducing fresh water utilisation
- Controlling chemical consumption
- Ensuring occupational safety
- Increasing plant efficiency and performance
- Enhancing human productivity.

Matthieu Gillet, Hydrex Water Treatment Additives, Asia Industrial, Veolia Water Technologies, says, "Fluctuations in cooling circuit conditions can negatively impact the various components in the cooling system. It's crucial that manufacturers take preventive measures by improving and optimising these conditions. A step up from generic cooling tower technologies, the Aquavista 5C is Veolia's breakthrough solution for smart chemical dosing and monitoring technology for cooling systems. In line with Veolia's motto of developing access to, preserving, and replenishing resources, we are confident that the Aquavista 5C will help manufacturers to mitigate the impact of their business activities on the environment." ■

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Energy Efficiency

For Heat Exchanger, Refrigeration And Air Conditioning

This article is the continuation of the two articles published respectively in the August 2016 issue of Cooling India on page no. 46 and September issue of Cooling India on page no. 44.

This article discusses a comprehensive review of energy sources, environment and sustainable development. This includes all the renewable energy technologies, energy efficiency systems, energy conservation scenarios, energy savings and other mitigation measures necessary to reduce climate change...

Industry's use of fossil fuels has been blamed for our warming climate. When coal, gas and oil are burnt, they release harmful gases, which trap heat in the atmosphere and cause global warming. However, there has been an ongoing debate on this subject, as scientists have struggled to distinguish between changes, which are human induced, and those, which could be put down to natural climate variability. Industrialised countries have the highest emission levels, and must shoulder the greatest responsibility for global warming. However, action must also be taken by developing countries to avoid future increases in emission levels as their economies develop and population grows. Human activities that emit carbon dioxide (CO₂), the most significant contributor to potential climate change, occur primarily from fossil fuel production. Consequently, efforts to control CO₂ emissions could have serious, negative consequences for economic growth, employment, investment, trade and the standard of living of individuals everywhere. Scientifically, it is difficult to predict the relationship between global temperature and Greenhouse Gas (GHG) concentrations. The climate system contains many processes that will change if warming occurs. Critical processes include heat transfer by winds and currents, the hydrological cycle involving evaporation, precipitation, runoff and groundwater and the formation of clouds, snow, and ice, all of which display enormous natural variability. The equipment and infrastructure for energy supply and use are designed with long lifetimes, and the premature turnover of capital stock involves significant costs. Economic benefits occur if capital stock is replaced with more efficient equipment in step with its normal replacement cycle. Likewise, if opportunities to reduce future emissions are taken in a timely manner, they should be less costly. Such flexible approaches would allow society to take account of

evolving scientific and technological knowledge, and to gain experience in designing policies to address climate change.

The World Summit (WS) on Sustainable Development in Johannesburg committed itself to "encourage and promote the development of renewable energy sources to accelerate the shift towards sustainable consumption and production". The WS aimed at breaking the link between resource use and productivity. It is about:

- Trying to ensure economic growth doesn't cause environmental pollution.
- Improving resource efficiency.
- Examining the whole life-cycle of a product.
- Enabling consumers to receive more information on products and services.
- Examining how taxes, voluntary agreements, subsidies, regulation and information campaigns, can best stimulate innovation and investment to provide cleaner technology.

Examining how taxes, voluntary agreements, subsidies, regulation and information campaigns, can best stimulate innovation and investment to provide cleaner technology.

The energy conservation scenarios include rational use of energy policies in all economy sectors and use of combined heat and power systems, which are able to add to energy savings from the autonomous power plants. Electricity from renewable energy sources is by definition the environmental green product. Hence, a renewable energy certificate system is an essential basis for all policy systems, independent of the renewable energy support scheme. It is, therefore, important that all parties involved support the renewable energy certificate system in place. Existing Renewable Energy Technologies (RETs) could play a significant mitigating role, but the economic and political climate will have to change first. Climate change is real. It is happening now, and GHGs produced by human activities are significantly contributing to it. The predicted global temperature increase of between 1.5 and 4.5°C could lead to potentially catastrophic environmental impacts. These include sea level rise, increased frequency of extreme weather events, floods, droughts, disease migration from various places and possible stalling of the Gulf Stream. This has led scientists to argue that climate change issues are not ones that politicians can afford to ignore, and policy makers tend to agree. However, reaching international agreements on climate change policies is no trivial task.

Renewable energy is the term used to describe a wide range of naturally occurring, replenishing energy sources. The use of renewable energy sources and the rational use of energy are the fundamental inputs for any responsible energy policy. The energy sector is encountering

difficulties because increased production and consumption levels entail higher levels of pollution and eventually climate change, with possibly disastrous consequences. Moreover, it is important to secure energy at an acceptable cost in order to avoid negative impacts on economic growth. On the technological side, renewables have an obvious role to play. In general, there is no problem in terms of the technical potential of renewables to deliver energy. Moreover, there are very good opportunities for RETs to play an important role in reducing emissions of GHGs into the atmosphere, certainly far more than have been exploited so far. However, there are still some technical issues to address in order to cope with the intermittency of some renewables, particularly wind and solar. Yet, the biggest problem with relying on renewables to deliver the necessary cuts in GHG emissions is more to do with politics and policy issues than with technical ones. The single most important step governments could take to promote and increase the use of renewables is to improve access for renewables to the energy market. This access to the market would need to be under favourable conditions and, possibly, under favourable economic rates as well. One move that could help, or at least justify, better market access would be to acknowledge that there are environmental costs associated with other energy supply options and that these costs are not currently internalised within the market price of electricity or fuels. This could make a significant difference, particularly if appropriate subsidies were applied to renewable energy in recognition of the environmental benefits it offers. Similarly, cutting energy consumption through end-use efficiency is absolutely essential. This suggests that issues of end-use consumption of energy will have to come into the discussion in the foreseeable future.

Discussions

Thermal comfort is an important aspect of human life. Buildings where people work require more light than buildings where people live. In buildings where people live the energy is used for maintaining both the temperature and lighting. Hence, natural ventilation is rapidly becoming a significant part in the design strategy for non-domestic buildings because of its potential to reduce the environmental impact of building operation, due to lower energy demand for cooling. A traditional, naturally ventilated building can readily provide a high ventilation rate. On the other hand, the mechanical ventilation systems are very expensive. However, a comprehensive ecological concept can be developed to achieve a reduction of electrical and heating energy consumption, optimise natural air condition and ventilation, improve the use of daylight and choose environmentally adequate building materials. Energy efficiency brings health, productivity, safety, comfort and savings to homeowner, as well as local and global environmental benefits. The use of renewable energy resources could play an important role in this context, especially with regard to responsible and sustainable development. It represents an excellent opportunity to offer a higher standard of living to local people and will save local and regional resources. Implementation of greenhouses offers a chance for maintenance and repair services. It is expected that the pace of implementation will increase and the quality of work to improve in addition to building the capacity of the private and district staff in contracting procedures. The financial accountability is important and more transparent. Various passive techniques have been put in perspective, and energy saving passive strategies can be seen to reduce interior temperature and increase thermal comfort, and reducing air conditioning loads. The scheme can also be employed to analyse the marginal contribution of each specific passive measure working under realistic conditions in combination with the other housing elements. In

regions where heating is important during winter months, the use of top-light solar passive strategies for spaces without an equator-facing façade can efficiently reduce energy consumption for heating, lighting and ventilation. The use of renewable energy resources could play an important role in this context, especially with regard to responsible and sustainable development. It represents an excellent opportunity to offer a higher standard of living to local people and will save local and regional resources. Implementation of greenhouses offers a chance for maintenance and repair services. Various passive techniques have been put in perspective, and energy saving passive strategies can be seen to reduce interior temperature and increase thermal comfort, and reducing air conditioning loads.

Renewable energy is the term to describe a wide range of naturally occurring, and replenishing energy sources. The use of renewable energy sources and the rational use of energy are the fundamental inputs for a responsible energy policy. The energy sector is encountering difficulties because increased production and consumption levels entail higher levels of pollution and eventually climate changes, with possibly disastrous consequences. Moreover, it is important to secure energy at acceptable cost to avoid negative impacts on economic growth. On the technological side, renewables have an obvious role to play. In general, there is no problem in terms of the technical potential of renewables to deliver energy and there are very good opportunities for renewable energy technologies to play an important role in reducing emissions of greenhouse gases into the atmosphere-certainly far more than have been exploited so far. But there are still technical issues to be addressed to cope with the intermittency of some renewables, particularly wind and solar. However, the biggest problem with relying on renewables to deliver the necessary cuts in greenhouse gas emissions is more to do with politics and policy issues than with technical ones. The single most important step governments could take to promote and increase the use of renewables would be to improve access for renewables to the energy market. That access to the market would need to be under favourable conditions and possibly under favourable economic rates. One move that could help-or at least justify-better market access would be to acknowledge that there are environmental costs associated with other energy supply options, and that these costs are not currently internalised within the market price of electricity or fuels. It could make significant difference, particularly if, appropriate subsidies were applied to renewable energy in recognition of environmental benefits it offers. Cutting energy consumption through end-use efficiency is absolutely essential. And this suggests that issues of end-use consumption of energy will have to come onto the table in the foreseeable future.

The scientific consensus is clear-climate change is occurring. Existing renewable energy technologies could play a significant mitigating role, but the economic and political climate will have to change first. Climate change is real, it is happening now, and greenhouse gases produced by human activities are significantly contributing to it. The predicted global temperature changes of between 1.5 and 4.5 degrees C could lead to potentially catastrophic environmental impacts-including sea level rise, increased frequency of extreme weather events, floods, droughts, disease migration from various places and possible stalling of the Gulf stream. This is why scientists argue that climate change issues are not ones that politicians can afford to ignore. And policy makers tend to agree, but reaching international agreements on climate change policies is no trivial task.

The most favourable orientation, which is due north, results in diminished excessive solar gains through the windows. However, most buildings cannot be oriented at will. If the only possible orientation is due south, and no external shade is used, the index reveals extra heat gains of some 0.26 over the value of totally shaded window. Application of the model results from exploring the relative importance of the thermal inertia of walls, floor and ceiling. Heat stored in building materials, as proven in old, massive buildings, can be compensated during high insolation hours with thermal losses at night and early morning hours, when ambient temperatures are below 25°C. Temperature variation will be lower for higher thermal capacities of building materials. However, it is known while thermal capacity increases the relative importance of individual heat flows change. For example, for lower wall temperatures, the contribution of radiative heat transfer will be reduced, and the relative importance of convective processes will increase, and thus the difficulty to calculate accurately the overall heat flows. The relevance of certain passive techniques is variable with prevailing weather.

Finally, the required temperature dependent air transport properties were evaluated by the following expression, which are valid between 2°C and 77°C with temperature expressed in k:

$$\text{Thermal diffusivity, } \alpha = 1.534 \times 10^{-3} T - 0.2386 \text{ (} 10^{-4} \text{ m}^2\text{s}^{-1}\text{)}$$

$$\text{Kinematics viscosity, } \nu = 0.1016 T - 14.8 \text{ (} 10^{-6} \text{ m}^2\text{s}^{-1}\text{)}$$

$$\text{Thermal conductivity, } k = 7.58 \times 10^{-5} T + 3.5 \times 10^{-3} \text{ (Wm}^{-1}\text{K}^{-1}\text{)}, \text{ and}$$

$$\text{Thermal expansion coefficient, } \beta = T^{-1} \text{ (K}^{-1}\text{)}$$

In order to depict the relative contribution of each of these techniques to inside temperature, a dimensionless index is defined as follows. When interior temperature exceeds 25°C, it will be considered as a temperature discomfort condition. This reference temperature is widely elements. Then the following expression:

$$F(t) = \max(T_i - 25, 25) \tag{1}$$

I_s a time function of truncated temperature and it will be able to estimate the overall discomfort by means of the integration along the day for each different scenarios S:

$$A(S) = \int_s F(t) dt \tag{2}$$

Then, for each passive technique, let:

$$A_{\max} = \max[A(S): \text{for all scenarios } S] \tag{3}$$

Finally, the normalised temperature index for each scenario S is:

$$I(S) = A(S)/A_{\max} \tag{4}$$

Naturally, it would be preferred, for comfort reasons that this index would be small, preferably nil. It may be seen that the variable is directly related to temperature discomfort: the larger the value of the index, the farthest will inside conditions be from expected wellbeing. Also, the use of electricity operated air conditioning systems will be more expensive the higher this variable is. Hence, energy expenditure to offset discomfort will be higher when comparing two index values; the ratio of them is proportional to the expected energy savings. When the external shade blocks the windowpane completely, the excessive heat gains belong to the lowest values in the set, and the dimensionless index will be constant with orientation. For the climate conditions of the locality, it can be seen that a naked window can produce undesirable heat gains if the orientation is especially unfavourable, when the index can have an increase of up to 0.3 with respect to the totally shaded window.

Conclusion

With increasing worldwide awareness of the serious environmental problems due to fossil fuel consumption, efforts are being made to develop energy efficient and environmentally friendly systems by utilisation of non-polluting renewable energy sources, such as solar

Nomenclatures

ACH	Air changes per hour
GSHP	Ground source heat pump
HRV	Heat recovery ventilator
PRT	Platinum resistance thermometer
1	condenser/heating
2	evaporator
a	air
b	brine
c	coil
cp	Specified heat at constant pressure (kJ/kg K)
Dp	dew point
e	electricity for other uses
f	fan
h	Enthalpy (kJ/kg)
hp	heat pump
hps	heat pump system
hpsf	hps plus fan-coil heater
g	Local acceleration of gravity (m/s ²)
i	inlet
L	latent
m	mean, motor
o	outlet
o/d	outdoor
R	radius
p	pump
S	sensible
tot	total
DC	Direct current
HSPF	Heating season performance factor
SEER	Seasonal energy efficiency ratio
Btu	British thermal unit
COP	Coefficient of performance (%)
N	Air change per hour (ACH) (h-1)

energy, industrial waste heat or geothermal water. The GSHPs are suitable for heating and cooling of buildings and so could play a significant role in reducing CO₂ emissions. Ground source or geothermal heat pumps are a highly efficient, renewable energy technology for space heating and cooling. This technology relies on the fact that, at depth, the Earth has a relatively constant temperature, warmer than the air in winter and cooler than the air in summer.

A geothermal heat pump can transfer heat stored in the earth into a building during the winter, and transfer heat out of the building during the summer. Furthermore, special geological conditions, such as hot springs, are not needed for successful application of geothermal heat pumps. The GSHPs are receiving increasing interest because of their potential to reduce primary energy consumption and thus reduce emissions of the GHGs. The GSHP is generally recognised to be one of the most outstanding technologies of heating and cooling in both residential and commercial buildings, because it provides high coefficient of performance (COP), up to 3-4 for an indirect heating system and 3.5-5 for a direct heating system.

The main benefit of using the GSHPs is that the temperature of the subsurface is not subject to large variations experienced by air. It is currently the most common thermal energy source for the heat pumps, and so would allow construction of more efficient systems with superior performance. The GSHPs do not need large cooling towers and their running costs are lower than conventional heating and air conditioning systems. As a result, the GSHPs have increasingly been used for building heating and cooling with annual rate of increase of 10% in recent years. ■

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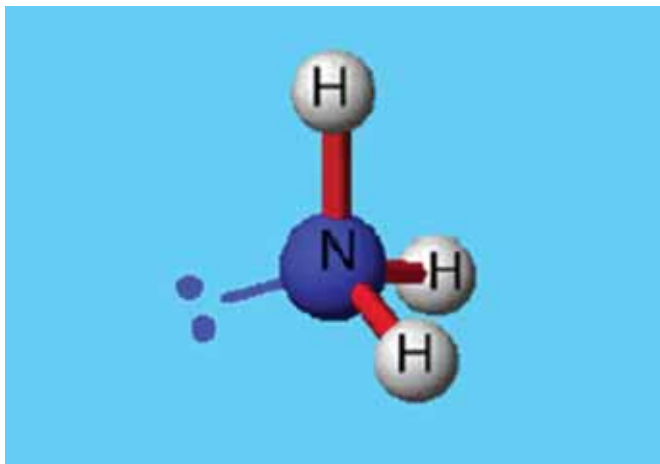
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Any new investments in HVACR equipment will be based on Low Global Warming refrigerants. If you are investing in new HVACR equipment you'll want to be sure it is future proof – doesn't require the use of High Global Warming synthetic refrigerants...



On October 8 /12 over 100 countries will meet to ratify amendments to the Montreal Protocol that will change the Refrigeration and Air Conditioning (HVACR) industry fundamentally, globally and forever. It is critical that the Parties to the Montreal Protocol agree to dramatically reduce the use of High Global Warming synthetic refrigerants; in Kigali on October 8/12. Probably for the first time in my knowledge, the need to stop using High Global Warming synthetic refrigerants has been stressed by the popular press – the Economist, Scientific American, The Twitter Dom and many others. They will probably agree to change the Montreal Protocol fundamentally or they will agree to agree soon.

The Montreal Protocol will become a global agreement to reduce global warming as well as reducing ozone depletion. It will establish the basis for the elimination of high global warming synthetic refrigerants. The parties to the Montreal Protocol will establish an agreement that will ultimately pertain to every country in the world.

The impact of this development is that a large proportion of refrigeration and air conditioning equipment will be replaced or rebuilt before the end of its life in order to enable the use of Low Global Warming refrigerants. This is a huge global investment but in most cases, it is commercially warranted.

Any new investments in HVACR equipment will be based on Low Global Warming refrigerants. If you are investing in new HVACR equipment you'll want to be sure it is future proof – doesn't require the use of High Global Warming synthetic refrigerants.

Many are not saying that the solution is natural refrigerant-based technology. Because of the commercial interests involved, there is ongoing confrontation between natural refrigerant-based technology and synthetic refrigerant based technology. Both will be promoted for direct emissions reduction reasons but the fact is that natural refrigerants are inherently more energy efficient.

India's built environment is projected to grow fivefold between 2005 and 2030 and vehicular density is projected to be more than triple by 2030. Rapid economic growth results in rising standards of living, Indian industrial refrigeration system is expected to grow with rapidly increasing use of refrigerant.

With the Montreal protocol phasing out use of ozone depleting substances, Indian industry is in a process of substituting hydrochlorofluorocarbons (HCFCs) used in refrigeration, air-conditioning, industrial refrigeration sector and other sectors with hydrofluorocarbons (HFCs). HFCs do not affect the ozone layer, but have significant global warming potential up to over a thousand times stronger than carbon dioxide.

The contribution to global warming of ever increasing emission of greenhouse gases from various sources threatens to lead to catastrophic climate changes. The need of mitigation policies for addressing global climate change concerns is an important item on the agenda of current international discourse.

India is going to ratify Paris agreement on 2nd October 2016. The agreement ambition is to limit global temperature rise to 1.5 Deg C. There will be a need to phase out all HFCs. Global Market is already shifting away from HFCs. European Union, Japan, USA, China and numbers of other countries are taking steps to phase down their use.

Indian government emphasize that the solution to phasedown refrigerant should be sustainable, energy efficient, should reduce power consumption from existing levels, economical, keep national interest, and most important it should follow "Make in India" policy.

Ammonia – the Natural Refrigerant in the field of Industrial refrigeration sector is the most viable option considering Indian tropical condition, sustainability, economic viability, energy efficiency and all above factors.

India is widely using Ammonia for more than 60 years. We have lots of refrigeration system are installed using Ammonia as a refrigerant.

When we select refrigerant we should normally consider following major important factors:

- Must eco-friendly natural refrigerant: Prime importance.
- Low GDW
- Low ODP
- Energy efficient
- Sustainable
- Low cost
- Easy availability and "Make in India"
- System design knowledge, manufacturing equipments and all system components are available in follow "make in India" Policy.
- Easy to use and charge.
- Availability of trained manpower;

Ammonia as a natural refrigerant full fills all above criteria. It is the only best choice as a refrigerant for refrigeration industry considering Indian climate conditions and available resources.

Why ammonia – The natural refrigerant and the Important Facts about ammonia as a refrigerant:

1. Ammonia is the oldest natural refrigerant worldwide used in refrigeration Industry.

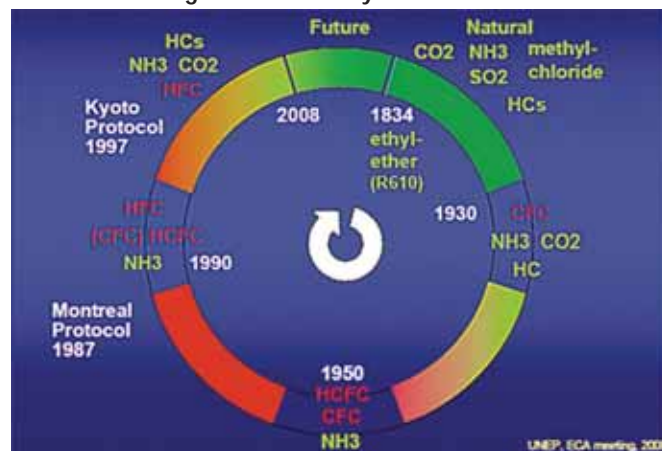


Figure: 1

From above Figure: 1 ammonia as a refrigerant is in used since 1832. We can observed that Ammonia as a refrigerant is continued to be

in use since 1832, however refrigerant like HCFCs & HFCs needs to be phased down and there is need to find out various new sustainable refrigerant alternatives to protect the world environment.

2. The properties of ammonia are given below in table : 1

Molecular symbol	NH ₃
Chemical name	717
Safety group	B2L
Boiling point at 1 atm	239.82 k / -33.33 Deg C
Freezing point at 1 atm	195 k / -77.66 Deg C
Critical temperature	405.37 k / 132.22 Deg C
Critical Pressure	11.34 MPa g / 115.6.6 kg/sq. cm g
Latent heat at -33 Deg C / 240.15 K	327.1 cal / g / 1.369 MJ / kg @ 1 atm
Liquid density -33 Deg C / 240.15 K	681.6 kg/cum @ 1 atm

From above ammonia is excellent refrigerant in Indian tropical condition.

3. GWP level as per ASHRAE Fundamental 2013 Table 3 are given below:

The most important parameter under present circumstances is Global Warming Potential of a refrigerant. Ammonia's GWP from Table: 2 below is less than 1 and Ozone Depletion potential (ODP) is zero.

This endorses ammonia as an obvious choice from environmental protection point of view.

Table 2: ASHRAE Fundamental Chapter 29 Tables: 3& 4

Refrigerant	ODP	GWP
Ammonia R-717	0	< 1
Co2 R-744	0	1
R-22	0.04	1790
R-134a	0	1370
R-404A	0	3700
R-407 c	0	1700
R-410A	0	2100

4. Energy efficient refrigerant:

Ammonia is the most energy efficient refrigerant at any given operating parameters. Following Table:3 indicate that ammonia COP is highest among all refrigerants. (The comparative refrigerant performance per kW of refrigerant @ -31.7/30 Deg. C EVP/Cond temperatures.

Table 3: (ASHRAE Fundamental 2013 table 8 chapter 29)

Refrigerant	Evp. Pr. MPa	Cond. Pr. MPa	Comp. Ratio	Ref. effect kJ/kg	Power consum. kW	C.O.P.
Ammonia	0.11	1.167	10.61	1079.1	0.3327	3.007
R-22	0.183	1.304	7.14	97.8	0.3651	2.739
R 404 A	0.190	1.42	7.46	104.9	0.3853	2.595
CO2	1.349	7.213	5.35	132.1	0.5892	1.698

5. Practical example of Energy efficient Refrigerant:

Let us take practical example of energy saving achieved by using ammonia refrigerant. Let us take the compressor power @ -5 Deg C evaporation temperature. Condenser for ammonia considered as water cooled and is compared with air cooled and water cooled condenser for R-404A with 40 Deg C & 52 Deg C condensing temperature respectively. The Table 4 below indicates that ammonia is energy efficient and considering 15 years of operation, considerable amount of energy saving can be achieved by using ammonia as a refrigerant.

Table: 4

Ref.	Shaft power kW@ 40 Deg C cond. (Water-cooled)	Diff. in shaft power w.r.t Ammonia	extra energy bill for 15 year s of plant life (RS)	Shaft power kW@ 52 Deg C cond. (Air-cooled)	Diff. in shaft power w.r.t Ammonia	extra energy bill for 15 year s of plant life (RS)
R-717	26.5	0		26.5*	0	
R-404a	45	6.56	27,22,44	45.11	18.61	114,62,596

The above calculations are based on 15 hr/ day operation, Rs 7.5/- electricity cost / unit, 365 days operation in a year, 15 years total life of plant. From above we can very well conclude that tremendous saving can be achieved if we opt for ammonia as a refrigerant.

6. Some of the other important properties of ammonia are:

- Lower density of ammonia vapour makes it possible to increase its speed in pipes and to therefore reduce the pipe diameter.
- Leak detection: Ammonia has pungent odour and even small leaks are immediately detected so maintenance person can take immediate action.
- Oil is immiscible in ammonia, hence very easy to remove oil from refrigeration system.
- Ammonia has higher heat transfer coefficient, so heat exchanger is smaller as compare to HFCs.
- Ammonia is lighter than air. Hence air ventilation is sufficient
- Lower pumping cost in case of flooded system.
- High critical pressure of 113 bar enables ammonia to cover wider temperature span in the normal refrigeration cycle.

7. Make in India:

The prime government policy is entirely applicable for ammonia refrigerant. We in India possess excellent knowledge of design, engineering, installation, commissioning of fully automated state of art PLC/PC based ammonia refrigeration system. We are producing all required equipments and components in India required for ammonia system.

8. Need no Retro fit to reduce Global warming:

There is no need to retrofit the existing ammonia refrigerant system to make it environmental friendly, like what we have to do for HFC refrigerationsystem. As and when new low GWP HFC refrigerant is developed, there is need to retrofit the existing system. End user has to bare financial burden of the same.

All above parameters justify use of ammonia as refrigerant and is the only environmental friendly refrigerant suitable in Indian tropical conditions.

What we all need to do to create awareness and to promote extensive use of ammonia- as natural refrigerant for industrial refrigeration application.

- There is a need to have Indian standard for ammonia refrigeration system. It should be ensured that all ammonia plants are design, installed, tested, commissioned, maintained and inspected by government agencies as per this standard. Also it will ensure that all plants follow safety procedure as per the standards. We cannot adopt international standards as it is in India considering our tropical condition, our way of operation, available resources etc.
- The latest trend is to design low charge ammonia systems. This will make existing system safer. Research work in this regards needs to be carried out extensively in India.
- There is need to motivate end user to make it a practice to follow all safety norms.

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- All misconception spread related with ammonia (Natural Refrigerant) pan India must be stopped. e.g. Ammonias going to be banned and it is highly unsafe to use as refrigerant. There is need to remove this misconception by way effective mass communications.
- Awards / recognition on all India level can be given to end users, who revamped their old plant by shifting to natural refrigerant.
- Skill development: Indian government is promoting skill development. There is need to develop skilled manpower to operate and maintained the ammonia refrigeration system. This will ensure safe and energy efficient operation thorough out the plant life.
- In case of HFCs the most critical part is to decide base line for consumption. This concept is not applicable for ammonia refrigerant.
- Power tariff subsidies can be given to an end user if he is using natural refrigerant in his refrigeration plant.
- The policy can be framed that refrigeration system of certain capacity and above must be installed using natural refrigerant.
- There is a need to create appropriate data base of all existing industrial refrigeration system having refrigerant charge say more than 270 kg. Similar to what is created in USA and Europe.

To contribute to achieve all above noble objectives "Association of Ammonia Refrigeration (AAR)" was incorporated in the year 2013. AAR is National organization registered in Pune with 200+ individual members and 30 + multinational corporate members from all over India. The members profile comprises of consultants, contractors,

manufacturers, senior technical professionals and end users of various organizations engaged in the field of ammonia refrigeration.

Since inception AAR is promoting use of ammonia as a refrigerant through education, training, information and standards. AAR has held seminars and trained more than 2000 delegates across pan India with varied themes of efficiency, sustainability and safety. AAR has developed the standard keeping in view of specific Indian Condition, keeping Indian way of operation, handling, maintenance & affordability. Handy posters are developed to guide operators in important maintenance activity such as oil drain, first aid etc. Practical guideline for cold storage load calculation and effective operation and maintenance of the plant is also developed. All these above literatures are developed in very simple practical way so that all can easily understand and effectively follow.

To conclude: Ammonia – natural refrigerant is the only most viable, energy efficient option for Indian industrial refrigeration systems. Proper preventive maintenance and safety precautions will lead to safe, trouble free, energy efficient plant operation throughout life of the plant. ■

Anil D Gulanikar
 Director
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DOE Offers Grants To Berkeley Lab

Three projects are being supported by the DOE's Office of Energy Efficiency and Renewable Energy (EERE)...



A thermal image of the Hansen Federal Building in Ogden, Utah, where Berkeley Lab performed a window retrofit study... (Credit: Berkeley Lab Windows and Envelope Materials Group)

Lawrence Berkeley National Laboratory (Berkeley Lab) has been awarded more than \$4 million by the Department of Energy (DOE) to undertake three projects aimed at improving the energy efficiency of buildings, which account for more than 40% of the country's energy consumption and greenhouse gas emissions.

The projects, including a nanoparticle-based super insulation, a platform for automated building controls, and an advanced moisture modeling tool, will help meet the DOE goal to reduce the energy intensity of the U.S. building sector by 30% by 2030. On average, nearly a third of the energy used in buildings is wasted. It's estimated that if the U.S. reduced energy use in buildings by 20%, the nation could save nearly \$80 billion annually on energy bills.

"Berkeley Lab has been at the forefront of building technologies research for more than 30 years, having pioneered innovations such as efficient lighting, low-emissivity windows and versatile tools for building designers. We are continuing to build on that foundation while utilizing more from the science toolkit, such as advanced materials and

nanoscience," said Ramamoorthy Ramesh, Associate Lab Director for Energy Technologies.

Nanoparticle insulation

The super insulation project is led by Berkeley Lab scientist Ravi Prasher, who discovered almost 10 years ago that nanoparticles could be assembled in a way to control the heat flow through them. "The purpose of insulation is to stop the flow of heat – it prevents heat from escaping your house during winter and letting heat in during summer. So you need a material with low thermal conductivity," Prasher explained.

His research found that the heat flow through nanoparticles is strongly dependent on three factors – the size of the nanoparticle, a property called acoustic mismatch, and the surface chemistry of the nanoparticle. "An optimal combination of these three things can dramatically reduce thermal conductivity and give you something similar to aerogel," he said.

Aerogel is an emerging insulation technology with low thermal conductivity – about twice as good as conventional insulation. However, because it is more than 95% air, aerogels are mechanically fragile. Additionally

because they use a process called supercritical drying in manufacturing the cost can be up to 10 times higher.

With \$1.5 million in DOE funding, Prasher, working with Berkeley Lab scientist Wei Tong, intends to develop a process that does not use supercritical drying for making the new insulation. "We want to use a nanoparticle that's cheap and abundant," Tong said.

In parallel, scientists at Oak Ridge National Laboratory (ORNL) will perform energy savings analysis and identify key performance criteria to make the product competitive. "We believe our insulation will have the same performance as aerogel at half the cost, and mechanically it will be at least 10 times stronger than aerogel," Prasher said.

Combined thermal and moisture analysis for building envelopes

In the second project, Berkeley Lab scientist D. Charlie Curcija will team with researchers at ORNL to add moisture analysis capabilities to

THERM, Berkeley Lab's popular envelope thermal performance analysis software. Currently available tools for moisture analysis are either expensive or not sufficiently accurate. With THERM's popularity among engineers, architects, manufacturers, and others for building thermal modeling, adding this functionality could enable great changes in building energy design.

Moisture resistance and energy efficiency are strongly linked. "Almost by definition, energy efficient building envelopes can't use heat to drive out moisture that has penetrated. Unless you pay attention to moisture issues during design, you can really create a health disaster in the form of mold," Curcija said. "This has led some builders to shy away from more energy efficient designs."

Moisture also tends to destroy constructions over time. "To be able to analyze moisture while optimizing envelope thermal properties will lead to design of buildings that are not only more energy efficient but also longer lasting."

DOE will provide \$1.25 million for the project.

Integrated design and implementation of building controls

The third project, with \$2 million in DOE funding, will tackle key problems in control systems. These systems manage heating, cooling, ventilation and lighting in large commercial buildings and try to maintain occupant comfort while minimizing energy use.

The typical process of designing and implementing control systems is manual and error-prone and results in more than 300 terawatt-hours per year of wasted energy (or about \$30 billion in energy costs), according to Philip Haves, Co-lead of the project.

"It's no exaggeration to say that controls are the Achilles heel of commercial buildings," he said. "The connection between the controls as designed and the controls that actually get implemented is often tenuous at best. If we're trying to get to innovative, high-performance buildings that use less energy, then the model used today for controls delivery is not going to work."

Berkeley Lab scientist Michael Wetter and co-lead Haves will develop a platform for automating the entire process of designing, implementing, and verifying the correct operation of building controls, reducing both manual effort – and cost – and manual error.

"Our tool, OpenBuildingControl, will allow the designer to run simulations to find the most energy efficient strategy before actually building the building. It will then translate the simulated controls into sequences that can run directly in the building control system. This will reduce installation cost and provide assurance to the building owner that controls are implemented and installed as designed," Wetter said.

A broad group of industry collaborators, including Arup North America, CBRE, and several large building portfolio owners, will provide input, testing facilities, and initial deployment channels to spur widespread adoption of the platform. "What we're doing is quite innovative for the building industry, and there are advantages for everyone, from controls companies to contractors to building owners," Haves said.

The benefits to the country's energy bills are also expected to be substantial. "Our goal is to reduce the current energy waste of \$30 billion annually, through a process that includes end-to-end quality control at lower cost to all stakeholders," Wetter said.

"This will be a win-win for all parties involved, he added." ■

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TRANSPORT REFRIGERATION

Over the last 150 years or so, refrigeration's great strides offered us ways to preserve and cool food, other substances and ourselves. Transport refrigeration has brought distant production centres and population together...



Refrigeration in general in its various applications from household refrigeration to transport refrigeration has become essential in today's society. Use of transport refrigeration in its various modes e.g., road-based, sea-based and air-based for the transport of preserved food items to medicinal supplies and much more has been growing with a great demand. Transport refrigeration equipment, cold chain monitoring solutions and replacement components help protect our global food supply and other perishable cargo. Companies are offering complete range of transport refrigeration units designed to suite

all types of vehicles, meet the needs for single or multi-temperature cooling and with qualities of unique performance, reliability, capacity, flexibility, ease of use and cost whilst also respecting the environment. Transport refrigeration is a vital part of every cold chain: perishable goods, mainly food but also medical supplies and other goods, have to be refrigerated on their way from harvest or production to the consumer. Refrigerated transport increases food safety and prevents economic losses due to spoilage. Trucks and trailers are in many parts of the world the main mode of transport for refrigerated goods. Fresh is not simply

about how recently produce was harvested or products were created. It is also about the conditions in which they have been transported. Transport refrigeration solutions allow for precise control of temperature and humidity, preserving all types of perishable cargo no matter where it needs to go. With a robust portfolio of products and services designed to help monitor and manage the cold chain of the world's most temperature-sensitive, perishable products, including food, pharmaceuticals, biologics, and industrial chemicals, transport refrigeration offers full-service supply chain visibility solutions that provide complete cargo transparency from origin to destination.

Development status

Over the last 150 years or so, refrigeration's great strides offered us ways to preserve and cool food, other substances and ourselves. Transport refrigeration has brought distant production centers and population together. It tore down the barriers of climates and seasons. And while it helped to rev up industrial processes, it became an industry itself. Refrigerated transport, undoubtedly an essential link in the cold chain, aims at supplying the consumer with safe, high quality perishable goods. The goods concerned are perishable foodstuffs or non-food goods such as flowers, plants, pharmaceuticals or chemical products. There are three basic types of transport: sea transport (conventional ships, container ships), land transport (road, rail) and air transport. Intermodal transport combines more than one of these types of transport. Frozen goods are transported at a temperature of -18°C or lower, chilled goods at a temperature above the freezing point. Driven primarily by the expansion of the chilled and quick-frozen foods market, with an annual sales level totalling 1200 billion USD worldwide in 2000 refrigerated transport is a major economic player. About 550 000 refrigerated marine containers and about 1 200 000 refrigerated road vehicles are currently in use and this clearly illustrates the importance of refrigerated transport worldwide. For each transport mode there is specialized refrigerated equipment to provide temperature control. Intermodal systems exist for all modes except for air transport. It must be noted that transport refrigeration systems not only cool, but also heat if necessary in order to achieve the correct transport temperature, an important consideration for chilled goods in cold climates. As a general rule, transport refrigeration equipment is designed to maintain temperature, not to cool down goods, so goods should be loaded already pre-cooled to carriage temperature. Exceptions are shipments of bananas and citrus fruit, for which appropriate cooling regimes are established. It is essential to establish rules governing hygiene, particularly with respect to cleaning of the body following transport. The majority of new transport refrigeration units use vapour-compression refrigeration with HFC refrigerants. Some equipment uses total-loss refrigerants (carbon dioxide or liquid nitrogen) for limited journey times. Road transport units may operate either from the vehicle engine or from an independent diesel engine.

Rail units may operate on electricity supplied from a generator wagon. Marine refrigeration is electrically driven from ships' supplies. Intermodal containers are also electrically driven, but can have portable diesel generator sets attached to them. Refrigerated equipment in air transport is relatively rare, and commonly uses "dry ice" (solid carbon dioxide), though some battery-operated systems are available.

The technical requirements for transport refrigeration units are more severe than for many other applications of refrigeration. The equipment has to operate in a wide range of ambient temperatures and under extremely variable weather conditions (sun radiation, rain...); it also has

to be able to carry any one of a wide range of cargoes with differing temperature requirements, and it must be robust and reliable in the often severe transport environment. For frozen goods, low temperature is needed, but generally a close range of temperature is not a critical requirement. Frozen foods at -18°C may not suffer if they go down to a lower temperature, so a simple on/off control system may be used, which provides cooling whenever the temperature rises to the set point. However, especially for long journeys, frozen foods must not be exposed to large temperature variations, which can lead to moisture migration and loss of quality. Chilled foods, on the other hand, require close temperature control between two limits — too low a temperature will damage them; too high a temperature will reduce shelf life. For example, chilled meat may need to be maintained throughout a long journey within a temperature range of between 0°C and -1.5°C , which modern equipment can achieve. Close temperature control systems for chilled goods require continuous, modulated refrigeration combined with high rates of air circulation. This involves a greater power and energy requirement than for frozen foods with on/off control. Longer journey times need better control. Temperature control available in ship and intermodal container transport provides the best conditions; road transport can be comparable but less severe specifications are acceptable for shorter journeys or for frozen foods. Relatively poor temperature control can be acceptable for rapid air transport. Estimated diesel power requirements (as equivalent fuel use) for road units are from 11 kW for a typical van unit to 23 kW for a trailer unit, giving an overall figure of around 0.05 kWh per tonne km.⁶ This high power requirement is necessary to obtain a fast temperature pull down and fast recovery in distribution with many door openings. This corresponds to equipment with cooling capacity about 4 times the body heat loss cooled at -20°C and 10 times the body heat loss cooled at 0°C at 30°C ambient. Running hours may be between 1800 and 4000 hours per year. Intermodal container units may require electrical power of around 2 kW for frozen goods and 5 kW for chilled, but this is very dependent on unit design and operating conditions. It is notable that the close temperature control requirements and more rapid air circulation needed for chilled goods result in higher power requirements than for frozen goods, despite the lower temperature differences to be maintained.

Transport refrigeration technologies

A transport refrigerator vehicle is designed to carry perishable freight at specific temperatures. Like refrigerator cars, refrigerated trucks differ from simple insulated and ventilated vans (commonly used for transporting fruit), neither of which are fitted with cooling apparatus. Refrigerator vehicle can be ice-cooled, equipped with any one of a variety of mechanical refrigeration systems powered by small displacement diesel engines, or utilize carbon dioxide (either as dry ice or in liquid form) as a cooling agent. Different transport techniques are briefly explained as:

Water cooling: water cooling systems are expensive, so modern vessels rely more on ventilation to remove heat from cargo holds, and the use of water cooling systems is declining. Air cooling and water cooling are usually combined. Air cooling removes the heat generated by the reefers while water cooling helps to minimize the heat rejected by the reefers. The reefers are using some heat exchangers that behave as water cooled condensers.

Cryogenic cooling: Another refrigeration system sometimes used where the journey time is short is total loss refrigeration, in which frozen carbon dioxide ice (or sometimes liquid nitrogen) is used for cooling. The cryogenically frozen gas slowly evaporates, and thus cools the container

and is vented from it. The container is cooled for as long as there is frozen gas available in the system. These have been used in railcars for many years, providing up to 17 days temperature regulation. Whilst refrigerated containers are not common for air transport, total loss dry ice systems are usually used. These containers have a chamber which is loaded with solid carbon dioxide and the temperature is regulated by a thermostatically controlled electric fan, and the air freight versions are intended to maintain temperature for up to around 100 hours. Full size intermodal containers equipped with these "cryogenic" systems can maintain their temperature for the 30 days needed for sea transport. Since they do not require an external power supply, cryogenically refrigerated containers can be stored anywhere on any vessel that can accommodate "dry" (un-refrigerated) ocean freight containers.

Redundant refrigeration: Valuable, temperature-sensitive, or hazardous cargo often require the utmost in system reliability. This type of reliability can only be achieved through the installation of a redundant refrigeration system. A redundant refrigeration system consists of integrated primary and back-up refrigeration units i.e., a container fitted with two refrigeration units and a single diesel generator. If the primary unit malfunctions, the secondary unit automatically starts. To provide reliable power to the refrigeration units, these containers are often fitted with one or more diesel generator sets.

Mechanical refrigeration: all mechanical transport refrigeration units normally includes a compressor, drive, and condenser combination; an evaporator or air-cooler; all necessary refrigerant lines and electrical wiring; and means whereby the unit can be suitably mounted and installed on a vehicle, used in transportation of perishable goods. The first successful mechanically refrigerated trucks were introduced by the ice cream industry in about 1925. There were around 4 million refrigerated road vehicles in use in 2010 worldwide.

System requirements

Transport refrigeration units used in different transport modes and vehicles always meet the most rigorous criteria for sensitive goods transportation. High performances and fast temperature recovery provide superior protection of goods. Innovative microprocessor controls and cab command makes operations easy and safe. Different levels of protection rise reliability and lower life cost of unit. Therefore, requirement is a comprehensive one-stop solution for the transportation of temperature-controlled freight with the threefold benefit for the customer as: safety, efficiency and permanently low total cost. Further, constant checking of the system components, using a trailer telematics system, centralized monitoring and control of servicing, maximizes the availability of the customer's investment. The development of the transport refrigeration unit using the latest state-of-the-art technology, which sets the benchmark for the premium segment require:

- Precise temperature control throughout the entire interior with minimal fluctuation.
- Excellent economy combined with high-performance cooling through efficient motor management.
- High refrigeration performance for fast cooling down.
- The best heat output among the direct competitors for the shortest possible interruptions in goods cooling when defrosting.
- 50 % fewer defrosting cycles due to the ice-reducing evaporator design.
- Durable industrial motor with intelligent speed control and compressor with cylinder deactivation for low fuel consumption.
- Greater operational reliability and control thanks to the electronic control unit.

- Longer maintenance intervals due to the specially dimensioned wearing parts.
- Transport refrigeration systems designed specifically for make and model of vehicle.
- The size of all components is carefully calculated to give maximum cooling output without adversely affecting the vehicle's fuel consumption for performance.
- To maintain the system in good working order and to minimize the loss of refrigerant, the refrigeration unit should be operated for a minimum of five minutes each week regardless of the season. This will assist in preventing the compressor seal from drying out; a condition which can cause loss of refrigerant and possible damage to the compressor.
- From the latest and best in refrigeration technology to the services required to keep units running efficiently.
- Next-generation transport refrigeration technologies require ever-higher standards in refrigerated container, truck and trailer systems while reducing fuel consumption, emissions and sound levels.
- Logistics security solutions in order to help to minimize product loss, ensure patient safety and protect product integrity by mitigating the risks associated with product distribution, such as theft, diversion, counterfeiting and chain of custody.

Challenges today, opportunities tomorrow

Transport refrigeration is one of the most demanding segments in commercial refrigeration. These refrigeration systems need to manage loads of varying sizes and types while dealing with exposure to harsh environmental conditions, ranging from sweltering desert heat to the corrosive salt of ocean swells.

Extreme ambient temperatures can cause interior temperatures to spike, posing a serious risk to food freshness and safety and significantly affecting fuel efficiency.

This application demands extremely high levels of engineering capable of simultaneously managing these competing concerns and helping to deliver high-quality foods at competitive prices. Unlike most commercial refrigeration applications for which many components are used interchangeably, the equipment used in transport systems is designed specifically to meet the challenges of navigating extreme conditions.

- Providing refrigerated products are handled carefully, using the right equipment, their size, freshness, firmness, texture, color, flavor, aroma and chemical balance are not compromised in transit.
- Different requirements for long-distance transport in trailers and distribution traffic in smaller vehicles leads to a range of cooling capacities. Similar to mobile ACs in passenger cars, the refrigerant leakage is high. These are in particular caused through constant vibrations during operation and at times when difficult road conditions lead to lose connections. Leakage rates can be as high as 20-30% per year.
- There are three key heat factors that impact on the temperature of products during transportation: outside temperatures entering the container during load and unload periods, the temperature of the product itself prior to loading, the ventilation is set according the cargo requirements. As a result, it's important that goods are pre-cooled ahead of transportation to achieve optimal temperature levels before they are loaded into a container. This will reduce the impact of outside temperatures on the valuable products during the transportation period.

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- It is important to note that there is currently no technology available to prevent or reverse the ageing of perishable goods.
- Palletized loads of refrigerated cargo must be capable of supporting a material's stacking of a good height. The material used for packaging must also be able to withstand moisture and allow a vertical airflow through boxes in order to maintain the desired temperature.
- According to industry analysts 32% of refrigerated cargo loaded onto refrigerated vehicles is at the wrong temperature at the time of loading. The loss of temperature typically happens as a result of poor loading practices.
- Many times, cargo is left sitting too long on the loading dock, and the carrier runs the risk of the load being rejected by the receiver.
- Refrigeration units are not designed to alter the temperature of the cargo; they are designed to maintain the cargo at the loaded temperature.
- If the refrigeration unit fails, the sensitive cargo is at risk. Modern refrigeration units can have more than 200 alarm/fault codes, which could threaten the ability to maintain the temperature of the cargo being transported.
- Drivers must be required to set the mode of operation of the unit to either continuous run or start/stop mode. Drivers also need to perform manual defrost of the refrigeration unit when required. To perform these basic configurations, drivers must be familiar with the operation of the controller of the refrigeration unit. This poses a big challenge to carriers in terms of driver training. It also exposes them to risks of driver mistakes when operating the equipment.
- Saving a load when something goes wrong or fails requires real-time data, immediate notification and identification of the cause and prioritization of the issue.
- The temperature controls distribution and logistics industry are moving toward more stringent rules, reporting and record-keeping.
- Carriers of temperature-sensitive goods will need to develop and implement procedures to describe how they will comply with provisions for temperature control and how they will provide this information to both shippers and receivers on demand. Drivers will need to be trained on temperature management, and reporting requirements and temperature records for each shipment will need to be retained.
- Drivers may find it difficult to monitor, analyze and fix temperature problems in compartmentalized vehicles and multi-temperature and multi-zone loads. Instead, control from the dispatch office without involving the driver may be a more effective solution.

Environmental considerations

For the first time, the prestigious competition recognized the urgent need to develop sustainable transport refrigeration systems to replace the highly polluting diesel-powered Transport Refrigeration Units (TRUs) that dominate the industry today.

Companies are developing innovative cooling refrigeration technologies to reduce greenhouse emissions and local air pollution. With investment in cold logistics booming around the world, it is a timely recognition of the inevitable damage to the environment and human health if the exponential growth in diesel powered transport refrigeration goes unchecked, and of the arrival of a potentially multi-billion market in 'clean cold' technologies.

Transport refrigeration requires a high level of system performance in some of the most demanding environments imaginable with reliability,

precision temperature control and efficiency. Ten years ago, less than 5% of the refrigerated container users employed scroll compressors. Now over half of the users employ scroll. Truck refrigeration and rail air conditioning have also seen a significant migration to scroll compressors.

- To understand the importance of temperature-controlled transportation in the time-sensitive perishables supply chain. This means moving perishables with the highest efficiency, retaining freshness and natural qualities from the point of produce to warehouses, to distributors and retail customers. Use of specialized temperature-controlled reefer/freezer trucks for refrigerated transport offers a seamless truck transportation chain for perishables and food items.
- Need to produce the transport refrigeration system that's engineered entirely without compromise utilizing the ground-breaking, liquid nitrogen powered engine, the system is being developed to offer industry leading performance, zero-emission and quiet operations, all without having to compromise on cost.
- Switch to natural hydrocarbon refrigerant HC-290 or HC-1270
- Switch to natural refrigerant R-744
- Leakage reduction (design/maintenance); e.g. use a hermetic compressor in alternator/inverter systems
- Optimize components (e.g. compressor, heat exchanger)
- Use inverter technology coupled with an alternator to improve part-load efficiency
- Use HC refrigerant with favorable thermodynamic properties
- Reduce leakage, as fully charged systems are more effective
- Reduce cooling needs by improving the insulation of the vehicle, optimizing delivery routes and proper handling of goods
- Optimize dimension of refrigeration unit based on size, insulation and use of vehicle
- Use of thermal expansion valves with interchangeable components for ease of service in transport applications.
- Use of long-lasting protection from moisture and contaminants for a trouble-free, leak-free operation for transport refrigeration.
- Electronic control solutions allow for improved energy efficiency, tighter temperature control, remote monitoring and diagnostics for transport applications.
- By installing a remote monitoring modem in the refrigerated container, this will allow for notifications of shipping companies and terminals of deviations outside of optimal ranges so they can take appropriate actions.

The future of transport refrigeration

Transport refrigeration is not a one-size-fits-all market. Rather, it's one in which environmental challenges and regulatory changes are rapidly driving the development of technologies specially adapted to provide maximum flexibility. To keep the transport industry moving forward efficiently and the food chain developing safely, it is critical that refrigeration component and equipment manufacturers establish close partnerships to develop solutions that help the industry meet its evolving performance objectives while anticipating future demands and challenges. ■

Dr S S Verma
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GEA Wins CPhI Pharma Award

These on-demand mini-factories can be set up to manufacture medicines at any production scale, anywhere in the world where basic facilities are available...

Recently, as a frontrunner in the design and supply of state-of-the-art manufacturing solutions for both solid and liquid dosage forms, GEA has won the Award "Excellence in Pharma: Manufacturing Technology and Equipment" for their ConsiGma continuous processing platform. The company has been awarded for best manufacturing technology and equipment at the CPhI Pharma Awards, held during the leading trade fair CPhI Worldwide in Barcelona, Spain.

The ConsiGma continuous tableting line is a multipurpose platform that has been designed to transfer powder into coated tablets in development, pilot, clinical and production facilities in a single compact unit. The system can perform dosing and mixing of raw materials, wet or dry granulation, drying, tableting, coating and quality control, all in one integrated solution.

"For us, Continuous Manufacturing (CM) is fundamental to the future of the pharmaceutical industry, CM represents an exciting step forward in drug production," said Marcus Michel, Executive Vice President of GEA's Pharma business. "That ConsiGma has been recognized by a panel of industry peers reflects and reinforces GEA's philosophy of implementing CM systems, particularly for high value products. We thank the judges for their considered appraisal of our technology, which is important for both our company and our customers, and the team behind our ConsiGma portfolio. We feel that CPhI is an excellent environment to present our advanced manufacturing solutions and enhance our clients' ability to develop and create high quality products," he added.

"To receive this award amongst a number of very strong contenders is an incredible result, and underpins the industry trend of implementing CM solutions. It's a milestone in the production of OSDs (Oral Solid Dosage) and truly represents the future of pharma manufacturing," concluded Marcus Michel.



GEA's ConsiGma continuous processing platform was presented with the award for manufacturing technology and equipment during the CPhI Awards ceremony. From L2R: Riccardo Tomassetti, Dr. Marcus Michel, Phil Gabb, Mark Rowland, Bernat Rodriguez.

CPhI
Pharma
Awards
2016

It's thanks to GEA's ConsiGma that, in 2015, Vertex Pharmaceuticals became the first pharma company to receive FDA approval for a therapeutic that was both developed and commercially manufactured using a CM platform. And GEA's ConsiGma 25 unit forms the basis of a groundbreaking – also award-winning – collaboration between Pfizer, GSK and G-CON to develop the next generation of Portable, Continuous, Miniature and Modular (PCMM) solutions for pharma production. These on-demand mini-factories can be set up to manufacture medicines at any production scale, anywhere in the world where basic facilities are available. GEA is convinced that ConsiGma will revolutionize the way that tablets are produced. ■

“We design systems or equipments that need minimum service after sales...”



Incorporated in 1981, by Jaysukhlal Desai, Mumbai-based **Bright HVAC Engineers Pvt. Ltd.** is a pioneer in manufacturing, exporting and supplying **HVAC clean room systems and cooling systems** – with experience in making products, such as **Deep freezers, Visi coolers, Bottle coolers, Water coolers** and many more. In an e-interview with **Cooling India**, **Dharmendra Desai**, the present **Director** of the company, is describing various aspects related to their business to **P K Chatterjee**. Excerpts...

What are the fast growing areas where you find high growth potential for the cooling and/or freezing machinery?

Cooling /freezing solutions and related systems, equipment & machinery are going to see very good market demand in the coming days. Major growing areas are supply chains of: fruits, vegetables, perishables like: flower-food industries, pharmaceutical sector and cold storage including transport refrigeration.

- Growing annually at 28% the total value of cold chain industry in India is expected to reach ~USD 13 billion by 2017 through increased investments, modernization of existing facilities and establishment of new ventures via private and government partnerships.
- India's cold chain industry is still evolving, not well organised and operating below capacity.
- The Indian cold chain market is highly fragmented with more than 3,500 companies in the whole value system.
- Organised players contribute only ~8% – 10% of the cold chain industry market.
- Most equipment in use is outdated and single commodity based need for cold chain.
- 11% of world's total vegetables production is accounted by India alone but India's share in global vegetable trade is only 1.7%.

- 127 Million Tonnes of milk was produced in 2011 - 12, but cold storage capacity is only available for 70,000 - 80,000 Tonnes of milk.

How is the demand pattern changing from the customers' end?

Customers are now looking for a single point source or vendor, total solution with complete turnkey job or total responsibility with saving in energy & time with competitive price & faster delivery.

What are the emerging features in cooling systems that are rigorously evaluated by the customers today?

Customers are looking for cost saving in capital investment as well as recurring or running expenses – that may be obtained from using energy saving products or solutions and deployment of possible automation in process.

Benefits of Saving Energy

We live in an age where energy is an absolute necessity to maintain our lifestyle – and it goes beyond the basics of providing comfort and convenience. We only need to think back to the last power cut to understand the reality of life without energy, when nothing that you've come to be dependent on works.

- Saving energy means wasting less money.
- Saving energy means wasting less primary fuel (coal, gas, oil, uranium).
- Saving energy means producing less pollution.

In the past 20 years, technology has changed the nature of manufacturing. In the old days, manufacturing and fabrication were all done by hand by people. Now that computers and technology have penetrated the industry, automation has become the competitive advantage in today's manufacturing world. Automation has enabled companies to go for mass production at outstanding speeds and with great repeatability and quality. Thus, automation has become a determining factor in whether or not a company will remain competitive within the manufacturing industry. Automation is constantly setting the standards for the industry, and has many advantages.

Advantages of Automation

- **Reduction in production time** – Having a machine that is automated definitely speeds up the production time. Since no thinking is needed by the machine operator, there is better repeatability and less human error.
- **Increase in accuracy and repeatability** – When an automated machine is programmed to perform a task over and over again, the accuracy and repeatability compared to an employee is far greater.
- **Less human error** – No one is perfect, and we are all prone to making mistakes. This is why a machine that performs repeated tasks is less likely to make mistakes than an employee.
- **Less employee costs** – By adding automated machines to an operation, means less employees are needed to get the job done. It also indicates less safety issues, which leads to financial savings. With having less employees, there are numerous costs that are diminished or reduced such as payroll, benefits, sick days etc.
- **Increased safety** – Having automated machines means having less employees who perform tasks that can be dangerous and prone to injury, which can make the work environment safer.
- **Higher volume production** – Investing in automated equipment creates a valuable resource for large production volumes, which in turn, will increase profitability.

How does Bright HVAC Engineers address those needs?

Bright has adopted and using the latest materials available globally to manufacture the Refrigeration Systems & Equipments to deliver maximum efficiency and life of equipments at competitive costs.

How do you keep the products cost competitive?

We are designing the Systems & equipments with latest available material to deliver better efficiency, life of equipment at competitive cost. Also, we have standardized the product or models to bring down the cost.

Do you conduct R&D activities in your premises or you outsource your development projects?

We do research & development in design, selection of materials, reducing failure, delivering longer life, etc. at our end. For this, we also take customers' valuable feedbacks.

What are your most innovative offers to the Indian market?

We have designed and been offering products, which deliver better performance. They are compact in size, user friendly, and designed for ease of maintenance. They need low volume of refrigerant gas, provide better life of system or equipment and so on.

Automation has enabled companies to go for mass production at outstanding speeds and with great repeatability and quality. Thus, automation has become a determining factor in whether or not a company will remain competitive within the manufacturing industry. Automation is constantly setting the standards for the industry, and has many advantages...

We have started... Worry free Cooling Solutions - offering Temporary / Rental cooling solutions to various demand in market for short or long term requirements – such as, break-down requirement, expansion requirements, instant requirements, switch over requirements, temporary

requirements with or without operating facility from 20 TR to 1000 TR.

What kind of after sales services do you offer?

We design systems or equipments that need minimum service after sales. We train customers' personnel for preventive and routine maintenance, supported by our manuals. And in case, if required, we deliver services as per customers need to satisfy them.

As a result, we have so many repeated customers associated with us since very long time.

We are a registered or regular vendor for Department of Atomic Energy of India (i.e., BARC, NFC, HWB, MRP, VECC) all over India.

Please tell me in brief about your export business.

At present, we are exporting to gulf. We are planning for more export in near future to developing countries.

What are your suggestions to the Indian customers?

Importantly, customers should look for the product – which is technically sound, delivers committed performance at competitive cost, offers energy efficiency (will benefit in long running), bears latest technological & user-friendly features. They should upgrade the existing technologies with the latest ones. ■

Evaporative Cooling Technology

Most of the under developed countries and rural areas do not have sufficient – and in some cases even minimal access to electricity. But preservation of food being an integral part of human life sustenance, exploring alternatives to commercial refrigerators has become necessary...



Food preservation is an important issue in the desert zone of Rajasthan. The heat and dust take their toll on precious crops. Most of the fruits and vegetables are rotten within three days. For increasing their shelf life, it is necessary to preserve them with the help of refrigeration. Conventional Refrigerators require electricity to run. Most of the under developed countries and rural areas does not have sufficient and in some cases even minimal access to electricity. But preservation of food being an integral part of human life sustenance, exploring alternatives to commercial refrigerators has become necessary. These refrigerators need to be inexpensive, easily available and should be environmentally friendly. Refrigeration by evaporative cooling is found to be successful in this regard. The working principle behind evaporative cooling is described hereafter.

The evaporative cooling system design which is popularly used consists of two clay pots. The first clay pot is a large clay pot inside which the second smaller clay pot can be placed. The food that is to

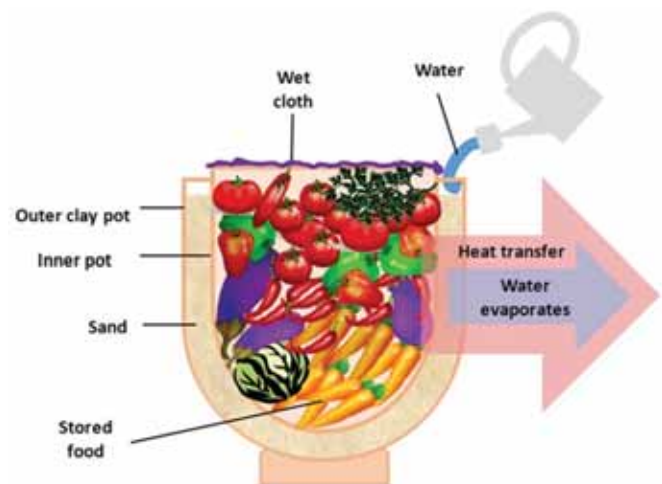


Figure 1: Principle of Evaporative Cooling Refrigerator...



Figure 2: Development of Evaporative cooling system (Grameen Fridge) at Village Swarupsar, District Sikar (Rajasthan)...



Figure 3: Development of Evaporative cooling system (Grameen Fridge) at Village Kohari, District Sikar (Rajasthan)...

be preserved is placed inside the smaller inner pot. The space between the two pots is filled with sand. The sand acts as a medium to retain water required for evaporative cooling. The water poured will fill the voids present in the sand. The outer clay pot being porous, allows water to permeate through it by hydraulic conductivity. The water thus arriving on the outer surface of the outer pot will be exposed to surrounding air. The latent heat of evaporation energy required is observed from the inner pot and thus water, by evaporating cools the inner pot area and brings about refrigeration of stored food.


Parameters affecting evaporative refrigeration

- A. **Ambient temperature:** The ambient temperature plays an important role in evaporative cooling. The higher the temperature higher will be the rate of evaporation, ensuring better cooling of the storage space.
- B. **Ambient relative humidity:** Relative humidity is the measure of water content already present in air. When the relative humidity of air surrounding the refrigerator is less, more water can be evaporated and hence cooling will be better. Theoretically it is found that with decrease in ambient relative humidity for a given temperature, the temperature of the storage space decreases.
- C. **Geometry and surface area of refrigerator:** The amount of evaporation taking place is directly proportional to area available for evaporation. Hence increase in the area for evaporation around the storage space enhances the cooling process.
- D. **Thermal conductivity of material used to hold water:** The material used to hold water between the pots should have as low

a thermal conductivity as possible to obtain lesser temperature in the storage space for a given ambient temperature and relative humidity. Theoretical as well as experimental studies have also confirmed that the material used should be of low thermal conductivity.

- E. **Thermal conductivity of material exposed to evaporation:** The material in contact with the ambient air should have lower thermal conductivity as well. But theoretical results have shown that though the temperature of storage space decreases with decrease in thermal conductivity, the effect is minimal.
- F. **Hydraulic conductivity of material:** Hydraulic Conductivity of porous material in contact with ambient air should be higher, but not too high to allow seepage. Theoretical analysis shows that the effect of hydraulic conductivity is also minimal on the cold temperature achieved at storage space
- G. **Movement of air:** The movement of air enhances the evaporation process and hence the cooling. Experimental results show that the temperature of storage space decreases with increase in wind speed for a given temperature and humidity. ■

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The Future Of Global Refrigerated Warehousing Market

Rise of End-to-End Integrated Services will significantly propel the market until 2020, says Technavio. The expectation is based on the recent trends like rise in trade of frozen food and sea food products, need to reduce food wastage and growth of organized retail sector...



Image Courtesy: www.smartcpeb.com

According to a recent report titled, '2016 ITA Cold Chain Top Markets Report' presented by International Trade Administration, Dept. of Commerce, USA, "Cold chain systems are crucial to the growth of global trade in perishable products and to the worldwide availability of food and health supplies. Each year, billions of tons of fresh food products and millions of dollars' worth of U.S. exports are lost due to poor cold chain systems in developing markets. The World Economic Forum lists food crises as fourth on its top global risks of highest concern for the next 10 years.¹ Globally, billions of dollars are spent on improving agricultural processes to create higher food yields, but the fact that nearly half of all food never makes it to a consumer's plate is largely ignored."

Can you imagine the severity of the situation?

The report also states that the "Global losses in the food industry total more than \$750 billion annually. These losses primarily result from

lack of proper facilities, improper food safety handling procedures and insufficient training for those personnel working in the cold chain. Additionally, over \$260 billion of annual biopharma sales are dependent on cold chain logistics to ensure the efficacy of their products."

Owing to the graveness of such a situation, now globally some governments are taking steps to culminate best ways to improve the status quo. Companies are also coming forward to give end-to-end Integrated Services. Development in the field of Information Technology (IT) is playing a big role in this expedition.

This is reflected in the latest research report released by Technavio. It conveys, "The global refrigerated warehousing market is expected to record a CAGR of more than 14% until 2020."

"Several cold chain service providers have recently started to offer end-to-end integrated services to end-users in the global refrigerated warehousing market. They are providing cold chain management

services to customers and participating in their decision-making processes. Many service providers offer end-to-end cold chain management services like inventory management, order scheduling, order forecasting, warehousing, and delivery management," said Jhansi Mary, one of Technavio's Lead Industry Analysts for warehousing and storage.

The report states that some of the other driving forces behind the growth of the global refrigerated warehousing market are as follows:

- Rise in trade of frozen food and sea food products
- Need to reduce food wastage
- Growth of organized retail sector

Rise in trade of frozen food and sea food products

The demand for seafood continues to increase globally, and the significant population growth in China, India and Brazil is an important demand driver in the frozen fish and seafood industry. Increased demand for seafood has led to a rise in its import and exports within countries, which required cold storage and transportation.

China and Norway were the largest exporters of seafood in 2015. China's exports amounted to \$20 billion, and Norway exported \$10 billion worth of seafood products. While China exported to almost all countries, Norway's exports were mostly to European nations. Fresh salmon constituted the majority of Norway's fish and seafood exports. According to the Technavio estimate that China's exports will grow at a CAGR of 15.68% over the forecast period. The European Union was the largest importer of seafood, worth USD 26 billion. The US and Japan followed, with seafood imports by the US amounting to USD 19 billion in 2015.

Need to reduce food wastage

According to United Nations Environment Programme (UNEP) and World Resources Institute (WRI) about one-third of the food produced every year is wasted. Fruits and vegetables wasted about 25% at the production level. In addition, perishable food products are often exposed to fluctuating temperatures during transit and handling, which adds to the wastage. The global population is expected to increase at a rapid pace in the future, which is expected to increase the demand for food products. Based on statistics, in 2015 the number of people suffering from malnutrition or starvation was about 956 million worldwide. Therefore, because of the increase in the global population and the food wastage, the need for effective cold chains is expected to increase substantially in the future. Therefore, the increased need to reduce the food wastage is one of the key drivers contributing to the growth of the market.

Growth of organized retail sector

Organized retail refers to modern retailing wherein a licensed retailer sells several goods belonging to different categories. It is the modern form of retail or chain stores that are owned or franchised by a central store or entity. The stores are organized and use better store systems technology, including better refrigeration, than traditional/unorganized retail stores and provide consumers with convenience and foods that are safe to consume. Organized retail formats include supermarkets, hypermarkets, forecourt retailers, discounters and convenience stores. Nowadays, an increasing number of consumers are purchasing grocery items, including frozen and chilled food from organized retail stores. APAC is witnessing a steady increase in the number of modern retail stores. With the growth of the organized retail sector and the increased consumer demand for frozen and chilled food, demand for cold chains has increased and is expected to increase further during the forecast period. ■

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The nature of products used in the shipbuilding industry has to be very robust yet providing utmost accuracy. They have to be safe, reliable, resistant to corrosion and impervious. JUMO is presenting some nice products for measurement & technology in marine industry...



approval makes it predestined for use in LNG tanks. The HART interface enables the configuration of different parameters, such as scaling the measuring range, to be made with ease.

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Measurement and control technology in the shipbuilding industry must not only be impervious to salty sea air. Strong vibrations, impacts, electrical disturbances, fluctuating temperatures, and dust also require high resilience of the implemented devices. For these requirements JUMO offers a variety of products that have been especially designed for use in water with high salt content and potentially explosive areas.

JUMO has the JUMO MAERA S29 SW level probe in its product range for use in ballast water tanks. The titanium version and the ATEX approval allow the level probe to be deployed in critical areas. Among other uses, the level probe is suited for level measurement in anti-heeling systems or for highly viscous media.

Another product that is suited for hydrostatic level measurement on ships is the JUMO dTRANS p20 pressure transmitter. Its additional ATEX

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Material That Cools The Skin

Researchers in Stanford have engineered a low-cost plastic material that could become the basis for clothing that cools the wearer, reducing the need for energy-consuming air conditioning...

Stanford engineers have developed a low-cost, plastic-based textile that, if woven into clothing, could cool your body far more efficiently than is possible with the natural or synthetic fabrics in clothes we wear today. Describing their work in *Science*, the researchers suggest that this new family of fabrics could become the basis for garments that keep people cool in hot climates without air conditioning.

"If you can cool the person rather than the building where they work or live, that will save energy," said Yi Cui, an associate professor of materials science and engineering at Stanford and of photon science at SLAC National Accelerator Laboratory.

This new material works by allowing the body to discharge heat in two ways that would make the wearer feel nearly 4 degrees Fahrenheit cooler than if they wore cotton clothing.

The material cools by letting perspiration evaporate through the material, something ordinary fabrics already do. But the Stanford material provides a second, revolutionary cooling mechanism: allowing heat that the body emits as infrared radiation to pass through the plastic textile.

All objects, including our bodies, throw off heat in the form of infrared radiation, an invisible and benign wavelength of light. Blankets warm us by trapping infrared heat emissions close to the body. This thermal radiation escaping from our bodies is what makes us visible in the dark through night-vision goggles.

"Forty to 60 percent of our body heat is dissipated as infrared radiation when we are sitting in an office. But until now there has been little or no research on designing the thermal radiation characteristics of textiles," said Shanhui Fan, a Professor of Electrical Engineering who specializes in photonics, which is the study of visible and invisible light.

Super-powered kitchen wrap

The easiest attribute was allowing infrared radiation to pass through the material, because this is a characteristic of ordinary polyethylene food wrap. Of course, kitchen plastic is impervious to water and is see-through as well, rendering it useless as clothing. The Stanford researchers tackled these deficiencies one at a time.

First, they found a variant of polyethylene commonly used in battery making that has a specific nanostructure that is opaque to visible light – yet is transparent to infrared radiation, which could let body heat escape. This provided a base material that was opaque to visible light for the sake of modesty but thermally transparent for purposes of energy efficiency.

They then modified the industrial polyethylene by treating it with benign chemicals to enable water vapour molecules to evaporate through nanopores in the plastic, said Postdoctoral Scholar and Team Member Po-Chun Hsu, allowing the plastic to breathe like a natural fiber.

Making clothes

That success gave the researchers a single-sheet material that met their three basic criteria for a cooling fabric. To make this thin material more fabric-like, they created a three-ply version: two sheets of treated



Image credit: L.A. Cicero

Stanford researchers began with a sheet of polyethylene and modified it with a series of chemical treatments, resulting in a cooling fabric...

polyethylene separated by a cotton mesh for strength and thickness.

To test the cooling potential of their three-ply construct versus a cotton fabric of comparable thickness, they placed a small swatch of each material on a surface that was as warm as bare skin and measured how much heat each material trapped.

"Wearing anything traps some heat and makes the skin warmer. If dissipating thermal radiation were our only concern, then it would be best to wear nothing," Fan said.

The comparison showed that the cotton fabric made the skin surface 3.6 F warmer than their cooling textile. The researchers said this difference means that a person dressed in their new material might feel less inclined to turn on a fan or air conditioner.

The researchers are continuing their work on several fronts, including adding more colours, textures and cloth-like characteristics to their material. Adapting a material already mass produced for the battery industry could make it easier to create products. "If you want to make a textile, you have to be able to make huge volumes inexpensively," Cui said.

Fan believes that this research opens up new avenues of inquiry to cool or heat things, passively, without the use of outside energy, by tuning materials to dissipate or trap infrared radiation. "In hindsight, some of what we've done looks very simple, but it's because few have really been looking at engineering the radiation characteristics of textiles," he said. ■



Tom Abate

Associate Director of Communications
Stanford University School of Engineering

Beckhoff Presents

Compact Drive Technology

The new servo terminals enable space-saving drive solutions with safety-related functions that can be directly integrated within the EtherCAT Terminal system...

The servo terminals in the Beckhoff EtherCAT Terminal system integrate a complete servo drive to facilitate highly dynamic positioning tasks in a standard I/O terminal housing. With the new EL72x1-9014 version, STO (Safe Torque Off) safety functionality is now available in an extremely compact terminal design for DIN rail installation. The new servo terminals enable space-saving drive solutions with safety-related functions that can be directly integrated within the EtherCAT Terminal system.

The EL72x1-9014 servo terminals streamline the implementation of STO (Safe Torque Off) safety functions, corresponding to safety level Cat 3/PL d, according to EN ISO 13849-1:2015. In conjunction with One Cable Technology (OCT), safety integration in an I/O terminal form factor results in a heightened ability to implement space-saving and cost-effective



The new EL72x1-9014 servo terminals with STO (Safe Torque Off) enable extremely compact and system-integrated drive solutions...

solutions with safety-related drive functionality. In addition, a 2-channel shut-off with corresponding contactors in the motor cable provides a considerable reduction in cabling, space requirements and cost; a single cable connects the safety output (e.g. EL2904) and the STO input of the servo terminal. In addition, the OCT solution minimises cable costs and space needed for the motor connection.

The EL7201-9014 variant comes in a 12 mm terminal housing and supplies an output current of up to 2.8 ARMS, while the 24 mm EL7211- 9014 version can supply a maximum of 4.5 ARMS. Both are suitable for powering servomotors from the AM8100 series. The integrated electronic type plate of the AM8100 motors can be read-in automatically by the servo terminals, simplifying commissioning considerably. ■

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13 *Game-changing Initiatives*

Among the initiatives, there are: a Google-led project that can catalyse the rooftop solar market for millions of people across the United States, an ingenious net that harvests fog from the air to provide drinking water for people on the edge of Morocco's Sahara Desert, North America's first revenue-neutral tax that puts a price on carbon pollution and a project that has established the first women-specific standard to measure and monetize women's empowerment benefits of climate action...

The UN Climate Change Secretariat (UNCCS) has recognized 13 actions. The Momentum for Change initiative is spearheaded by the UN Climate Change secretariat to shine a light on some of the most innovative, scalable and replicable examples of what people are doing to address climate change. The recent announcement is a part of wider efforts to mobilize action and ambition as national governments work toward implementing the Paris Climate Change Agreement and the Sustainable Development Goals.

"The Momentum for Change Lighthouse Activities underline how climate action and sustainable development is building at all levels of society from country-wide initiatives to ones in communities, by companies and within cities worldwide. By showcasing these remarkable examples of creativity and transformational change, along with the extraordinary people behind them, we can inspire everyone to be an accelerator towards the kind of future we all want and need," said UNFCCC (United Nations Framework Convention on Climate Change) Executive Secretary Patricia Espinosa.

Each of the 13 winning activities touches on one of Momentum for Change's three focus areas: Women for Results, Financing for Climate Friendly Investment and ICT Solutions. All 13 will be showcased at a series of special events during the UN Climate Change Conference in Marrakech, Morocco (7 November to 18 November 2016).

The 2016 Lighthouse Activities were selected by an international advisory panel – as part of the secretariat's Momentum for Change initiative, which operates in partnership with the World Economic Forum Global Project on Climate Change and the Global e-Sustainability Initiative.

Gothenburg Green Bonds, Sweden

In 2013, the City of Gothenburg became the first city in the world to issue green bonds, which enable it to borrow money for investments that benefit the environment. More than 75% of proceeds from green bonds issued between 2013 and 2015 are used by the city to fund climate change projects that promote the transition to low-carbon and climate-resilient growth.



Crowdfunding for Community Solar Projects, The Netherlands

Zonnepanelen Delen is working to ensure everyone in The Netherlands has access to solar power, even if they don't have a roof. The largest crowdfunding platform in the EU for community solar projects, WeShareSolar connects site owners who have a suitable roof (but are not able to invest in solar themselves) with consumers that want to buy a solar panel but do not have a suitable roof. The project makes it easier for third parties to develop and operate a community solar project.



Off Grid Electric, U.S.A. & Tanzania

Off Grid Electric (OGE) is a ground-breaking company based in San Francisco and Arusha, Tanzania, with the ambitious aim of powering off-grid homes across Africa with affordable, renewable energy. OGE currently provides solar systems to homes and businesses in rural communities through an innovative financial solution. It offers "solar as a service" to customers who suffer from an expensive grid, an unreliable grid, or have no grid access at all.



Revenue-Neutral Carbon Tax, Canada

In 2008, the Canadian province of British Columbia introduced North America's first revenue-neutral carbon tax applied to the purchase or use of fuel in British Columbia. The carbon tax has been hailed as the most comprehensive of its kind, covering approximately 70% of provincial emissions. Since the tax is revenue neutral, every dollar generated is returned to British Columbians in the form of personal and business tax measures.



Connected Mangroves, Malaysia

Ericsson's Connected Mangroves project, the first of its kind in the world, combines cloud, machine-to-machine and mobile broadband to help the local community in Selangor, Malaysia, to better manage the growth of new mangrove saplings. The project uses sensors to provide near real-time information to restore dwindling mangrove plantations.



Mapping for Rights, Cameroon, Central African Republic, Congo, Democratic Republic of the Congo, Gabon, Ghana, Peru

This initiative of the Rainforest Foundation UK supports forest peoples to counter harmful extractive industry and advocate for legal reforms by equipping them with low-cost technologies to map and monitor their lands, and making this data available on an online platform.



SOLshare, Bangladesh

SOLshare has successfully piloted the world's first ICT-enabled peer-to-peer electricity trading network for rural households with and without solar home systems in Shariatpur, Bangladesh. Along with its implementation partner, the NGO UBOMUS, its financing partner IDCOL and research partner United International University-Centre for Energy Research, SOLshare combines solar home systems and centralized mini-grids to enable more rural households to access renewable electricity at a lower cost.



Project Sunroof, U.S.A.

Last year, Google introduced Project Sunroof to enable tens of millions of potential solar customers from across the U.S. to evaluate if their home is suitable for solar and how much they could save on electricity. Project Sunroof works by using high-resolution aerial imagery from Google Earth to help calculate a roof's solar energy potential.



Climate Right, Sweden

The Climate Right project in Uppsala, Sweden, makes it possible for people to measure and reduce their climate impact. Using a free app developed for the project, participants were able to track their climate impact through their choice of food, mode of transport and way of living, encouraging them to live in a climate friendly way.



Women's Empowerment for Resilience and Adaptation Against Climate Change, Uganda

Women's Empowerment for Resilience and Adaptation Against Climate Change has formed an association of women-led groups that collect individual-savings of at least USD 1 once a week to generate a pool of funds, from which women borrow and invest into income-generating activities that address climate change. This initiative also empowers women undertake land planning, agro-forestry and soil conservation practices and use energy saving stoves.



Rural Community Leaders Combating Climate Change, India

Swayam Shikshan Prayog, an Indian NGO, trains rural women in entrepreneurship and builds their capacities for marketing clean-energy products in their communities. Currently, an active network of 1,100 women entrepreneurs is working across 8 districts in India. The women provide a complete 'ecosystem' approach as clean-technology users, educators, providers and supporters in their communities, which helps make it easier for people to adopt energy-efficient technologies and products that address climate change.



Women-Led Fog Harvesting for a Resilient, Sustainable Ecosystem, Morocco

Dar Si Hmad, a women-led NGO in Morocco, designed and installed what is now the world's largest operational fogwater harvesting system. It is an innovative solution to persistent water stress where fog is abundant, a technique inspired from ancient water practices. The Dar Si Hmad project provides accessible potable water to more than 400 people in five villages, most of them women and children.



The W+ Standard

The W+ Standard is a unique certification scheme developed by WOCAN, which measures how companies, governments and individuals can drive social and economic empowerment for women. The W+ Standard can accelerate investments in women as it 'rewards' projects that combine climate action with women's empowerment, and by doing so recognizes and values women's critical role in tackling climate change.



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Retrofitting to improve performance

Traditionally, air cooled chillers were used for smaller applications with lower heat loads, but in the last 10 -15 years, with the advances in centrifugal compressor technology, air cooled chillers are being used in larger...

Air cooled chillers are a preferred choice in designs where availability of water is scarce and the weather is hot and dry for a majority of the year. Air cooled chillers offer many advantages such as the lesser number of system components (lowering maintenance costs), compact design, effective use of open space, lower operating costs etc. Traditionally, Air cooled chillers were used for smaller applications with lower heat loads, but in the last 10 -15 years, with the advances in centrifugal compressor technology, Air cooled chillers are being used in larger, more critical installations. Multirole compressor configurations have allowed the designers to offer designs for a wide range of loads thus further optimizing on the costs. The Air cooled chiller also scores better on the overall life cycle costs since the operating costs are lower due to absence of the condenser water systems and cooling towers.

Since condensation of the refrigerant is undertaken using the ambient air, the heat exchanger is a key component of the Air cooled chiller and the performance of the plant is directly affected by the performance of the heat exchanger. Deterioration of the heat exchanger effectiveness will have a direct impact on the capacity of the chiller to provide desired cooling to the work space. Unfortunately, the performance of the heat exchanger is dependent on a number of factors which all contribute to lowering heat transfer rates as the chiller operates over time, thus lowering the system efficiency as the plant ages. System performance can be dramatically improved by replacement of the condenser cooling coils when system performance has deteriorated beyond acceptable levels. This article showcases a case study of the retrofit of the condensers coils of an air cooled chiller and the benefits that accrued to the owners

System overview

The air cooled chiller that this case study is based on is part of 3 chillers system for air conditioning a large office space which has 24x7 operations. The building is located in the northern part of India, which experiences long hot and dry summers and a short monsoon season. The plants are located on the terrace of the building and the location of the building is such that there is adequate air flow across the terrace, without any large buildings obstructing the flow patterns. The key characteristics of the chiller are listed in table 1. The operations and maintenance of the chillers is undertaken by a dedicated onsite team and the systems are maintained to a high standard.

Need for retrofit

The chillers were installed in 2007 when the building became operational. As part of the M&M teams annual maintenance shutdown activities in late 2015, performance assessment of the 3 chillers was undertaken. The chillers physical condition, efficiency, operating parameters etc. were analyzed from the system logs as well as onsite visual assessment. While the typical life of Air cooled chiller is 12 – 15 years, the performance of the chillers was observed to be below the design parameters, with higher condenser pressures and lower EER (Energy Efficiency Ratios) or kW based on calculations. The reasons for the deterioration of the performance was analyzed and the problem identified as the ineffective heat exchange across the condenser, leading to higher system pressures and consequent lower efficiency. The heat exchanger fins were seen to have a high level of deterioration as well. The cause of the higher level of deterioration of the heat exchange surface was attributed to the ambient conditions. The building was located in a zone where the last 4 – 5 years had seen a large number of building construction activities, leading to higher dust levels and increase size of suspended particulate matter in the air.

Since the condensers performance effects the overall chiller performance, a decision was taken to replace the condenser coils for one of the chillers due to the limited time available for shut down provided by the Maintenance team.

Business case for the retrofit

Condenser coils replacement involves both time and financial outlays. While the performance of the chiller was not as per design, the overall air conditioning system was delivering required thermal comfort to the occupants and workspace due to the redundancy and design of the system. However, the energy costs of the system had been increasing steadily over the past 4 – 5 years. There was thus a case to undertake corrective action to lower operating costs.

Chiller energy performance was reviewed from the BMS system data and annual energy consumption and correlated costs documented to create the baseline. With the help of the chiller manufactures, cost estimates were developed for the heat exchanger replacement and the projected efficiency gains calculated. The new heat exchanger coils evaluated enabled higher heat exchange rates due to the advances in fin design that had taken place since the chiller was installed. The key costs associated with the chiller heat exchanger replacement were identified as

- Cost of the heat exchanger
- Import costs as the Heat exchanger coils had to be procured from the OEM's international locations
- Labor and material costs during the replacement phase
- Refrigerant top up costs
- Testing and commissioning costs post replacement

The potential efficiency gains and subsequent lowering of energy consumption as a comparison to the cost of the replacement were analyzed. The resulting Return on Investment (RoI), based on a simple Net Present Value (NPV) approach was assessed to be approximately 18 months. The relatively short payback period and high efficiency gains helped get a sign off from the management for the replacement.

Why heat exchanger performance fails

A Heat exchanger (HE) as the name suggest, is used to transfer heat across a surface. When the transfer is between two liquids, sensible heat is transferred, while if it there is a phase change, latent heat transfer takes place. Most HVAC applications involve sensible heat exchanger.

The rate of heat transfer across a heat exchanger is given by the formula $Q = UA\Delta tm$ where

- Q is the rate of heat transfer
- U is the Overall heat transfer coefficient
- A is the surface area across which the heat transfer takes place
- Δtm is the temperature difference between the two liquids

In the above equation, U depends on the properties of the material and the distribution of the heat exchange surface such as cross flow or counter flow arrangements. The larger the areas A, the more the heat transfer that can occur and hence, HE design focuses a great deal on how to increase transfer area without increasing overall size. The temperature difference is a function of the system design as it depends on the inlet and out let temperatures required for the application in mind. Another important parameter in HE operations and design is the "approach Temperature. Refer to figure 1. The approach is the difference between T2 and t1. A smaller approach will need a larger surface area to get the desired heat transfer.



Figure 1: Heat Exchanger Temperatures...

With the above overview of HE theory, we can now correlate why a heat exchanger's performance can deteriorate during its life. The key reasons are

- **Lowering of U:** The heat transfer coefficient changes due to various factors but mostly due to fouling of the surfaces. The scales reduce the velocity of flow and hence the heat transfer rate in addition to the actual heat transfer. Scaling occurs due to poor treatment of the water or due to high temperatures in the system than designed. Other causes of increase in U dust and microbiological growth over the fins in air cooled chiller and algae growth in the headers and condenser plates of water cooled chillers.
- **Reduction of surface area:** In air cooled chillers, the fins across which heat transfer occurs are fragile and tend to get damaged over a period of time and use. The damaged sections, due to the reduced surface area are not able to contribute to the full extent to the heat exchange and the overall transfer rates reduce.

- **Temperature difference:** When the HE is selected, the plant load is used as the basis. If during the life of the plant, there is a significant change in the heat load, the HE will be operating at higher temperatures which will result in lowering of the efficiency.

Results of retrofit

The retrofit was carried out in the month of Dec which is a typical lean month for HVAC operations. Post commissioning and operations, the plant's functioning was compared with the other air cooled chiller in the system during the summer months. This helped the O&M team to quantify the actual gains due to the change in the heat exchanger. Table 1 lists the comparison of the operating parameters:

Chiller Energy Consumption			
Day	Chiller with old coil (kWH)	Chiller with new coil (kWH)	Average Saving per day (kW)
1	645.23	464.2	181.03
2	564.64	345.1	219.54
3	825.18	437.64	387.54
4	899.21	424.19	475.02
5	645.23	464.9	180.33
	3579.49	2136.03	288.69

The replacement of the chiller resulted in a savings of approx. 8 – 9 % on the energy consumption. In addition, the overall system efficiency was improved as the time taken to cool the workspace reduced. Indicated Kw, which is a direct measure of the energy output to the energy input for chiller was brought down from 0.998 to 0.58 due to the change of the heat exchanger coil.

Conclusion

As air conditioning systems age, the performance of the plant starts to deteriorate from the design point, leading to higher powerconsumption and operating costs. The failure rates also increase due to the plant operating at off design values. While replacement may not always be an option, component level replacements that can increase the efficiency of the plant can be evaluated to keep costs low. There is an investment requirement for such changes as replacement of the HE coils, but with advances in technology, the new components tend to be significantly more efficient and hence, the returnof Investments period reduces. O&M team should thus identify opportunities such as the case study shared above to improve system performance as well as reduce operating costs. ■

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Cold Storage & Transport Refrigeration

Food preservation is a highly sophisticated phenomenon and so is its transport...



Many meats, fish, fruits, and vegetables are perishable, and their storage life can be extended by refrigeration. Fruits, many vegetables and processed meat, such as sausages, are stored at temperatures just slightly above freezing to prolong their life.

Other meats, fish, vegetables, and fruits are frozen and stored many months at low temperatures until they are defrosted and cooked by the consumer.

The frozen-food chain typically consists of the following links: freezing, storage in refrigerated warehouses, display in a refrigerated case at food markets, and finally storage in the home freezer or frozen-food compartment of a domestic refrigerator.

Fruits and vegetables should be frozen quickly after harvesting and meats frozen quickly after slaughter to maintain high quality. Truckload and railcar-load lots are then moved to refrigerated warehouses where they are stored at -20 to -23°C , perhaps for many months. To maintain a high quality in fish, the storage temperature is even lower.

Food moves from the refrigerated warehouses to food markets as needed to replenish the stock there. In the market the food is kept refrigerated in display cases held at 3 to 5°C for dairy products, unfrozen fruits and vegetables. Frozen foods and ice cream are kept at approximately -200 . In the India about 10,000 refrigerated display cases are sold each year.

Table 1: Storage conditions and properties of food products...

Product	Temperature °C	Relative Humidity %	Approximate Storage Life	Water content %	Highest Freezing point °C
Apples	- 1 to 0	85-90		84.1	-1.5
Bananas	14.5	95	For ripening in 8-10 days	74.8	-0.8
Butter	0 to 4.4	80-85	2 months	15.5-16.5	-
Milk, Pasteurized	0.5	-	7 days	87	-0.6
Eggs	- 1.5 to - 0.5	80-85	6-9 months	66	-2.2
Fish, fresh	0.5 to 1.5	90-96	5-15 days	62-85	-2.2
Frozen	- 23.5 to - 18	90-95	8-10 days	62-85	-
Grapes	- 0.5	85-90	3-8 weeks	81.9	-1.3
Beef, fresh	0 to 1	88-92	1-6 weeks	62-77	-2.2
Frozen	- 23.5 to - 18	90-95	9-12 months	62-77	-
Mangoes	10	85-90	2-3 weeks	81.4	-0.9
Potatoes, late crop	3 to 4.5	85-90	5-8 months	77.8	-0.6
Tomatoes, green	14 to 21	85-90	2-4 weeks	94.7	-0.6
Ripe	7 to 10	85-90	2-7 days	94.1	-0.5

Table 2: Transport temperature requirement of food products...

Chilled products	Temperature (°C)
Fresh fish (in ice), crustaceans and shellfish (excluding live ones)	+2
Cooked dishes and prepared foods, pastry creams, fresh pastries, sweet dishes and egg products	+3
Meat and cooked meats pre-packaged for consumer use	+3
Poultry	+4
Non-sterilized, untreated, unpasteurised or fermented milk, fresh cream, cottage cheese and curd	+3
Milk for industrial processing	+6
Cooked meats other than those which have been salted, smoked, dried or sterilized	+6
Frozen Products	Temperature (°C)
Ice and ice cream	-25
Deep frozen foods	-18
Fishery products	-18
Butter and edible fats, including cream to be used for butter making	-14
Egg products poultry	-12
Meat	-10

Cold Storage

Though cold storage is understood to be merely an application of refrigeration, it is in fact a complete air-conditioning system in which room air is cooled to too much lower temperature over a cooling coil and supplied back to the storage space. The conditions maintained inside the storage space depend on the nature of the product stored. It is to be noted that in cold storages, often, strict control of both temperature and relative humidity is required. Also, the storage life depends a great deal on the temperature at which a product is stored. The required storage conditions for a number of important food products are given in Table 1. It is seen that in the case of bananas, there is no storage period. Instead, there is a period of ripening. Bananas cannot be stored after they have ripened. The best temperature for slow ripening is 14.5°C. Further, in the case of milk, the storage temperature is 0.5°C, whereas its highest freezing temperature is - 0.6°C. Thus, air is to be maintained within a close tolerance of 0°C so that milk does not freeze. The same is also true for the pasteurization process.

Food Transport Refrigeration

Road transport refrigeration equipment are required to operate reliably in much harsher environments than stationary refrigeration equipment. Due to the wide range of operating conditions and constraints imposed by available space and weight, transport refrigeration equipment have lower efficiencies than stationary systems. This, coupled to rapidly increasing use of refrigerated transport arising from the much wider range of transported goods, home delivery and greater quality expectations, is placing considerable pressures on the food industry to reduce the energy consumption of refrigerated transport.

There are also specific temperature requirements for certain categories of food. Examples of specific temperature requirements for chilled and frozen food products are given in Table 2.

Many factors are considered in the design of the envelope of a refrigerated transportation unit: extremes of exterior weather conditions, desired interior conditions, insulation properties, infiltration of air and moisture, tradeoffs between construction cost and operating costs and

physical deterioration from shocks and vibrations.

The performance of insulation materials deteriorates with time due to the inherent foam characteristics. If one considers the large number of refrigerated vehicles and containers in use worldwide the global impact of the reduction of insulation effectiveness is considerable.

Refrigeration Units

The most common refrigeration system in use for refrigerated food transport applications today is the vapour compression system.

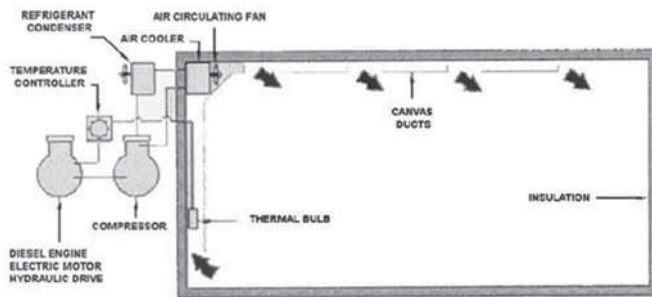



Figure 1: Refrigeration system with false bulkhead...

Air Delivery Systems

A typical arrangement of the refrigeration system and air distribution in a refrigerated semi-trailer is shown in Figure 1. In these vehicles, top air delivery is predominately used. Refrigeration unit fans cause temperature-controlled air to circulate around the inside of the vehicle roof, walls, floor, and doors to remove heat which is conducted and infiltrated from the outside, returning to the cooling coil via the floor or space under pallets.

S D Bandal
Consultant
Owner, Solar Electronics



Emerging Food Preservation Technologies

New preservation technologies are not just working to increase longevity; they are also functioning to sustain the same qualities of the food that make it desirable in the first place...

Increasing demands of consumers for high quality fresh food products have increased the interest in the development of new food processing technologies over the past decade. Food preservation is processing designed to protect food from spoilage caused by microbes, enzymes, and autooxidation. It is one of the oldest technologies used by human beings to prevent from food-borne disease hazards. The basic idea behind food preservation is either to slow down the activity of disease-causing bacteria or to kill the bacteria altogether. Nowadays different preservation techniques commonly used worldwide like Refrigeration and freezing, Canning, Dehydration, Freeze-drying, Salting, Pickling, Pasteurizing, Fermentation, Carbonation, Cheese-making and Chemical preservation.

Refrigeration and Freezing

Refrigeration and freezing are the most popular forms of food preservation in use today. In the case of refrigeration, the idea is to slow bacterial action or stunt microbial growth to a crawl so that it takes food much longer (perhaps a week or two, rather than half a day) to spoil. In the case of freezing, the idea is to stop bacterial action altogether. In freezing bacteria become completely inactive. Refrigeration and freezing are used on almost all foods like meats, fruits, vegetables, beverages, etc. In general, refrigeration has no effect on a food's taste or texture. Freezing has no effect on the taste or texture of most meats, has minimal effects on vegetables, but often completely changes fruits (which become mushy).

Canning and Bottling

Canning and bottling remains a very common technique of food preservation. The process is very efficient and it can leave the food edible for many years. It has provided a way to store foods for extremely long periods of time. In canning, food is boiled in the can to kill all the bacteria and sealed (either before or while the food is boiling) to prevent any new bacteria from getting in. Since the food in the can is completely sterile, it does not spoil. Once the can is opened, bacteria enter and begin attacking the food, hence it is necessary to "refrigerate the contents after opening". Major drawback of canning is that canned food remains susceptible to anaerobic microbial growth, most notably that of *Clostridium botulinum*.

Pasteurizing

Boiling of food can kill all bacteria and make the food sterile, but it significantly affect the taste and nutritional value of the food. Pasteurization a food (almost always a liquid), is heating it to a high enough temperature to kill certain (but not all) bacteria and to disable certain enzymes, with minimizing the effects on taste as much as possible. Commonly pasteurized foods include milk, ice cream, fruit juices, beer and non-carbonated beverages. Milk, for example, can be pasteurized by heating to 145 degrees F (62.8 degrees C) for half an hour or 163 degrees F (72.8 degrees C) for 15 seconds. Ultra high temperature (UHT) pasteurization completely sterilizes the product. It is used to created "boxes of milk" that you see on the shelf at the grocery store. In UHT pasteurization, the temperature of the milk is raised to about 285 degrees F (141 degrees C) for one or two seconds, sterilizing the milk.

Dehydrating Food

Many foods like powdered milk, dried fruits and vegetables, pasta and instant rice etc. are dehydrated to preserve them. Since most bacteria die or become completely inactive when dried, dried foods kept in air-tight containers can last quite a long time.

Freeze-Drying

In freeze-drying, food is frozen and placed in a strong vacuum to removes all moisture and tends to have less of an effect on a food's taste than normal dehydration does. The water in the food then sublimates - that is, it turns straight from ice into vapor. Freeze-drying is most commonly used to make instant coffee, but also works extremely well on fruits such as apples.

Salting and Pickling

Salting is an ancient preservation technique. The salt draws out moisture and creates an environment inhospitable to bacteria. If salted in cold weather (so that the meat does not spoil while the salt has time to take effect), product can last for years. Pickling was widely used to preserve meats, fruits and vegetables in the past. Pickling uses the preservative qualities of salt (see above) combined with the preservative qualities of acid, such as acetic acid (vinegar). Acid environments inhibit bacteria.

Drying and Fermentation

Drying is for the purpose of moderating the amount of water activity to prevent the growth of bacteria by aerobically respiring. Clearly, drying food does not fully prevent contamination, but in addition, the process changes the physical properties of the food. The acidic products that result from fermentation help to kill off contaminating microbes, Fermentation uses yeast to produce alcohol. Alcohol is a good preservative because it kills bacteria. But similarly to drying, fermentation changes the chemical properties of the food.

Carbonating

Carbonated water is water in which carbon dioxide gas has been dissolved under pressure. By eliminating oxygen, carbonated water inhibits bacterial growth. Carbonated beverages (soft drinks) therefore contain a natural preservative.

Cheese Making

Cheese is way of preserving milk for long periods of time. Cheese-making is a long and involved process that makes use of bacteria, enzymes and naturally formed acids to solidify milk proteins and fat and preserve them. Once turned into cheese, milk can be stored for months or years. The main preservatives that give cheese its longevity are salt and acids. Cheese-making is complicated. It produces a product that preserves milk proteins and sugars with acids and salt.

Chemical Food Preservation

The use of preservatives in food has expanded a great deal in recent years. There are two forms of chemical food preservatives: antimicrobial preservatives and antioxidants.

- a) **Antimicrobial preservatives** work to break down, and prevent the growth of bacteria and fungi. Chemical preservatives are added to food to either inhibit the activity of bacteria or kill the bacteria. Commonly used preservatives in foods are Benzoates (such as sodium benzoate), Nitrites (such as sodium nitrite) and Sulphites (such as sulphur dioxide) and sorbic acid.
- b) **Antioxidants** are used to avert the oxidation of the food. Antioxidants generally include Butylatedhydroxyanisole (BHA), Butylatedhydroxytoluene (BHT), and tert-Butyl hydroquinone (TBHQ).

Latest Preservation Technology

Preventing the growth of microbes for the sake of storing food can be achieved through many diverse methods. Continuous innovation to food preservation techniques has been necessary for subsistence across the globe. Over the years, improved techniques for processing foods have resulted in the expansion of our food supply by prolonging keeping times, preventing spoilage and increasing the variety of food products available. More modern techniques have been evolved such as irradiation and high pressure food preservation. Some of the latest methods of food preservation are irradiation, e-beam irradiation, high pressure processing, Pulsed electric field treatment, extrusion, natural preservative, Ozone, and nanotechnology. Although these methods are currently in use, they are expected to expand and develop further.

Food Irradiation

Nuclear radiation is able to kill bacteria without significantly changing the food containing the bacteria. So if food is sealed in plastic and then radiated, it will become sterile and can be stored on a shelf without refrigeration. Irradiation of food is the process of exposing food to

ionizing radiation (x-rays or gamma radiation) to kill bacteria and mold. It may be combined with vacuum packing to seal out microbes. Irradiation to a dose of between 1 kGy and 10 kGy is an effective method of reducing the microbial load of food. Low dose irradiation (less than 1 kGy) is also used to inhibit sprouting (e.g. onion, garlic, potato), delay ripening (e.g. of mango, papaya and other fruits) and is also used for the purpose of insect disinfestations and inactivation. Food irradiation is effective against a wide variety of pathogens including bacteria, fungi, viruses and parasites without harming the food. Irradiation is attractive because of its selective targeting. It will extend the shelf life of food because spoilage organisms are also reduced in number, and as with heat treatment, irradiation may also inactivate enzymes that would otherwise assist food spoilage. The Food and Agriculture Organization (FAO), the International Atomic Energy Agency (IAEA), and World Health Organization (WHO) concluded in their report, that any food irradiated up to a maximum dose of 10 kGy is considered safe and wholesome. Essentially three things were concluded in their report:

- 1) It won't lead to toxicological changes in the food that will negatively affect our health,
- 2) The technology won't increase the microbial risk of the consumer, and
- 3) Irradiation won't lead to nutritional losses.

But due to the words "nuclear radiation", irradiated food is not very common in this country.

E-beam Irradiation

E-beam irradiation, though it uses the same term as gamma ray irradiation, is a completely different kind of treatment. High-energy electron beams are produced in an electron gun, a larger version of the cathode ray gun found in devices such as televisions and monitors. The electrons can be directed by a magnetic field to a target food. The term "irradiation" is really a misnomer, since the food not exposed to electromagnetic radiation or beta rays (electrons produced by a radioactive source). Nevertheless, the process has a similar effect to that of gamma ray irradiation. E-beam irradiation requires shielding as well, but nothing like the concrete bunkers used in gamma ray irradiation.

Advantages

- They can be turned on only as needed
- They do not require replenishment of the source as does cobalt-60
- There is no radioactive waste

Disadvantages

- Shallow depth of penetration (about an inch), preventing its application to many foods and limiting the amount of food that can be processed in bulk.
- e-beams must be converted to x-rays to penetrate large items such as carcasses
- High electric power consumption
- Complexity, and potentially high maintenance

High Pressure Processing (HPP)

High Pressure Processing (HPP) is a way to process foods without using heat. It has the potential to produce high-quality, fresh, nutritious, safe-to-eat foods without using chemical preservatives. HPP involves subjecting food to 300 to 700 MPa of pressure. For comparison, atmospheric pressure is normally around 0.1 MPa and the pressure at deepest point in the ocean is around 110 MPa. The high pressure used in HPP kills most micro-organisms, by damaging cell components such as cell membranes. The main applications of high pressure processing

are preservation and preparation. For preservation applications, enzymes and micro-organisms are inactivated under high pressure. This results in a preserved product while remaining fresh taste, flavour and colour. Examples are pasteurization of fruit juices, fruit desserts and guacamole. In Japan, for example, several rice-based foods are available with novel textures induced by high-pressure treatment. Other examples are gelatinization of starches and proteins, preparation of pectin gels (jams) and tenderization of meat. Commercial products have now been appearing in the US and Europe.

Advantages

- Fresh-like quality
- Retention of taste, texture and nutrients
- Shelf life is increased
- combined with heat or antibacterial agents (spores inactivation)
- Food poisoning organisms can be destroyed leading to safer products

Disadvantages

- Discontinuous or semi Discontinuous or semi continuous process
- Expensive equipments
- Impact on texture, structure, appearance, functionality
- Spores are not sensitive
- Resistant bacteria
- Expensive. High-pressure machines typically cost \$3 million.

Pulsed Electric Field Treatment (PEF)

Pulsed electric field (PEF) processing is a non-thermal method of food preservation that uses short bursts of electricity for microbial inactivation and causes minimal or no detrimental effect on food quality attributes. PEF can be used for processing liquid and semi-liquid food products. PEF processing offers high quality fresh-like liquid foods with excellent flavor, nutritional value, and shelf-life. Since it preserves foods without using heat, foods treated this way retain their fresh aroma, taste, and appearance. PEF has been mainly applied to preserve the quality of foods, such as to improve the shelf-life of bread, milk, yogurt, soups, orange juice, liquid eggs, and apple juice, and the fermentation properties of brewer's yeast.

PEF processing involves treating foods placed between electrodes by high voltage pulses in the order of 20–80 kV (usually for a couple of microseconds). The applied high voltage results in an electric field that causes microbial inactivation. The electric field may be applied in the form of exponentially decaying, square wave, bipolar, or oscillatory pulses and at ambient, sub-ambient, or slightly above-ambient temperature. After the treatment, the food is packaged aseptically and stored under refrigeration.

Advantages

- Continuous process
- Fresh-like quality
- Retention of nutrients
- Application for acid food
- Low acid food: combined process for spore inactivation = under investigation

Disadvantages

- Up scaling of process ?
- Liquid products only
- Dependence of el. conductivity of food
- Spores are not sensitive
- Ohmic heating occurs during the PEF discharge, which cause the

temperature of the sample to rise, and hence a cooling system has to be in place in order to maintain a low temperature of the liquids.

- Potential health risk (electrolytic reaction) since the electrodes have to be immersed in the liquid, they are regarded as major contamination sources to the liquid due to the erosion of electrodes during discharge.
- PEF technology is not being used to preserve foods commercially at present.

Extrusion

Extrusion a process by which a set of mixed ingredients (compressed into a semi-solid mass) are forced through an opening in a perforated plate or die with a design specific to the food, and is then cut to a specified size by blades. The machine which forces the mix through the die is an extruder, and the mix is known as the extrudate. The extruder consists of a large, rotating screw tightly fitting within a stationary barrel, at the end of which is the die. Extrusion can take place under high temperatures and pressures or can be simply a non-cooking, forming process. Extrusion enables mass production of food via a continuous, efficient system that ensures uniformity of the final product. Food products manufactured using extrusion usually has high starch content. Extrusion processing has become an important food process in the manufacture of pasta, breads (croutons, bread sticks, and flat breads), many breakfast cereals and confectionery, pre-made cookie dough, some baby foods, full-fat soy, textured vegetable protein (TVP), some beverages, and dry and semi-moist pet foods.

Natural Preservatives

Some of the natural compounds are being used as safe alternatives to chemical preservatives. One of the examples of natural preservative is bacteriocin. These are produced by some good bacteria to kill competing organisms such as *Listeria monocytogenes*. The whole bacteria that produce the bacteriocin, or the purified bacteriocin itself, can be added to foods such as soft cheeses to reduce the risk of pathogen growth.

Ozone in the Food Industry

Ozone is a safe and powerful disinfectant. It can be used to control biological growth of unwanted organisms in products and equipment used in the food processing industries. In aqueous solutions, ozone can be used to disinfect equipment, process water, and some foodstuff. In gaseous form, ozone can act as a preservative for certain foods products and can also sanitize food packaging materials. Some products currently being preserved with ozone include eggs during cold storage, fresh fruits and vegetables, and fresh fish.

Advantages

- Most powerful oxidizer available
- Instantly destroys microbes
- Eliminates chemical storage
- Environmentally friendly
- Stops mold spores
- Does not affect product taste
- No harmful by-products
- Can be used in air and water

Nanotechnology in Food Industry

Nanofood can be considered a term to define a food product which is produced using any application of nanotechnology. It promises improved food processing, preservation, packaging, quality and safety, enhanced flavour and nutrition, functional foods, as well as increased

production, cost-effectiveness and sustainability. Nanotechnology can help to preserve food in at least two different ways: The first way that nanotechnology can improve food is by sealing the bags that the food is in. nanotechnology can help this is by forming a criss-cross net over the container that takes air a very long time to get through. The other way that nanotechnology can help preserve food is mostly limited to bread, specifically. When you first buy (or bake bread) it's loaded with many proteins and fat cells that are sturdy and fight each other for space. Over time, however, the stronger fat cells eventually win out and the bread begins to get stiff and moldy. Nanotechnology can help this by reinforcing the proteins to make them stronger which means that the fat cells take much longer to take over.

Conclusion

In conclusion, food preservation has been essential to our society since the beginning. Preservation has come from simple processes such as salting, to more complex preserving methods such as irradiation, HPP and PEF etc. New preservation technologies are not just working to increase longevity; they are also functioning to sustain the same qualities

of the food that make it desirable in the first place. The physical characteristics and chemical composition of the food will no longer be compromised during the preservation process. With new techniques and innovations to packaging materials, meals maintain their same fresh qualities over the course of their storage. ■

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Taking Cold Chain Business To Next Level

Last year (2015), the two-day long conference created an excellent forum for discussing and disseminating the latest technological advances in Cold Chain. This year, the conference is expected to deliver more...

India Cold Chain Show is coming back to Mumbai this month (17th to 19th October, 2016). Beside the exhibition there will be the interesting conference called India Cold Chain Conference 2016. The conference will continue from 17th to 18th October, 2016 at Bombay Exhibition Centre, Goregaon, East Mumbai. Interested participants may follow the tentative schedule as given below.

Conference Day One – 17th October 2016

- 0930 - 1045** – Registration and Networking Coffee
- 1045 - 1130 – Inauguration, Lamp lighting and YES BANK - White Paper Launch
- 1125 – 1130 (5 min) – YES BANK - White Paper Launch – Knowledge Partner
- 1130 - 1345 – Industry Vision
- Session 1: 1130 – 1300 (1 hrs 30 min) : **Panel Discussion: Macro View of Cold Chain Industry in India and the way forward**
- What is the industry landscape today and expected pace of growth in next five years?
 - How is the investment climate in the sector at present?
 - What are the latest additions in the application sectors of cold chain services?
- Session 2: 1300 - 1345 (45 min): **Growth boost provided by regulatory & nodal bodies to the industry**
- Identifying key boulders in the growth of cold chain sector from policy and regulatory support perspective
 - What are the important steps required to overcome these challenges?
- 1345 - 1430** – Networking Lunch Break
- 1430 - 1800 – Cold Storage: Business expansion, increasing revenue & mitigating costs
- Session 3: 1430 - 1515 (45 mins) : **Evolution of cold storages into multi-commodity distribution centres to increase revenue**
- Costs of operations continue to increase due to several external and internal factors. It is time to explore avenues to boost up the revenue adding directly to the bottom line. What are the benefits to amend the existing storage facility into multi commodity distribution centres? How to ascertain the combination of products to be stored to maintain high standards of quality?
- Session 4: 1515 - 1600 (45 min) : **Exploring models to expand capacity with modern technology and low investment**
- How to minimize your investments in order to make these changes? What are the latest technologies and equipment available to facilitate these amendments?
- 1600 - 1615** – Networking Coffee Break
- Session 5: 1615 - 1700 (45 min) : **Analyzing impact of e-retail on operations of cold storages**
- Online retail has opened up huge opportunity for cold chain sector with an equal amount of challenges in operations? How does this new sector affect cold chain business? What are the geographical and technical challenges in order to cater to this booming industry? How does it impact the human resource requirements in a cold store facility?
- Session 6: 1700 - 1745 (40 min): **Mitigating costs in running a cold store – Infrastructure, Technology and alternate resources**
- Apart from moulding the facility into multi commodity storage centre, what are the other ways to reduce the ever increasing cost of operations? Alternate Resources, Energy Efficiency, Green Building etc.
- Keynote Presentations:**
- 1700 – 1715 (10 min): – Alternate Resources: Solar Power to run cold stores – Benefits, Cost Implications and Investments
- 1715 – 1730 (10 min): – Technology
- 1730 – 1745 (10 min): – Infrastructure:

Conference Day Two – 18th October 2016

- 0900 - 0955 – **Registration and Networking Coffee**
- 1000 - 1130 – YES BANK – Knowledge Partner Sessions
- 1130 – 1330 – Cold Transport: Factors influencing buying decisions
How reefer transport companies gearing up for the impact of GST?

Session 7:

- 1130 – 1210 – It is being widely understood that logistics is one of the biggest benefactor of GST implementation, At the same time, it opens up Pandora's box with several questions and doubts on the implementation and its actual benefit. How transport companies gearing up to adapt to the biggest reform in recent past? What are the required changes in the fleet to maximise benefit from this tax reform?

Session 8:

- 1210 - 1250 – **Evaluating impact of e-retail on fleet procurement and management (Last mile Fulfillment)**
Online retail does not only impact the modus operandi of a storage facility but also has a big impact on distribution network. What are the last mile delivery challenges in e-retail business? How does the transport needs changes in the operations?

Session 9:

- 1250 - 1335 – **Explore the latest technology & innovations to take the reefer business to next level**
With the industry landscape changing really fast with implementation of GST and growing online retail business, what is the technical advancement available in order to keep up with these changes?

Keynote Presentations

- 1250 – 1305 – Phase Change Materials(PCM) based solutions for passive temperature control for storage and transport of food products.
Speaker: Mr. Samit Jain, Managing Director, Pluss Advance
- 1305 – 1320 – Tracking and Tracing
- 1320 – 1335 – Innovations
- 1335 - 1420 – **Networking Lunch Break**
- 1420 - 1620 – Supply Chain: Overcoming challenges & tapping opportunities

Session 10:

- 1420 - 1505 – **Explore means to ensure Just-in-Time performance to maintain quality of fresh products.**
With time, consumer awareness on the quality of fresh produce is increasing. Also, with growing competition delivering products in prescribed time is becoming a challenge. What are the best practices around the world in order to ensure Just-In-Time delivery mechanism?
- 1505 – 1545 – **Reverse logistics – adding direct to your business's bottom line**
Reverse logistics is the least talked about subject in supply chain sector. It has been proved world over that a structured implementation of reverse logistics model directly adds to the company's bottomline with a negligible addition to costs. What is the current status of this segment in cold chain sector? What are the best practices in order to implement as sound reverse logistics model without compromising on the quality of products?
- 1545 – 1625 – **Avenues to infuse funding to scale up business**
With growing needs to expand the operations and consolidate position in the market place, investment becomes an important aspect to scale up operations. What are the sources available to bring in the funding in the sector? How M&A playing in this sector?
- 1625 – 1630 – **Closing Remark**

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FLIR India offers One-Time Use Data Logger

A compact device, sized like a credit card, with USB connector records your product's accurate temperature data. This one-time use data logger is suitable for monitoring temperature readings for food, pharmaceuticals, and other cold chain goods during shipment or simultaneously monitoring temperature levels in various locations throughout an office building, warehouse, or storage facility.

Easy-to-use: Plug into a PC to adjust the settings, Put the Data logger back inside plastic bag and seal the opening, Place in an area where temperature is to be monitored and press START for the unit to start recording, and When data logging duration is completed, plug back into a PC where it will automatically generate a PDF report.

Features:

- User programmable settings are language, sample rate, start delay time, alarm delay time, high/low alarm range and security feature.
- Bookmark 8 locations in a data recording log.
- Long battery life.
- 1-year warranty.

E-mail: flirindia@flir.com.hk



MECO presents new 6000 Count TRMS Digital Clampmeters

MECO has introduced new 6000 Count TRMS Digital Clampmeters, Models: 1080-TRMS and 1008-TRMS. 1080-TRMS is a 3 5/6 Digit 6000 Counts, Current Range up to 1200A AC & DC, Auto / Manual Ranging Digital Clampmeter with LCD Backlight having Voltage Range up to 1000V DC & 750V AC – and with Jaw Opening size of 30mm.

Basic accuracy for DC Voltage is $\pm 0.5\% \text{rdg} + 3 \text{dgt}$ and for AC Voltage $\pm 0.8\% \text{rdg} + 5 \text{dgt}$, for DC Current $\pm 0.8\% + 10 \text{dgt}$ and for AC Current $\pm 2.0\% \text{rdg} + 30 \text{dgt}$. In addition, it has special features like Auto Power Off, Resistance, Capacitance, Frequency, Duty Cycle, Temperature, Diode Test, Audible Continuity, Data Hold etc.

1008-TRMS is a 3 5/6 Digit 6000 Counts, Current Range up to 1000A AC Auto / Manual Ranging Digital Clampmeter with LCD Backlight having Voltage Range up to 1000V DC & 750V AC with Jaw Opening size of 30mm.

Basic accuracy for DC Voltage is $\pm 0.5\% \text{rdg} + 3 \text{dgt}$ and for AC Voltage $\pm 0.8\% \text{rdg} + 5 \text{dgt}$, and for AC Current $\pm 2.0\% \text{rdg} + 30 \text{dgt}$. In addition, it has special features like Auto Power Off, Resistance, Capacitance, Frequency, Duty Cycle, Temperature, Diode Test, Audible Continuity, Data Hold etc.

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New Cooling Tower provides up to 50% more cooling capacity

SPX Cooling Technologies, Inc., has launched Marley NC Everest Cooling Tower, a crossflow evaporative cooling system that provides up to 50% more cooling capacity than any other single-cell, factory-assembled cooling tower.

As per the company, in addition to unmatched cooling capacity, the NC Everest uses up to 35% less fan power to achieve higher energy savings. Its unique design minimises piping and electrical connections to reduce installation costs. Seven-foot doors provide access to the tower's interior service decks and mechanical components, making routine inspections and maintenance safer and easier.

Featuring the new, patent-pending MarKey Drift Eliminators, the NC Everest Cooling Tower achieves the lowest measureable drift rate, down to 0.0005% of circulating water flow, so less water escapes the tower.

NC Everest Cooling Tower sound levels have been independently verified per CTI ATC-128 test code by third-party CTI-licensed test agents and certified acoustical engineers. SPX Cooling Technologies' Marley brand is the only package tower subjected to this rigorous independent sound testing. ■

Website: www.spxcooling.com



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

Honeywell's corporate headquarters awarded LEED USGBC



With solar panels, the building generates 300kW of electricity, and power consumption has drastically reduced because of LED lighting...

Honeywell's corporate headquarters in Morris Plains, New Jersey, has been awarded the Leadership in Energy and Environmental Design (LEED) Gold Certification by the U.S. Green Building Council (USGBC).

Honeywell's headquarters achieved the Gold Certification for several design elements and construction practices that were incorporated with environmental sustainability, worker satisfaction, and productivity in mind. For example, the headquarters uses natural daylight as a method of both saving energy and creating a more pleasing work atmosphere. Additionally, its close proximity to public transportation reduces greenhouse gas emissions while creating convenience for employees.

With more than 1,000 rooftop solar panels, the building generates 300kW of electrical capacity, and the parking garage, which is 86% undercover, reduces the heat island effect. The site also boasts water-efficient landscaping that shrinks water consumption and LED lighting that has led to an overall power consumption 35% below energy code requirements. ■

Daikin receives LEED Platinum Certification



The TIC is a building structure that combines Daikin technologies for achieving a Zero Energy Building (ZEB)...

Daikin Industries recently received the highest rank of Platinum Certification in the LEED (Leadership in Energy and Environmental Design) for New Construction (LEED-NC) rating system for the Technology and Innovation Centre (TIC). This was the first time in Japan for a large-scale office building to obtain this level.

Developed and managed by the U.S. Green Building Council (USGBC), LEED is a green building certification system that has expanded globally as an evaluation system for environmentally-responsible buildings and area development.

Key evaluation points for LEED platinum certification include energy & atmosphere and indoor environment quality, innovation, water efficiency and regional priority.

The TIC is a building structure that combines Daikin technologies for achieving a Zero Energy Building (ZEB). Here new energy-saving technologies are constantly being tested and verified with the building serving as a solution model for sustainability.

In receiving this certification, the company earned high praise for its efforts for the TIC overall as well as for energy savings centred on Daikin air conditioning technologies, the comfort of the indoor environment, and the planning involved for energy measurement and data collection. ■

Zucchetti Tower comes up with steel cage



It will become an innovation and progress symbol not only for Zucchetti, but also for the whole city of Lodi...

The renovation work of the former Lodi Province Palace is at the height of its activity. It will start from the spring-summer 2017, officially becoming Zucchetti Tower. The new headquarters of the most important Italian software company will be composed of 14 floors and will host 350 workers. It will become an innovation and progress symbol not only for Zucchetti, but also for the whole city of Lodi. Furthermore, the building is a good example of sustainability and is undergoing the LEED certification.

The tower, designed by the architect Marco Visconti, is characterised by a steel cage with a shading effect that covers the entire building – and is a technologically advanced model, almost self-sufficient from an energetic point of view.

For the internal comfort of the building they have installed 2 NECS-WQ 1204 multi-purpose heat pumps by Climaveneta, for the production of both hot and cold water, even simultaneously.

These units are thus able to work both in summer and in winter without any seasonal switching but above all without any CO₂ emissions, thus helping to hit the LEED certification targets. ■

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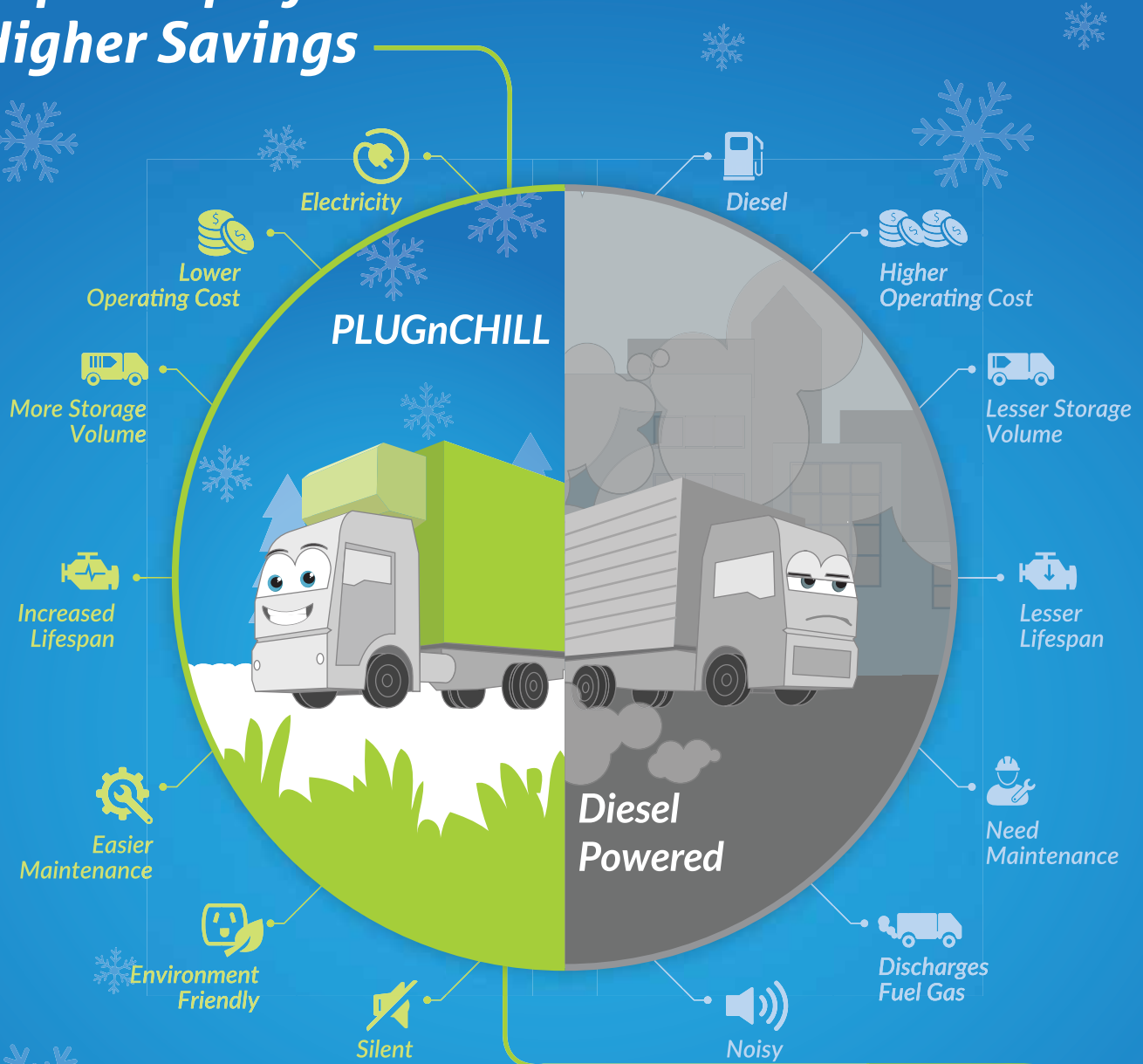
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