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Publisher's Letter



Publisher's Letter

We Urgently Need Robust Cold Chains

The final report of one of the studies; titled 'Assessment of Quantitative Harvest and Post-Harvest Losses of Major Crops and Commodities in India' by ICAR – Central Institute of Post-Harvest Engineering and Technology; was submitted on 31.03.2015. Accordingly, it was estimated that annual value of harvest and post-harvest losses of major agricultural produces at national level was of the order of Rs. 92,651 crore. The latest available annual figures on food loss are: fruits and vegetables together – Rs. 60,000 crore; and cereals, meat, pulses and flowers together Rs. 2,50,000 crore.

What are we supposed to do immediately? I know the unanimously accepted answer is: we have to improve our cold chain segment. The recent report of the pilot study initiated by Carrier is also echoing the same thought, i.e., investment in the cold chain – specifically pre-cooling and transport refrigeration equipment – can reduce food loss by 76% and carbon dioxide equivalent emissions (CO₂E) by 16%.

Kinnow is a high yield mandarin hybrid, which is available in bulk quantity in and near Punjab. This area stands as the world's second largest producer of fruits and vegetables, however quite unfortunately, it accounts for just 1.5% of global produce exports due to losses running as high as 20 - 50% of the total production. Through their pilot study, Carrier tried to identify how modified cold chain technology could improve supply of these fruits – to upgrade their end-point quality, to widen their reach and to enhance profitability out of their sales in all seasons, including the off season.

Interestingly, the study has brought out positive values for all stakeholders along the supply chain – growers, aggregators, transporters, distributors and retailers. It has also rectified the false notions like: cold chain needs a complex set-up from farm to retail, it is dependent on other stakeholders to invest along the supply chain and it needs a high cost of investment.

In 2016, India ranked 22 in the Global Hunger Index (GHI value: 28.5, where values beyond 20.0 indicate serious hunger...). We need to address this issue immediately. Twenty-five irradiation centres are coming up in the country under the India-Russia collaboration programme – as low dosage of radiation frees agro products from germs and insects, increasing their longevity and shelf-life. However, there is a strong opposition from several quarters on distributing irradiated food items in the country. Then, in order to ensure sustainability of the food supply system, why not to put additional impetus only on improving Cold Chains?

Please send your comments at pravita@charypublications.in

Pravita Iyer
Publisher & Director



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2	Chilled Water Temp in °C (Assumed)	5°C	5°C
3	Supply Temp. from CT / LTMCS	33°C	30°C
4	Approach to WBT	4°C	1°C
5	ΔT for Chiller	28°C	25°C
6	Chilled Water Compressor Motor Kw for 1200 TR	720	643
7	Energy Saved in %	-	10.7%
8	Energy Saved in Kw	-	77 Kw/Hr
9	Total Running Hours per Annum	8640	8640
10	TOTAL POWER SAVED PER ANNUM	-	6,65,280 Kw



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Air Cooled Condensing Unit



Water-Cooled Condensing Unit



Evaporator



Panel



Consumables



Axial Fan



Ethylene
Generator



Refrigerant



Controls

Dixell Controls



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FROM THE EDITOR...

Towards Environment-friendly Refrigeration



Out of many research and development projects that have been undertaken by the refrigeration community, some are highly significant owing to their multiple targets...

Although lots of measures have already been adopted and many are being proposed worldwide, the sure and certain control on the process of global warming is yet to be determined. Refrigeration is one of the high potential areas that offers a wide scope for innovation, owing to this fact, globally many organisations are trying to develop the most environment-friendly way of refrigeration that will not only be effective in slowing down the environmental decay, but also simplify the refrigeration process as a whole.

Any refrigeration system consists of three major and active components, namely: Compressor, Condenser and Cooler. Next to them, the most vital role in the system is played by the Refrigerant, which literally holds the key to make the system environment-friendly. Out of many research and development projects that have been undertaken by the refrigeration community, some are highly significant owing to their multiple targets. To be a bit more descriptive, let me cite here two instances.

In 2016, the U.S. Army Natick Soldier Systems Center (NSSC) has awarded S-RAM Dynamics a contract for \$1 million to build and test a mobile refrigeration system demonstration prototype using the new S-RAM energy recovery compressor that utilises the natural refrigerant Carbon Dioxide (CO₂). The target of the R&D project is reduction of the Army's mobile refrigeration assets in excess of 50%, decreasing fuel consumption for forward operating bases without using synthetic refrigerants. The mobile CO₂ demonstration refrigeration system will be installed on the army's Multi-Temperature Refrigerated Container System (MTRCS). Obviously, success of this project will make a big impact in the field of mobile refrigeration.

The vapour compression process of refrigeration consumes lot of power, but there are several materials that can produce cooling when acted upon by magnetic, electric or mechanical forces. However, owing to their low efficiency and failure to be cost-effective, those have not so far witnessed commercial exploitation in mass scale. Last year, scientists and engineers of CaloriCool; a material research consortium led by the Ames Laboratory, Iowa State University; have initiated a research programme targeting to improve the energy-efficiency of refrigeration technology by 20 to 30% within a decade through the use of caloric materials for cooling.

Obviously, at this point of time, we can expect that within the next decade several such initiatives will yield positive results, and those will radically change the scenario in the refrigeration segment.

Pl. send your views at miyer@charypublications.in

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Editor: Mahadevan Iyer

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Tata Steel gets 'Greenco Platinum' rating

Tata Steel's Jamshedpur unit has won the platinum rating for sustainable practices. Tata Steel has always been committed to the Tata Value of Responsibility and has been a trendsetter in the country in creating sustainable values for all its stakeholders. The underlying belief has always been to go beyond compliance and regulatory requirements in caring for people and the planet. In line with its vision and commitment to improve and protect environment performance as an integral way of doing business, Tata Steel has become India's first steel manufacturing company to receive Greenco platinum rating by CII Green Building Council (GBC).

This recognition is testimony to the perseverance of Tata Steel employees and of the aspirational leadership which ensured actions for improvements resulting in getting a Platinum Rating in the first assessment. This makes Tata Steel the first integrated steel plant in the country and the first company in the Tata Group to



receive Platinum Greenco rating. In addition, among the ten assessment criteria, Tata Steel has received the highest scores in eight criteria as compared to the other Greenco rated companies. Speaking on the achievement, T V Narendran, MD, Tata Steel India & South East Asia, "We believe that our vision of making steel and building sustainable communities is a major foundation of a sustainable world that can be achieved through resource efficiency and reduction of the environmental impact over the lifecycle of the products. Having achieved this leadership position in Greenco, Tata Steel realizes its responsibility to seek further daunting targets in its journey of Sustainable Business Development."

Panasonic to set up refrigerator plant in Haryana

Home appliances and consumer electronics company Panasonic India said it has invested Rs 115 crore to set up a manufacturing plant at Jhajjar, Haryana, to produce refrigerators locally. The factory spread across 1,50,000 sq ft, with an annual production capacity of five lakh units will be operational in November 2017 and the company expects the sales from the facility to start from April 2018. "This will fill the balance pie that was missing from Panasonic's locally manufactured product portfolio in India. Refrigerators to a large extent will be manufactured in India except the large capacity refrigerator," said Panasonic India and South Asia President and CEO Manish Sharma. Panasonic currently imports fridges from Thailand, Indonesia and Vietnam and will continue to import the large-capacity refrigerators.

Indian pharmaceutical plant gets LEED Gold rating

The Indian Green Building Council (IGBC) LEED-India has awarded its prestigious gold level rating to Phase 2 of ACG's capsule manufacturing plant in Pithampur, Madhya Pradesh.

The award was presented to ACG representatives at the IGBC Convention recently held at Mumbai. ACG ACPL, Phase 2, Pithampur implemented various sustainable measures, such as infrastructure for rainwater harvesting, usage of recyclable material during construction, optimal usage of natural resources and installation of energy efficient equipment or systems. The management employed methods for preventing soil erosion or carryover of soil from site during construction. It also provided various amenities or facilities for employees in and around the site like public transport, courier services, bank or ATM services, prayer areas and medical assistance.

Fisher Construction wins Built by the Best Award

Fisher Construction Group was named the winner of the International Association for Cold Storage Construction (IACSC) Built by the Best Award for their project with Lineage Logistics and Titan Frozen Fruit.

Lineage Logistics contracted with Fisher Construction Group to build a 216,777 sq ft LEED certified facility, which includes 151,000 sq ft of cold storage and dock space, and 65,000 sq ft dedicated to onsite food processing for Lineage's tenant Titan Frozen Fruit. Fisher developed solutions to challenges during the construction of the LEED-certified facility, at times managing over 120 workers in 10 trades to allow Titan Frozen Fruit to start processing strawberries just seven months after ground breaking.

"I speak for the entire project team in saying that we are honoured to have been

chosen as the winner of this prestigious award," said Scott Guimond, Project Manager, Fisher Construction Group. "The project certainly had its challenges and we are happy we found the solutions needed to help Titan meet the deadlines around a crucial berry harvest time."

With the capacity to blast freeze one million pounds of product per day, the state-of-the-art facility will play a major role in meeting the expanding food processing needs in the Santa Maria, California region.

One of the most unique factors of the project is the shared resources between the third-party logistics company (Lineage Logistics) and the food processor (Titan Frozen Fruit). The partnered facility gives Titan the benefit of a shared refrigeration system and having their refrigeration needs managed by onsite refrigeration expert Lineage Logistics.



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Danfoss and the EurActiv discuss energy efficiency in Europe

Danfoss and the EurActiv Institute hosted a high-level forum to discuss taking a more holistic and system-oriented approach



to energy efficiency. The European Commission recently presented its 'winter package' which included a revision of the Electricity Market Design legislation, the Renewable Energy Directive, the Energy Performance of Buildings Directive and the Energy Efficiency Directive. And, in its freshly published 'World Energy Outlook' report, the International Energy Agency (IEA) identified the efficiency potential of electric motor systems and the capacity for energy neutrality in the water sector.

According to the IEA, electric motor systems consume more than 50% of the global electricity consumption; almost 30% of that is consumed by industrial

motor systems. And, with the IEA identifying that 4% of total world wide electricity is used in the water and wastewater sector, it's clear

that the importance of finding cost-effective solutions to meet global energy-efficiency targets has never been higher on the agenda. For decades, Danfoss Drives has been at the forefront of developing AC drives that optimize the energy efficiency of electric motor systems to reduce energy bills. Of the total energy reduction potential, 30% can be addressed by using AC drives to adapt the variable load.

And, looking into an industry-specific example, providing proven technologies can create an energy-neutral water cycle, significantly reduce the electricity bill of municipalities, and help to establish smart energy systems.

Star Renewable Energy to receive two awards

Star Renewable Energy, part of UK-based Star Refrigeration, has been shortlisted to receive two ACR and Heat Pump Awards at a ceremony on 26 January 2017. The shortlisted heat pumps, based on ammonia, are used in district heating. The first heat pump to be formally recognised is the Neatpump Air Source Heat Pump. The technology can heat water above 60 degree Celsius, and paves the way to low carbon, affordable heating and hot water for vulnerable households. Designed in partnership with Glasgow Housing Association, this is the first community air source heat pump installation in Great Britain to provide renewable as a source of central heating for residential high-rise buildings. Star is shortlisted twice in the Heat Pump Product category, next for its Water Source Heat Pump which is being used to supply heat and hot water to one of the largest town's district heating schemes in the country.

Mitsubishi Electric Hydronics & IT Cooling Systems S.p.A. comes to life

Climaveneta S.p.A., RC Group S.p.A., and DeLclima Finance S.r.l. resolved to merge the three companies into a new company, that is now called Mitsubishi Electric Hydronics & IT Cooling Systems S.p.A. (MEHITS). The new company will also integrate the entire staff of MELCO Hydronics and IT Cooling S.p.A., the former corporate operational entity, previously known as DeLclima S.p.A. This transaction represents a further step in the integration process of DeLclima within the Mitsubishi Electric Group, and aims at simplifying the legal structure, reducing unnecessary costs for the corporate bodies and their relative administrative tasks, and streamlining and strengthening business support services. Vincenzo Maragliano, designated CFO, observed, "Our company structure will become leaner and even more effective. We are combining all of our resources."

Cold Chain Market explores new opportunities by 2020

Cold chain involves proper logistic planning of temperature sensitive products through thermal and refrigerated packaging methods. The application of cold chain is mainly applied to chilled and frozen foods to increase their self-life and maintain quality standard for long duration of time. Cold chain specifically helps in maintaining the biochemical and physical properties of the frozen foods and regulating market price in off-season. It also helps to prevent the product from loss and reduce the waste, which ultimately increases the overall income of manufacturer or producer.

After economic slowdown in 2010, many big players increased the investment on frozen food industry, which leads to directly impacted overall cold chain market. Use of cold chain involves in many industries such as fruits & vegetables, bakery, confectionery, dairy, frozen desserts, fish, meat and seafood. In order to maintain these food fresh for long run,



there need a proper cold chain logistics system. This leads to helps in the growth of cold chain market across the globe. The global cold chain market is growing with a high potential. North America is the largest market for cold chain. The growth in demand of frozen chilled and frozen foods in western counties triggered the cold chain market in North America. Increasing demand of daily products, vegetables and fruits heading towards more export form one reason to another. This has also led to boost the cold chain market.



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*Source: 'India Office Fit Out and Facility Management Market Outlook 2020' by Global Infrastructure Facilities and Project Managers Association (GIFPMA)

Linde & Praxair announce intention to merge

Linde AG and Praxair announced that the companies intend to combine in a merger of equals under a new holding company through an all-stock transaction. The companies have signed a non-binding term sheet and expect to execute a definitive Business Combination Agreement as soon as practicable. The combination would create a company with pro forma revenues of approximately \$30 billion (EUR 28 billion), prior to any divestitures, and a current market value in excess of \$65 billion (EUR 61 billion).

The proposed merger would bring together two leading companies in the global industrial gas industry, leveraging the proven strengths of each. The transaction would unite Linde's long-held leadership in technology with Praxair's efficient operating model, creating a global leader. The combined company would enjoy strong positions in all key geographies and end markets and create a more diverse and balanced global portfolio. Additionally, it would enable the

development and delivery of more innovative products and services to customers. "The strategic combination between Linde and Praxair would leverage the complementary strengths of each across a larger global footprint and create a more resilient portfolio with increased exposure to long-term macro growth trends," said Steve Angel, Praxair's Chairman and CEO. "We consider this to be a true strategic merger, as it brings together the capabilities, talented people and best-in-class processes of both companies, creating a unique and compelling opportunity for all of our stakeholders."

"Under the Linde brand, we want to combine our companies' business and technology capabilities and form a global industrial gas leader. Beyond the strategic fit, the compelling, value-creating combination would achieve a robust balance sheet and cash flow and generate financial flexibility," said Professor Dr Aldo Belloni, CEO of Linde.

Daikin acquires air filter manufacturer Dinair

Daikin Industries announces the acquisition of Dinair AB, an air filter manufacturer in Sweden, by American Air Filter Company Inc, (hereinafter referred to as 'AAF'), a Daikin subsidiary involved in the filter business. The acquisition of Dinair was performed through AAF-Lufttechnik GmbH, an AAF Group company in Germany, and all procedures have been completed. Dinair has been expanding its business focused primarily on Northern Europe in the countries of Sweden, Norway, and Finland. In addition to its headquarters in Sweden, Dinair has production facilities in Finland and Latvia and is engaged in manufacturing and sale of air filters for residential and commercial use air conditioners. In terms of scale, the European air filter market ranks only behind that of the United States, and more than 30 percent of the market is occupied by Germany and Northern Europe in particular.

LG USA recalls 500,000 portables

The US arm of Korean manufacturer LG has recalled over 500,000 portable air conditioning units after reports of fire. The recall involves 466,000 models sold in the USA and 36,000 sold in Canada between February 2011 and August 2016. LG Electronics USA is said to have received four reports of fires that have caused \$380,000 in property damage. No injuries have been reported. The models involved are 7,000 and 8,000 BTU models with model numbers LP0711WNR, LP0813WNR, and LP0814WNR. Consumers have been advised to stop using the recalled portable air conditioners and contact LG to schedule a free repair at an authorised service centre.



UAE AC Market to Grow at CAGR 9% till 2021

According to TechSci Research report, "UAE Air Conditioners Market By Product Type, By End Use Sector, Competition Forecast & Opportunities, 2011 - 2021", air conditioners market in the UAE is forecast to grow at a CAGR of over 9% during 2016-2021, on account of implementation of government initiatives to improve the country's infrastructure, due to upcoming events such as World Expo 2020, Dubai Plan 2021 and Abu Dhabi Vision 2030. These developments are anticipated to drive infrastructural developments such as expansion of shopping malls, hotels and tourist sites, construction of residential spaces, stadiums, etc.

New residential and commercial infrastructural development is expected to steer demand for air conditioners in the UAE.

UAE air conditioners market is dominated by split air conditioners due to various features such as less operating

noise, high effectiveness in extreme climate conditions, integration of latest technologies and high energy efficiency. Moreover, residential sector is the largest demand generator for air conditioners in the UAE due to increasing population base and rising number of household units. Various measures are being adopted by the government to diversify into non-oil sectors by 2030 and increase investments in transportation, manufacturing, retail, hospitality and real estate sectors. Consequently, these initiatives are anticipated to boost construction of private and public infrastructure and drive sales of air conditioners in the country in the coming years.

Abu Dhabi and Dubai are major cities that have witnessed growth in number of houses and gross leasable office area and this trend is anticipated to grow during the forecast period. Dubai, the most populous city in the UAE and comprises 50% of the total construction activities.



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Modine offers latest in classroom HVAC noise reduction

Modine Manufacturing Company, a leader in technology in the HVAC industry, has introduced the STUDY Package, an upgrade to their ClassMate vertical unit which achieves the highest standard for noise reduction in its class. With a redesigned cabinet to reduce air flow velocity, and a redesigned baffle for improved air flow path, the ClassMate with STUDY Package was developed to meet background noise prerequisites for LEED-designed facilities.

"We conducted extensive sound attenuation research to provide the best noise-reduction features possible," said Kimberly Raduenz, marketing communications manager for Modine. "The result is the ultimate noise reduction solution for classroom heating and cooling



ventilation systems, leading to fewer distractions in the classroom." The noise reduction features of the ClassMate with STUDY Package include:

- Improved acoustic insulation with barrier
- Redesigned acoustic plenum to improve noise reduction
- Up to 7dB(A) improvement

"The ClassMate with STUDY Package sets the bar for high acoustical performance," said Raduenz. "Even in challenging noise conditions, this unit is perfect for any situation that is looking for efficient operation and wants the quietest unit possible."

Alfa Laval wins SEK 150 mn order in Middle East

Alfa Laval – a world leader in heat transfer, centrifugal separation and fluid handling – has won an order to supply compact heat exchangers to a natural gas plant in the Middle East. The order, booked in the Energy & Process segment late December, has a value of approximately SEK 150 million and delivery is scheduled for 2017 and 2018.



The order comprises the delivery of compact heat exchangers which will be used to recover energy in the gas cleaning process, thereby bringing down the plant's power consumption and CO2 emissions. "These heat exchangers are commonly used in demanding applications as they are both safe and reliable," says Svante Karlsson, President of the Process Technology division in Alfa Laval. "The order confirms Alfa Laval's position as a reliable partner for the oil and gas industry."

Blueprint for Ecoliving

GoodEarth Malhar is an eco-village located at Kengeri, Bangalore. The project has been developed in phases and will have a total of 500 homes once finished. It is being built in smaller communities of 60-90 homes. There are already two communities that are completed and about 60 families have made Malhar their home. The campus is built being sensitive towards the environment. Materials & techniques which make the spaces more comfortable and impact the environment less have been used. Natural resources are conserved and the design works to reduce energy consumption. Rainwater is harvested and ground water recharged. The sewage is recycled and the water used for flushing and gardening. As the communities take shape, it motivates us to see resident initiatives towards cultural activities and garbage management, sports activities like cricket clubs arising spontaneously and not promoted by the builder but by the community.

Industry seeks support from Government at ICA in Mumbai

International Copper Association India (ICA India) in association with Hindalco Industries Ltd and Vedanta Ltd



organised the prestigious India Copper Forum recently in Mumbai. The event brought together experts and thought leaders from the copper fraternity on one platform for deliberations on opportunities, challenges and future of the country with copper.

The International Copper Association India (ICA India) is a member of Copper Alliance and the Indian arm of the International Copper Association, the leading not-for-profit organization for the promotion of copper worldwide. ICA India is driven by the same objective as that of its parent organization, which is to 'defend and grow markets for copper based on its superior technical performance and its contribution to a higher quality of life

worldwide'. ICA India contributes mainly through its catalytic role, accelerating changes and transforming the long-

term markets for Copper in a sustainable way through its major initiatives such as electrical safety and energy efficiency. ICA India's activities focus on helping end users to better understand and appreciate the positive attributes of copper.

Since 2000, India's domestic copper usage has registered a very healthy growth rate which is in-line with the robust GDP growth witnessed by India during the same period. As per ICA India's estimates, the copper usage in India grew at CAGR of 5.3% from 2006 to 2015 to reach 1.2 million tonnes in 2015. However, India's per capita copper usage is around 0.8 kg whereas the world average is 3.7 kgs, indicates clearly that there is a huge potential for growth.

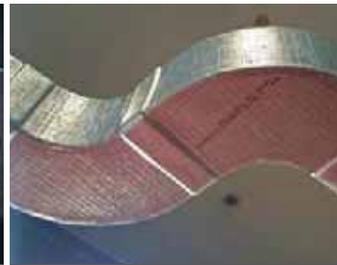
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Airedale appoints Adam Yarrington as Product Development Director

Airedale has appointed Adam Yarrington as Product Development Director. Adam will take over the reins from George Hannah who has occupied the position for the past six years. Adam joined Airedale in September 2005 after graduating from the University of Leeds with a MEng Degree in Automotive Engineering. During the last eleven years Adam has progressed from Test Engineer to Customer Services Manager working in various departments and achieving Chartered Engineer status along the way. In his most recent role as Customer Services Manager, Adam was responsible for the applications engineering, contracts, sales order processing, project engineering and drawing office teams. His remit included the design of customised units for complex projects such



Adam Yarrington

as Vodacom's award winning containerised data centre solution, and a project to design manufacture and install chillers that involved two 40-minute helicopter lifts onto the roof of the London offices of a global professional-services firm.

In this new strategic role, Adam will lead the development of Airedale's design, engineering and research offering to underpin their growth strategy.

Commenting on his new role as Product Development Director, Adam said, "With more than ten years' experience in product development to draw upon, I hope to continue George's excellent work in helping Airedale to continue to progress and evolve as part of a changing HVAC sector which is going through a period of rapid technological change." ■

GSS selects Ralph Weir as new CEO

Gas Sensing Solutions (GSS), the leading designer and manufacturer of low power, high speed Non-Dispersive Infrared (NDIR) carbon dioxide gas sensors, has a new CEO. Ralph Weir will work closely with GSS Founder Alan Henderson, to scale the business, building on the platform of world beating technology and products developed to date to drive its global expansion.



Alan Henderson with Ralph Weir

Ralph is a seasoned CEO with extensive experience of building up high-growth technology companies. He has been CEO at Cambridge Nanotherm, phase vision and growth consultants Actiri. His earlier career includes commercial leadership roles in fast-growing business such as Mirics Semiconductor, Elixent and Blue Wave Systems – all of whom enjoyed significant success across Asia, Europe and the US. Speaking at the 'Sensing The Air We Breathe' conference in Glasgow, organised by GSS in partnership with The Innovation Centre for Sensor and Imaging Systems (CENSIS), Ralph said, "GSS is a business that has been around for 10

years and is a well established international supplier of proven technology.

"The challenge now is to take the company and scale it into hyper growth, enabled by world-beating products, significant manufacturing capacity and quality systems. The Far East is a particularly buoyant market for us and we will be focused on making major inroads there over the next couple of years."

Alan Henderson, founder of GSS, welcomed Ralph's appointment, saying, "Ralph's arrival allows me to focus on the aspects of the business I've always enjoyed the best – working with key customers, supporting the growth of GSS by expanding our OEM customers base and further developing exciting growth markets like China."

GSS has already delivered hundreds of thousands of sensors globally. In addition to being a national winner of the Institute of Physics award for Innovation in July 2014, GSS won first prize in the Shell Springboard awards in 2012, John Logie Baird Innovation award in 2008 and five TSB Awards. ■

Steve Gowing joins Stonegrove Refrigeration

Industrial refrigeration contractor Stonegrove Refrigeration has appointed Steve Gowing as design and project engineer. Steve has worked for a number of industrial contractors, most recently EJM.



Steve Gowing

Dan Cashmore, MD of Stonegrove said, "Steve's appointment further strengthens our design and project management capability. This is a significant time for Stonegrove as we look to build upon our successes gained from a reputation for delivering innovative and technically

sound projects."

Stonegrove Refrigeration is a leading independent refrigeration company in the UK, capable of designing, installing, servicing and maintaining all types of refrigeration systems. The firm has completed a number of prestigious projects for companies including Ocado, Eddie Stobart, Fox's Biscuits and Kuehne & Nagel. It has also won a number of industry awards, including ACR News Contractor of

the Year 2016. ■

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Ant Wilson awarded MBE

Ant Wilson, a director of consultant engineers AECOM, has been awarded an MBE for services to building and engineering. Named in the 2017 New Year's Honours List, Ant Wilson (59) leads AECOM's Sustainable Development Group promoting low energy or carbon building designs. Well-known in the building services industry, Ant is a BSRIA council member, chairs the BSRIA Energy and Sustainability network and sits on the CIBSE Low Carbon Consultants steering group. He is a Fellow of both the Chartered Institution of Building Services Engineers and the Royal Academy of Engineering.

With a BSc (Hons) in Building (Environmental) Engineering from Bath University, Ant joined Oscar Faber (now AECOM) in 1979.

He has worked on a wide range of construction and



Ant Wilson

research projects mainly from an energy performance perspective and has been very involved with thermal modelling and using computer simulation techniques in building services design. His efforts have previously been recognised with a Silver Medal from CIBSE for contributions to the Institution in 2007 and with an ACE (Association for Consultancy and Engineering) engineering ambassadors award in 2008. He was awarded the construction and building

services division prize for 2009 for his outstanding contribution in the execution, promotion and advancement of the art of engineering and science of building services and construction by the Institution of Mechanical Engineers and received the AECOM Excellence Award for Thought Leadership in 2007. ■

Aqua Cooling Wins International Science Award

Hampshire-based specialist engineering firm Aqua Cooling has been honoured by the international Institute of Physics (IOP) during a parliamentary reception at the Palace of Westminster.

The team was presented with a Commended Innovation award for its patented Leak Prevention System (LPS) that puts a basic scientific principle to work in a commercial application for the first time. The award which was sponsored by Alok Sharma, Member of Parliament for Reading West, was received by Aqua directors Kevin Lancaster and



Kevin Lancaster Director Aqua Cooling, Roy Sambles IOP President and Professor of Physics at University of Exeter, Simon Davis Director Aqua Cooling, Suella Fernandes Member of Parliament for Fareham

Simon Davis with Fareham MP Suella Fernandes.

By incorporating the LPS into its range of water-based cooling systems, Aqua can guarantee optimum efficiency and continuous, 100 per cent leak-free performance — which makes its systems ideal for installation and operation in sensitive environments such as data centre and on-chip cooling. Aqua's LPS uses the Venturi effect and the basic scientific premise

that water under negative pressure cannot escape through a hole or breach in a pipe, hose, or joint. ■

Honeywell gets Best Retail Energy Project Award

Honeywell announced that a project based on its Solstice® ze refrigerant has been recognized as the year's best retail energy project during the Energy Awards 2016 in London. The Energy Awards recognize the achievements of companies that contribute to reducing energy consumption and lead the way in innovative energy use, aiming at reducing the impact on the carbon it uses. Honeywell was awarded for its energy and carbon savings in the new category 'Retail Energy Project'. Solstice ze (R-1234ze(E)) is combined with carbon dioxide in a unique supermarket application that combines cooling, heating and air



Solstice® ze refrigerant has been recognized as the year's best retail energy project

conditioning needs into one system, making separate systems unnecessary. This highly efficient system achieved a reduction of installed power supply of 45kW, lower carbon output, and is expected to achieve energy savings of approximately 35 percent per year compared with stores with separate cooling, heating and air conditioning systems. "We are committed to developing environmentally preferable refrigerants that have been proven to help customers lower

their energy consumption as well as their carbon footprint," said Julien Soulet, Managing Director for Honeywell Fluorine Products in Europe, Middle East, Africa and India. ■

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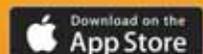
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A Path to Inclusive Growth

Energy is a strategic input for any economy, particularly, so for India (Oil & Gas contributes 34 % of primary energy consumption in India. Petroleum imports constitute 70% of Petroleum products is imported to meet the domestic demand...

Nations across the globe recognize that energy security is critical to fuel their economic and developmental engines. However, with the fast pace of industrial development, the world is facing a significant threat to the readily depleting non-renewable energy resources. This model of development poses a question on our ability to sustain



Navi Mumbai Municipal Corporation

the pace of our growth and compels us to explore newer ways of development.

There are many pressing reasons why Industry needs to embrace energy efficiency, some of them are

- Global warming
- Reducing operating cost
- Compliance with statutory legislations
- Market demand

'The GDP.. A Dangerous Smokescreen'

Energy is a strategic input for any economy, particularly, so for India (Oil & Gas contributes 34 % of primary energy consumption in India. Petroleum imports constitute 70% of petroleum products is imported to meet the domestic demand.

Imagine a world where human well-being, social equity and protection of our natural capital (environment) are the considerations for making business decisions. Sounds too utopian? Not if you go by what some of today's environmental think-tanks call the 'Green Economy'. Environmental circles are buzzing with the term, much banded sustainability. But what exactly does it mean? To understand it, we need to first look at India's economic terms.

India's wealth as measured by gross domestic product (GDP) per capita which has been hovering @ 7%. Focus on GDP alone is myopic and flawed. Considering Natural Manufactured Capital the figure will be very disappointing.

The prevailing economic growth model is increasing the GDP above all other goals. While this system has improved incomes and reduced poverty, it comes with significant and potentially irreversible social, environmental and economic costs, for as many as two and a half billion people, and the natural wealth of the planet is rapidly being drawn.

According to a new 'Inclusive Wealth Indicator' designed to augment measure of economic progress, India's natural capital or the sum of a country's assets from forests to fossil minerals, declined by as much as 31%.

It is essential to adopt sustainable business practice which will lead towards inclusive growth.

Green Life-Style...Quality Of Rate Matter -- Not Just The Rate!

With changing socio-economic fabric of India, people have higher aspirations, than they have ever had before. With all the envisaged growth, it must be noted that, no development process can afford to neglect the environmental consequences of economic activity. This would mean use of far more energy efficient technologies, pursue development which is 'inclusive & sustainable'.

Way Forward

Three pronged approach towards achieving energy efficiency:

- **Design Efficiency:** Selection of the best possible technology and most efficient system
- **Construction Efficiency:** Integration and commissioning of system
- **Operations Efficiency:**
 - Best Management Practices (O&M)
 - Measure, Monitor & Analysis of Energy End use.

Attitude which governs the behaviour and ultimately forms a culture is one of critical aspect which cuts across all the above three approaches.

One often reads about how cities in other parts of the world have successfully embraced greener lifestyles and technologies. Along with attractive incentives and returns on investment, a critical prime mover in these countries has been the change in people's attitudes.

Attitudinal challenge lies in the conventional way that people perceive resources. In our society, being in possession of excess and flaunting it, has always been construed as a mark of prosperity. The first step in dealing with these mindsets is aggressively creating awareness about resource conservation. A lack of information breeds ignorance and fallacious assumptions which leads people to make poor decisions.

Design Efficiency

People often fail to look beyond the initial costs until they are shown hard hitting figures of the kind of payback that

could be leveraged from making smart green choices. They are unaware of how they can contribute simply by making small changes- both behavioral and technological, in their own homes. It is a collaborative approach amongst all the stakeholders of the project.

Design commences from architectural design of the building, simulating (energy / lighting simulation) the performance of the building systems, selection of hi-energy efficient equipment (motors, pumps, chillers etc), robust monitoring system by installation of measuring devices like energy meters, BTU meters etc.

All the above aspects should be critically evaluated during the design stage. Hi-Performance Building Envelope will address the heat gain in the building which will be result in down-sizing of systems, reduction in contract demand with electricity board, which will result in considerable reduction in operational cost. Hence, a holistic approach towards investment will result in addressing the overall cost of the project.

Construction Efficiency

Seldom one comes across poor design of the systems; the challenge is execution and implementation of the design. Construction stage is one of the most critical one to convert and realize best of the design. Project management by way of proper, timely communication and coordination at various stages amongst the stakeholders is of great essence.

Systems installed should be tested and commissioned to validate its site performance with respect to design assumptions.

Operations Efficiency

Best Management Practices (O&M)

- Identification of areas for improvement and selection of appropriate technological intervention for improving the efficiency eg. Heat recovery is very beneficial in process where in one can offset the heating requirement. Key lies in implementation of the strategy as this is not off the self solution. Some of the technological interventions worth reviewing Solar

Thermal heating for residential projects, Solar PV, Heat Pump (Heating & Cooling), etc.

- Capacity Building: Skill development, training programs for budding architects or engineers with case study will go a long way in inculcating a culture of sustainable design. Facility and project management team have initiated such programs at their end to sensitize and bring awareness towards best management practice.

Measure, Monitor & Analysis Of Energy End Use

What is not measured is not accounted for..?

It is proven that energy metering and monitoring at macro level and micro level catalyses the energy accounting process. With goal of 'Measure to Save', over 5% energy cost saving is often pegged to granular metering.

Successful metering strategy requires more than installing the meters and getting data from it. One of the significant merits of having metered data over long period of time is in enabling prediction of energy consumption. Metered data through a centralized Building Management or Energy Management system (BMS/EMS) is of great essence as it enables 'Real Time

of the Day' (RTOD) data recording, correlate the data with some of the critical events in the building's systems.

It is high time that facility staff do away with manual data logging system which is prevalent in most of the projects. Very few (on conservative estimate not more than 20%) projects have been successful in integration of entire systems with BMS to gather the data for analytical use. Normal practice is to log the data manually, in isolation (energy / water / chiller / boiler). There is a big question mark on the time of the day accuracy. Data recording should be at same time every day.

Manual data logged is converted into a spreadsheet — The data "rests in peace" over there for most of the projects.

Modern Buildings have Complex Electro-Mechanical Systems. A systematic approach helps:

- **Devising Formats**
 - Devising of Formats to record the data which can be easily interpreted, co-related and analyzed is of great essence.
- **Benchmarking**
 - Defining of 'Base & Variable Load': Irrespective of change in operations (schedule, internal load variation over Time of day etc) a typical system experiences a base load.

- Time of the Day usage pattern, gap analysis between supply and demand, efficiency evaluation of each equipment in the system are very critical for energy management.
- Energy metrics like Energy Performance Index (EPI) or Energy Usage Intensity (EUI) has to be worked out.

- **Data Acquisition, Analytical Interpretation and Forecasting**

- Analyzing the energy data and co-relating the same with schedules and load is of great essence. Many a time it is observed that analysis of data is done in isolation not considering other operational factors.
 - One of the significant merits of having metered data over long periods of time is in enabling prediction of energy consumption with improved accuracy
- **Calibration of meters**
 - Once a year calibration of all metering device is very much essential to ascertain and maintain the degree of accuracy of data.

Existing Buildings

Existing Buildings offers great potential (@ 15-20%) for energy or water efficiency



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improvement. The reason being the systems are pretty old, absence of system level monitoring which does not capture the information which impairs right decision making process by senior management.

A lot of existing buildings all over the world now are striving for improved efficiency and ways to reduce their environmental impact. There is a significant difference in approach of looking at a new building and an existing building.

In an existing building the 'Architectural design, Façade, Glazing, HVAC system, Lighting' are already in place. Hence the challenge is not best design but to best utilize these, operate and maintain these very systems.

Hence the rating system for existing building under IGBC is referred to as 'IGBC EB – O&M'. Here aspects like ongoing usage of water, energy, purchasing of consumables, durables goods having sustainability criteria, housekeeping equipments etc are given priority.

Case Study Of Existing Building Retrofit - Godrej PL-13 Annex Building

PL-13 Annex.' building is 'Platinum' rated under the IGBC EB O&M. PL-13 Annex building also received 5 Star rating for energy efficiency by BEE.

PL-13 Annex is a magnificent, iconic building of Godrej located at Vikhroli East. It is a mixed use building having diverse operations.

PLANT 13 ANNEXE BUILDING	VIKHROLI EAST, MUMBAI
Built	2008
Built up Area	24,443 Sq Mt
Air- Conditioned Area	16,050 Sq Mt
BUILDING USAGE – FLOOR WISE	
Basement Floor	Utilities & Parking
Ground Floor	Kitchen and Canteen
First Floor	Cafeteria & Office
Second Floor	Office
Third Floor	Conference Rooms
Fourth Floor	Auditorium and Banquet



Green Features of the Building

Energy Management

- 36% saving in energy has been demonstrated w.r.t. base case as per ECBC.
- En. Cons. / Sq. mtr. / Ann. : 97 kWh/ sq. mtr./ Ann.
- Solar PV 120 KW (Generating @ 7% of Total Energy Requirement)
- Recessed glazing and shading device
- Natural Daylight Harvesting in the occupied area
- Roof Garden
- High SRI paint on paved terrace areas
- Natural surrounding with trees which help maintain micro-climate
- Screw chiller with secondary variable pumping system
- Building Management System
- Retrofitted T-8 Fluorescent Tube lights with T-5 (HE) Low-mercury tube lights
- System Level Monitoring of Energy



Water Management

- STP : Recycling of soiled water
- Non-Potable water use for landscaping, flushing & C. Tower make up
- Rain Water Harvesting
- Lo-Flow Fixtures
- Landscape: Native and adaptive species.



Waste Management

- Segregation of waste
- Vermicomposting

Major Challenges faced

- Diverse Building Operations (Dining, Food Manufacturing, Office, Hubble, Conference Rooms)
- Varying Occupancy
- Benchmarking

Take-Away From Certification Journey

The certification system facilitated in identifying the gap in operations and maintenance performance.

Institutionalizing best practices which provide an outline for enhancement of building's performance.

Optimization in energy, water end use, natural resources; waste management improve the indoor environment; and continual focus on operating efficiencies.

Other benefits

- Improve upon the building's systems performance
- Address cost streams associated with building operations.
- Improvement in occupant comfort resulting in productive employee workspaces
- Enlighten the building occupants / visitors regarding the benign impact on environment
- Provide Public recognition for leadership in sustainability
- Show case study for other corporate to emulate in future. ■

Rumi Engineer
Sr. General Manager,
Head – Energy Management &
Green Initiatives,
Godrej & Boyce Mfg. Co. Ltd.



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INSUmelfoam (Melamine foam): Unique, flexible, non-fibrous open cell foam, possessing a combination of low weight, a Class '0' non-flammable fire specification and good sound absorption properties

Are We Breathing Well?

Indoor Air Quality (IAQ) is one of the most important areas of Indoor Environmental Quality (IEQ), particularly, in terms of the impact of a building on the health of occupants. IEQ encompasses more than air quality, including thermal comfort, visual comfort and acoustical quality...

Most people spend as much as 90% of their time indoors. They ingest almost 3-4 liters of water and one kg of food daily, but inhale almost 15 liters of air each day. Therefore,

maintaining a superior Indoor Air Quality (IAQ) in occupied spaces can translate to occupant health and safety, greater productivity and reduced healthcare costs.

Indoor air is often more polluted than

outdoor air (albeit with different pollutants). Research has shown that indoor air in buildings can be two to five times—and occasionally up to 100 times—more contaminated than outdoor air. In fact, indoor air is often a greater health hazard than the corresponding outdoor setting, although this has not changed the common understanding of air pollution.

Indoor air pollution consistently ranks among the top five environmental risks to public health. US Occupational Safety and Health Administration (OSHA) estimate that 30 percent of workers in non-industrial buildings—including offices, schools and hospitals—are



exposed to poor indoor air quality.

The World Health Organization (WHO) estimates that 4.3 million people in 2012 lost their lives due to indoor air pollution. Estimates from the WHO and others suggest that between 30 and 150 times more people are killed due to indoor air pollution than global warming.

Air tight buildings made for higher energy efficiency - if not provided with sufficient ventilation - lead to a common problem viz buildup of carbon dioxide and various pollutants. This leads to “sick building syndrome,” the term introduced in 1980s to describe the increasingly common maladies caused by improperly designed and ventilated buildings. By 1984, a WHO Committee reported that “up to 30% of new and remodeled buildings worldwide may be the subject of excessive complaints related to indoor air quality.” Since that time, consciousness increased on this subject mainly in the developed countries and standards were introduced.

What is indoor air quality?

IAQ is one of the most important areas



of Indoor Environmental Quality (IEQ), particularly, in terms of the impact of a building on the health of occupants. IEQ encompasses more than air quality, including thermal comfort, visual comfort and acoustical quality.

Indoor Air Quality (IAQ) deals with the content of interior air that could affect health and comfort of building occupants. It refers to the presence or absence of air pollutants in buildings. There are many different types of pollutants that can affect indoor air and they come from a wide range of sources.

According to the US Environmental Protection Agency (EPA) and National Institute of Occupational Safety and Health (NIOSH), the three key elements that contribute to the quality of the air people breathe when they are inside include,

- Introduction and distribution of adequate ventilation air
- Control of airborne contaminants
- Maintenance of acceptable temperature and relative humidity

How does Indoor Air Pollution impact us?

Poor IAQ leads to a variety of health risks that have significant costs for the people affected directly as well as for their family members, employers and society at large. Despite the fact that IAQ can have an immense impact on health and general quality of life, it is generally an unregulated field.

The Environmental Protection Agency notes that occupants may experience adverse health effects from indoor air pollutants soon after exposure – or years later. Health conditions associated with poor IAQ can be categorized as either building related illness (BRI) or sick building syndrome (SBS).

Building Related Illness (BRI)

As defined by the World Trade Center Resource Guide, BRI includes specific, identified maladies attributed to an identified material, product or system in a home or building. Examples include Legionnaire’s Disease, hypersensitivity pneumonitis, humidifier fever and asthma-like symptoms in non-asthmatic

individuals. Approximately 25% of the ailments associated with indoor air quality can be identified specifically and are attributed to BRI.

Sick Building Syndrome (SBS)

SBS refers to a general set of symptoms that affect building occupants during the time they spend in the building and that diminish or go away during periods when they leave the building. SBS cannot be traced to specific pollutants or sources within the building, and it typically is multi-factorial, or caused by a number of factors combined with or worsened by inadequate ventilation. About 75% of building-related health cases are classified as SBS. Common SBS symptoms include headaches, nose, eye and throat irritation, a dry cough, dry skin irritation, dizziness or nausea, difficulty concentrating and fatigue.

SBS and BRI are frequently confused with each other. BRI usually entails a specific diagnosis of a set of symptoms caused by a specific environmental factor, one that has developed into an illness that persists whether that factor is present or not. SBS refers to more general symptoms of malaise or discomfort, which are temporary and limited to time spent in the building. Conversely, BRI is often associated with a longer recovery time than SBS symptoms.

What are indoor air pollutants and where do they come from?

There are many potential sources that lead to poor indoor air pollution with the most common being mold, radon, second hand tobacco smoke, smoke from burning wood, gas furnaces and various allergens. Volatile Organic Compounds (VOCs), formaldehyde, pesticides, lead and asbestos are also common sources of air pollution. Some of these items are naturally occurring, some are man-made and some depend on chemical reactions to occur under the right conditions.

Particulate matter is the prime villain. The most lethal are the smallest particles (also known as PM2.5, for particulate matter smaller than 2.5 microns in diameter, about one-third the diameter of a

Table below outlines the common indoor pollutants and their sources

Contaminant	Description	Common sources
Biological Contaminants	Biological contaminants are a natural and unavoidable part of the world. They are so small, so numerous and so adaptable that they cannot be eliminated from most indoor environments. However, the built environment can be made less hospitable to them by source control of mold and moisture.	Common sources may include, <ul style="list-style-type: none"> • people, • animals, • water, • soil, • plumbing leaks, • water damaged buildings • standing water in HVAC system, • plant debris
Combustion Products	Combustion—in heating, cooking, smoking, transportation and power generation—is intrinsic to the activity of people and buildings. Unfortunately, combustion also releases numerous compounds that can potentially contaminate indoor air.	<ul style="list-style-type: none"> • unvented or malfunctioning gas appliances, • tobacco smoke, • fireplaces, • furnaces, • automobile exhaust from attached garages etc.
Particulate Matter (PM)	PM is a complex mixture of extremely small particles and liquid droplets in the air, many of which are hazardous. It includes aerosols, smoke, fumes, dust, ash and pollen. Any material within a building can under certain conditions, emit or form particulates, which could then be inhaled and possibly lead to health risks.	<ul style="list-style-type: none"> • Tobacco smoke, • fireplaces, • furnaces, • aerosol sprays, • carpet (shedding fibers), • ceiling tile, • insulation, • textured fabrics, • printers and copiers
Volatile Organic Compounds (VOCs)	VOCs are a large group of carbon-based chemicals that easily evaporate at room temperature. While most people can smell high levels of some VOCs, other VOCs have no odor. There are thousands of different VOCs produced and used in our daily lives such as Acetone, Benzene, Ethylene, glycol, Formaldehyde, Methylene chloride, Perchloroethylene, Toluene, Xylene, 1,3-butadiene Studies have shown that the level of VOCs indoors is generally two to five times higher than the level of VOC's outdoors. Some VOCs are carcinogens, suspected carcinogens or known irritants at typical levels.	Building Materials <ul style="list-style-type: none"> • Carpets and adhesives • Composite wood products • Paints, Coatings, sealants • Solvents • Upholstery fabrics • Varnishes • Vinyl Floors • Wall Coverings Cleaning and Personal Care Products <ul style="list-style-type: none"> • Air fresheners • Air cleaners that produce ozone • Cleaning and disinfecting chemicals • Cosmetics • Fuel oil, gasoline
Formaldehyde	It is a colorless, flammable gas at room temperature and has a strong odor. Exposure to formaldehyde may cause adverse health effects. At higher concentrations in air, inhaled formaldehyde can irritate the eyes and mucous membranes, resulting in watery eyes, headache, a burning sensation in the throat and difficulty breathing.	Adhesive resin, including urea formaldehyde and phenol formaldehyde, used in manufactured wood products. Examples include, <ul style="list-style-type: none"> • Particle board, • fiberboard, • plywood and • medium-density fiberboard (MDF); • glues; • manufactured wood products, such as furniture; • preservatives; • permanent press fabrics; • paints; • inks; • paper product coatings; • insulation; • pesticides • paper products

HVAC & R

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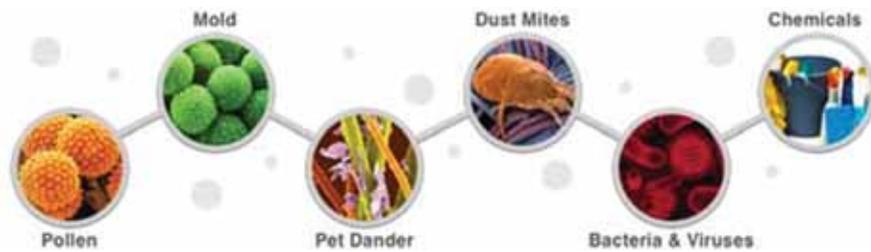


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red blood cell), which are produced by combustion and household activities like cooking. These specks can get deep into the lungs, tarring the airways and weathering the heart, disrupting its ability to breath properly. Many studies have linked exposure to PM2.5 with heart attacks, cardiac arrhythmias, strokes, chronic obstructive pulmonary disease, worsened symptoms of asthma and an increased risk of respiratory illness.

Worldwide, particulate matter contributes to about 800,000 premature deaths each year, according to the WHO, making it the 13th leading cause of death worldwide. Other pollutants also cause major problems, especially indoors—radon, a gas produced naturally in the Earth, is the second leading cause of lung cancer in the US, and additional gases like carbon monoxide and volatile organic compounds (VOCs) cause innumerable health effects.

Strategies to control indoor air pollution

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

Materials Selection

Selection and use of low-emitting, non-toxic materials to construct and furnish the buildings is one of the key elements to meet a goal for good air quality. The evaluation process for materials calls for understanding the

emission potential of each product under consideration. Several categories are considered in a standard testing procedure, including amount of particulates, total volatile organic compounds (TVOCs), and formaldehydes. Materials and products that are third-party certified for conformance with accepted IAQ standards are most recommended. Examples of IAQ Third-party Certification Programs include certified laboratories.

Ventilation Systems

Ventilation involves introducing exterior air into an interior space while exhausting stale interior air to the outside. A variety of common strategies and technologies can be used, including operable windows and exhaust fans. Mechanical systems with adequate ventilation rates, appropriate pressures, and efficient air-filtration are some of the effective strategies for better IAQ.

During Construction

The indoor air in buildings and homes can be compromised by construction activities even before occupants move into a space. In both residential and commercial sustainable projects, a "Construction IAQ Management Plan" should be prepared by the contractor and approved by the client or designer prior to commencement of the work. IAQ strategies should then be implemented during interior construction works to avoid health issues for workers (during construction phase) and occupants (during occupancy phase).

During Operations

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

- Refrain from blocking air vents, as doing so can unbalance your office's HVAC system and affect the ventilation of neighboring offices.

- Comply with your building's smoking policy and smoke only in designated areas.
- Clean up spills immediately and report any water leaks to management to avoid the possibility of mold growth.
- Dispose of all garbage promptly in the proper receptacle.
- Store food properly. Do not leave food in your desks or on shelves.
- Contact building management if you suspect an IAQ problem.

EPAs tips for employers include

- Maintain a good working relationship with building management regarding IAQ issues.
- Regularly check your building's HVAC system to ensure it's in good working order, and coordinate with building management "when responsibility for design, operation and maintenance of the ventilation system is shared," EPA states.
- Create a policy that protects non-smokers from secondhand smoke exposure.
- Refrain from using products that can cause IAQ problems.
- Use pest control products only when necessary, and non-chemical methods if possible.

While above strategies can be a good start, there can be several other more elaborated strategies applicable to different type of buildings or applications. As per our experience at AEON on such IAQ projects, it is experienced that a thoughtful and an integrated design approach is required to be applied in a building design and validated through computer simulation techniques to achieve enhanced IAQ.

Indoor air quality crosses economic status, race and ethnicity. Poor indoor air quality can be present at work, home, school or vehicles. Hence, this is a subject that needs to be addressed carefully for our present as well as future well-being. ■

Ashish K Jain
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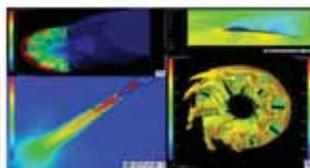


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“Govt needs to focus on reefer infrastructure”



Sateesh Kulkarni, Director, Corporate Catalyst India feels efforts need to be made in order to introduce the concept of green technology, as also the use of renewable energy for the cold chain sector in an interaction with Supriya Oundhakar...

ICAR study has estimated that annual value of harvest and post-harvest losses of major agricultural produces at national level was of the order of Rs. 92,651 crore calculated using production data of 2012-13 at 2014 wholesale prices. Looking at this scenario, where is Indian cold chain industry lacking? Do you think that Indian cold chain infrastructure is upto the mark to arrest these losses?

India is among the world leaders in horticulture. Even though production of fruits, vegetables, milk, poultry, fish and meat is on the rise, prices have always been ruling high. One reason for this is the inadequate and at times absence of proper supply chain management - logistics infrastructure, cold chain in particular, and warehousing and storage facilities. The farm to fork concept, which needs an integrated and holistic system in place is still very much on paper only.

The cold chain sector is an approximately USD 3.5 billion industry. Around 90% of market is controlled by the Temperature Controlled Warehouses. The balance 10%

comprises of Temperature Controlled Vehicles.

Given the fact that around 70% of the warehousing capacity is taken up by one product i.e. potatoes, the balance 25% is not adequate for the other commodities that need cold storage and cold transport facilities.

There is a severe shortage of cold chain warehousing capacity as only 25% of the capacity is available for fruits, vegetables, processed foods and pharmaceuticals, whereas 75% of the capacity is dedicated to potatoes.

Standardisation of cold chain infrastructure, logistics, handling and operations is still at a nascent stage. Technical standards followed in India are mostly unsuitable for Indian conditions, which results in lower performance of standard refrigerated systems.

Lack of proper training: Low awareness of labour in handling temperature-sensitive products: Most workers handling such products are not properly trained in handling temperature-sensitive products resulting in deterioration of product quality before reaching the consumer.

High fuel cost and power cuts: Fuel costs in India constitute around 30% of operating

expenses of cold storage in India as compared to 10% in the developed countries. Uninterrupted power supply is a basic pre-requisite for cold storages. This is not always available everywhere and therefore, cold storage operators have to rely on power backups. This results in escalation of capital cost.

What is current market scenario of India?

In spite of growing demand, warehousing continues to see little investment. Current spending on organized warehousing in India constitutes nine percent of total logistics spending, as against 25 percent in the US and the developed world. Logistics costs account for around 6-10 percent of average retail prices in India as against the global average of 4-5 percent. Therefore, there is a clear scope to improve margins by 3-5 percent by improving the efficiency of the supply chain and logistics processes. Developing an integrated supply chain, including cold chain can save up to Rs 300 billion annually and at the same time reduce the wastage of perishable horticulture products.

What are the regulatory initiatives takes by the government to

promote Indian Cold Chain industry?

The government is taking steps for the sector, such as schemes for capital investment subsidy from the National Horticulture Board, the National Horticulture Mission and the Ministry of Food Processing Industries for the agri-investors to set up cold chain infrastructure. Government has set up National Centre for Cold Chain Development (NCCCD) which would help in establishing building standards through international benchmarking and to promote research and development activity in the cold chain sector. The government has also established partnership with Indian Railways to set up cold chain infrastructure.

The government's initiatives like rollout of GST, 'Make in India' will help Indian cold chain industry to make progress?

Introduction of GST is likely to benefit warehousing. Warehousing companies can consolidate stock at their warehouses. Demand variation at a particular warehouse can also be reduced. This in turn improves demand planning and improved inventory management. Under the GST regime, instead of maintaining smaller warehouses in each and every state, the companies can go in for bigger warehouses at a few select places and can follow hub and spoke model for freight movement from warehouses to manufacturing plants, distributors and retailers. Therefore, this is a big opportunity for 3PL service providers and logistics providers who can manage these longer routes and effect deliveries efficiently.

The economies of scale achieved through this consolidation will reduce variable costs, enable automation and improve operational efficiency. Connectivity of these warehouses to consumption centres will improve with the development of multi-modal transportation systems.

What are the major gaps that need to be fulfilled and the infrastructural developments that the cold storage facilities in India

need to go through in order to keep a check on inflation and to maintain a smooth relationship with the economy?

Market is highly fragmented. In India, the supply chain of most products is long and fragmented. A product changes many hands from source to delivery point.

Capital intensive sector - Most of the companies operating in the cold chain industry are capital intensive (cost of real estate and refrigeration equipment). Major part of the funding in the cold chain industry is done through debt funding and this has resulted in heavy interest expenses. High operational costs - Power (electricity charges) and fuel forms one of the major components of the cold chain industry along with labour and repair & maintenance cost. Small land holdings pose a major logistical challenge.



Technical standards followed in India are mostly unsuitable for Indian conditions, which results in lower performance of standard refrigerated systems.

Other factors – seasonality of demand, single product focus

High cost of borrowing has led to squeezing of the net profit margin.

High Energy Costs: Energy expenses alone make up about 30 percent of the total expenses for the cold storage industry in India compared to 10 percent in the West. These factors pose as a high entry barriers to potential players in the business.

Rising Real Estate Costs: With the rising real estate price, the cost of setting up a cold storage units is also rising. It constitutes approximately 10-12 percent of the project cost. Being a capital-intensive project, it requires heavy investment in fixed assets like plant and machinery, building, insulation and panels

What is your outlook for the sector in 2017-18?

Besides optimising the production and distribution of goods and services, the GST Bill will also help speed up cargo movement. The stoppage expense

(average expense incurred due to the stops along the way such as check-posts and customs) per tonne-km has increased from Rs 0.16 per tonne-km to Rs 0.28, a 75 per cent increase between 2011-12 and 2014-15.

Opportunities exist in the following segments of the cold chain sector:

- Requirement of training establishments
- Need for energy efficient technology
- Efficient logistics network to be a key differentiator
- Controlled atmosphere/modified atmosphere storage for extension of storage life of perishables
- New technologies for storage of processing grade potato
- Low cost solutions for pre-cooling at farm
- Modern pack houses and ripening chambers
 - Innovation, cost-effectiveness and service support in reefer technology
 - Low cost technology for automation of operations in a cold store
 - Space and energy saving solutions in cold storage.

What government measures would you expect for the growth of the sector?

India needs a more effective, efficient and well-thought-out cold storage infrastructure. Special focus and emphasis needs to be laid on development of reefer infrastructure in view of India's exports thrust and potential.

Energy-efficient practices like energy recovery systems, energy-efficient designs of refrigeration equipment and automation are some of the innovative features. Efforts need to be made in order to introduce the concept of green technology, as also the use of renewable energy for the cold chain sector

Financial institutions should play a major role to encourage the investment in cold chain industry in terms of term loan sanctioning, nominal interest rates and disbursement. This will boost investment. State government must make a step towards subsidising the electrical tariffs, encouraging use of renewable energies. ■

Total Number of Cold Storages in India

as per the study conducted by M/s Hansa Research Group, Mumbai

Sl. No.	Name of State	No of Cold Storages
1	Andaman & Nicobar	11
2	Andhra Pradesh	645
3	Assam	24
4	Bihar	170
5	Chandigarh	5
6	Chhattisgarh	82
7	Delhi	45
8	Goa	16
9	Gujarat	432
10	Haryana	206
11	Himachal Pradesh	17
12	Jammu & Kashmir	18
13	Jharkhand	20
14	Karnataka	205
15	Kerala	158
16	Madhya Pradesh	164
17	Maharashtra	532
18	Orissa	45
19	Pondicherry	9
20	Punjab	425
21	Uttaranchal	14
22	Uttar Pradesh	1385
23	West Bengal	498
24	Tamil Nadu	115
25	Rajasthan	109
26	Other North Eastern States	17
	T O T A L	5,367

The Government has got a study done on 'Assessment of Quantitative Harvest and Post-Harvest Losses of Major Crops and Commodities in India' by ICAR - Central Institute of Post-Harvest Engineering and Technology (CIPHET), Ludhiana. The study was commissioned in 2012 and the final report submitted on 31.03.2015. The study has estimated that annual value of harvest and post-harvest losses of major agricultural produces at national level was of the order of Rs 92,651 crore calculated using production data of 2012-13 at 2014 wholesale prices. The percentage of post-harvest losses as assessed by the study areas under:

Crops	Cumulative wastage (%)
Cereals	4.65 – 5.99
Pulses	6.36 – 8.41
Oil Seeds	3.08 – 9.96
Fruits & Vegetables	4.58 – 15.88
Milk	0.92
Fisheries (Inland)	5.23
Fisheries (Marine)	10.52
Meat	2.71
Poultry	6.74

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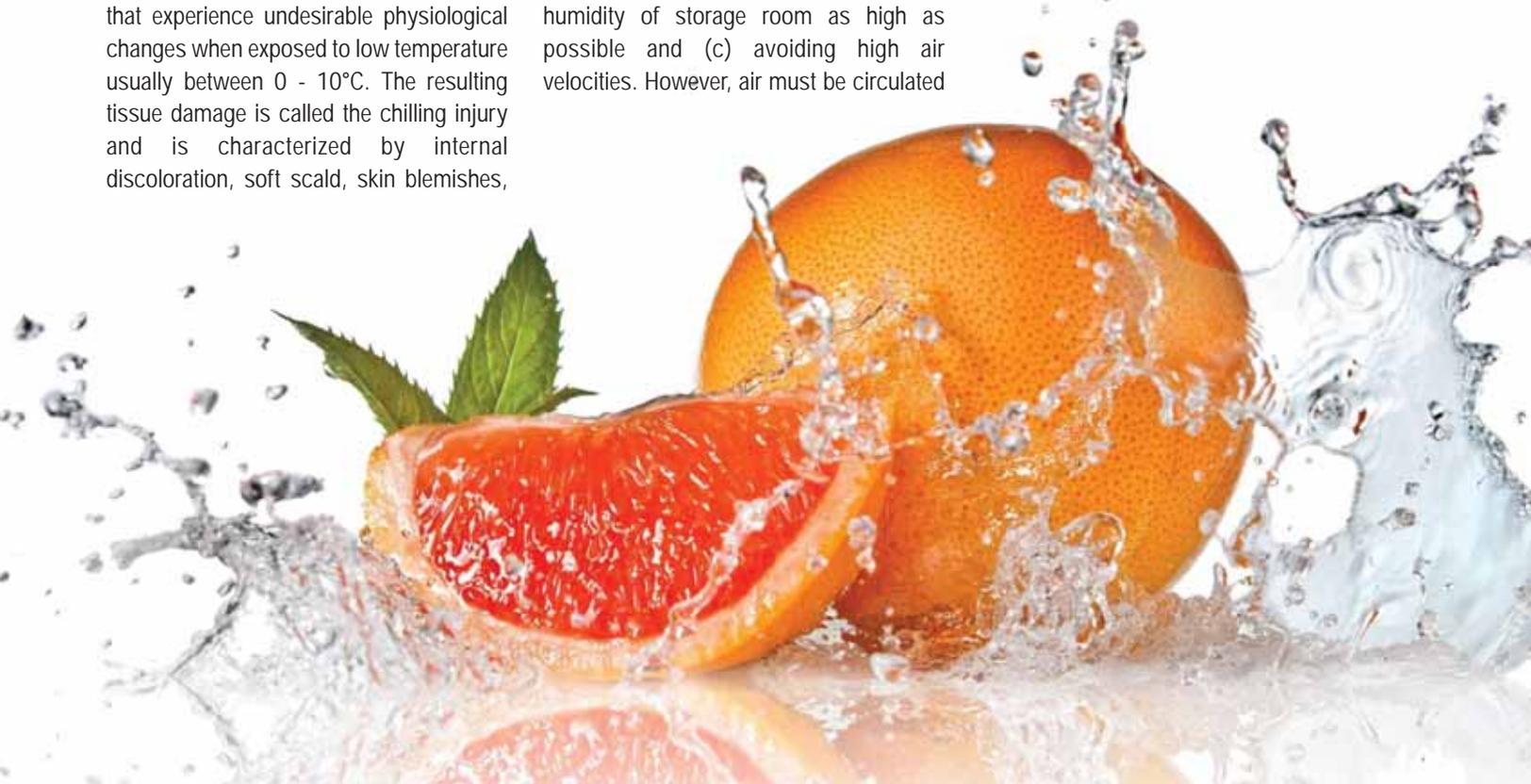
Improving Energy Efficiency

Moisture loss from fresh produce causes it to shrivel or wrinkle and lose quality. Therefore, proper measures must be taken during cold storage to minimize moisture loss which also represents a direct loss of saleable amount...

Refrigeration of perishable food products is an important and fascinating application area of heat transfer and thermodynamics. Refrigeration slows down the chemical and biological processes in food and accompanying deterioration and loss of quality. The optimum storage temperature of most fruits and vegetables is about 1°C to 4°C. But this is not the case with some fruits and vegetables like bananas, cucumbers (summer season produce) that experience undesirable physiological changes when exposed to low temperature usually between 0 - 10°C. The resulting tissue damage is called the chilling injury and is characterized by internal discoloration, soft scald, skin blemishes,

soggy breakdown and failure to ripen. The severeness of chilling injury depends upon both the temperature and length of storage at that temperature. Moisture loss from fresh produce causes it to shrivel or wrinkle and lose quality. Therefore, proper measures must be taken during cold storage to minimize moisture loss which also represent a direct loss of salable amount. Moisture loss can be minimized by (a) keeping the storage temperature as low as possible. (b) Keeping relative humidity of storage room as high as possible and (c) avoiding high air velocities. However, air must be circulated

continuously throughout the refrigerated storage room to keep it at uniform temperature. To maintain high quality and product consistency, temperature swings of more than 1°C above or below the desired temperature in storage room must be avoided. Waxing reduces moisture loss and thus slows down shriveling and maintains crispness in some products such as cucumbers, mature green tomatoes, peppers and turnips. But a wax coating that is too thick may actually increase decay especially when no fungicide is used. Sprouting of onions, potatoes and carrots becomes a problem in a storage that are not adequately refrigerated. The problem can be controlled by using sprout inhibitors. Heat treatment or radiations can be used to control decay and kill insects and micro-organism on or near the fruit surfaces.





Fresh and shrivelled Kinnow fruit



Chilling injury in Guava & Tomato



Properly waxed and over waxed Kinnow

Refrigerated spaces are maintained below the temperature of their surroundings thus there is always a driving force for heat flow towards refrigerated space from surroundings. As a result of this heat flow, temperature of the refrigerated space will rise to the surroundings unless heat gained is promptly removed. Fresh fruits and vegetables are live products and they continue giving off heat that adds to refrigeration load of cold storage room. The storage life of fresh perishables like fruits and vegetables can be extended by several weeks by cooling. We cannot do much

about the physiological characteristics of perishables but we can certainly alter the environmental conditions to more desirable levels through heating, cooling, ventilation, humidification, dehumidification and control of oxygen levels.

Cold storage projects, while performing the important task of preservation of foods, consume a lot of energy for their operation. Energy efficiency is, therefore, very important for cold stores. Normally, energy efficiency of any product or system is defined as ratio of (Work out put) / (Energy input). The ratio is always less than one or

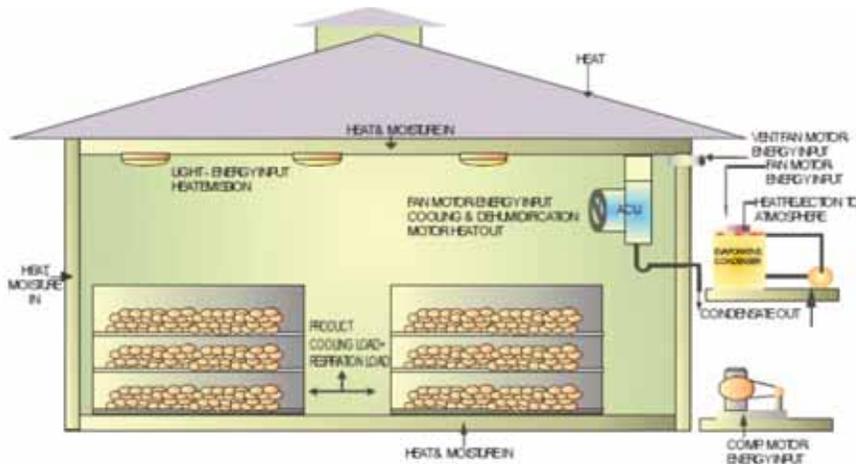
in percentage less than 100%. So, cold stores are not very energy efficient and with increasing cost of electricity, their margins are shrinking. Under prevailing business model of cold stores, the farmers are not willing to pay more tariffs and the large number of cold store owners feels that there is no incentive to modernize. Currently, the store owners do not take any responsibility of the weight loss and quality deterioration during storage and generally service levels are poor.

Ever since potato processing industry has realized the importance of quality of potatoes (high dry matter, low sugar, firm and free from other defects) there is increase in cold stores with better storage conditions, the processors particularly large companies like Pepsi, McCain and ITC are insisting on the following storage conditions-

- Use of sprout suppressant – CIPC which also enables storage of potato between 10°C-12°C
- High humidity- more than 95% to avoid shrinkage and maintaining firmness of the potato which helps in peeling while processing.
- Maintaining CO₂ level- less than 3000 ppm which avoids black hearts and stress to potato.

Considering these requirements of major companies, substantial improvement needs to be made in the existing stores. The retrofitting budget for a typical chamber of a traditional cold store for 2000-2500 tonnes is quite high. However, the modernization definitely improves the quantity and quality of stored potatoes. But before arriving at this decision, the cost benefit ratio, the use of energy and its potential leakage points be investigated thoroughly. Reducing energy use makes perfect business sense. It saves money, enhances the reputation of your business and promotes the fight against climate change. Energy saving doesn't need to be expensive. Upto 20% can be cut in many refrigeration plants through actions that require little or no investment. In addition, improving the efficiency and reducing the load on a refrigeration plant can improve its reliability and reduce the likelihood of a breakdown.

Any energy efficiency initiative dealing



with refrigeration should start by reviewing the heat gains on your system. If you understand the nature of these gains, you'll be able to manage the amount of cooling that needs to be done and make energy savings. Heat gains include warm air entering cold room and heat produced by electrical equipment within the cooled space. The single largest load on cold rooms is usually caused by warm air getting through open doors. This typically accounts for 30% of the total heat gain by a cold room. Gaps between insulated panels or at points where pipes penetrate the walls can also allow a small but constant stream of warm moist air into the store.

Good operation practices for lowering energy costs

- Introduce good door management and keep the door of your cold store closed whenever possible. This will keep warm air and moisture out, and energy costs down.
- Make sure airflow from the evaporators is not obstructed.
- Run your cold store at the highest possible temperature for the product.
- Ensure the product loaded into your cold room has not warmed up by being left in an ambient temperature area.
- Switch off the lighting in your cold room when it is not in use

Energy Consumption Profile of System Components

1. Compressor Consumption Is Highest : 60% ~ 90%
Typical savings with low voltage drives - 10-20%

2. Evaporator Fans Consumption is 5 ~ 15%
Typical savings with low voltage drives - 20-50%
3. Condenser is 3 ~ 5%
Typical Savings with low voltage drives - 15-20%
4. Brine Pump is 2 ~ 3%
Typical Savings with low voltage drives - 20-40%

Compressors & Condenser

The compressor is the heart of the refrigeration system. These are always the single most intensive energy consumer in the system. The compressor raises the pressure of the refrigerant from the evaporator to a level that will allow the heat to be rejected to ambient air at the condenser. The difference between the refrigerant temperature in the evaporator (evaporating temperature) and the condenser (condensing temperature) often determines how hard the compressor has to work. The larger the difference, the more work will be required by the compressor and the more energy it will consume.

In almost all cases, the single most effective energy-saving action you can take is to reduce the temperature difference. For every degree that this difference is reduced, you will save around 3% of the compressor energy. The main method of reducing temperature difference is to lower the temperature at

		
	5 ~ 10% Energy Efficiency 	
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which heat is discharged in the condenser (condensing temperature). Traditionally, condenser control (head pressure control) systems were programmed to run all year round at a condensing temperature designed for summer conditions. Changing the control to allow the temperature to reduce in cooler weather offers a great potential saving.

Compressor Condensor Technology upgrade

Variable speed control of a compressor offers the ability to match the cooling capacity to the actual need based on measurements in the refrigeration system. Costs are reduced both through energy savings when running at lower speed, but also through lower installation costs caused by optimization of the refrigeration system and the compressor itself. Variable speed controlled also reduce the need for compressor packs because the individual compressor is adjusted to the actual need. The lifetime of the compressor is increased due to few starts and stops which cause mechanical wear and tear

Evaporator

An evaporator is so called because the liquid refrigerant inside evaporates at low pressure. This is what creates the cooling effect. It is mounted on the wall or ceiling of a cold room (figure 5.0). If the evaporator is blocked or is not controlled

properly, the cooling will be inadequate – and your energy costs will rise. Like any heat exchanger, evaporators must be the right size for the job. If an evaporator is too small, the compressor will have to work harder and longer. It will also have to defrost more often, increasing your energy costs. Evaporators in most applications need to be defrosted periodically. While this is usually done with timers, intelligent controls can detect when a defrost is required and will 'defrost on demand.

Many cold rooms are set too low – set the temperature only as low as needed. Turning the thermostat up by just 1°C will reduce energy use by up to 2%. The evaporator controller is usually the room thermostat – make sure this is set as high as possible without compromising food or process quality. Keep an eye on your evaporators – if you see a permanent build-up of ice on the coil, something is wrong. Evaporators should be cleaned when they get dirty. They lose performance as dirt builds up. Fans lose performance in the same way. Get your technician to include a thorough deep-clean of the evaporator coils when necessary.

Maintenance

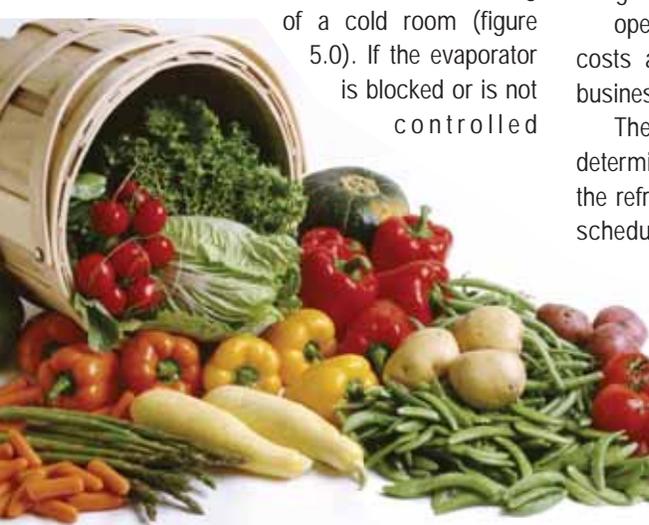
Appropriate regular plant maintenance will save money by ensuring the refrigeration plant

operates efficiently, reducing service costs and making interruptions to your business by breakdowns less likely.

The maintenance schedule will be determined by the size and complexity of the refrigeration plant. As a minimum the schedule should cover the following points:

- Refrigerant levels in the receiver and the liquid line sight glass.

- Refrigerant leak testing and repair as required
 - Condenser cleaning, especially air cooled types (the frequency of cleaning will depend on the condenser location and its surrounding environment).
 - Condenser fan and pump condition and condition of safety equipment such as fan guard.
 - Evaporator cleaning.
 - Operation of the defrost system. Condition of fans and safety equipment should be covered as per the condenser
 - Compressor oil levels and on systems which have suitable gauges fitted, suction and discharge temperatures and pressures. Accuracy of gauges, guards, operation of all safety controls.
 - Checking of control parameters to the optimum set point. Suction superheat to ensure that the expansion valves operate properly.
 - Checks for undue noise and vibration.
 - Condition of insulation.
 - Condition of door seals on cold stores
- Cost savings of up to 50% are possible by making sure that your refrigeration plant is well operated and maintained. Also, improved reliability will reduce the chance of unplanned stoppages or business interruption. Appointing a good maintenance contractor is key to achieving these savings. Also, it is possible to reduce running costs by up to 15% by re-commissioning equipment, especially multi-compressor systems, so this should be included in your maintenance contract. ■



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Cooled Headgear for Qatar Workers

Cooled helmets developed in Qatar set to keep SC workers cool in summer months...

An innovative cooled helmet has been designed and developed by leading researchers in Qatar. The helmet has the potential to significantly reduce the skin temperature of construction workers by up to 10 degrees centigrade. This will allow for safer and more comfortable working conditions in the summer months, according to researchers working on the new system at Qatar

University.

The solar-powered helmet has been rigorously tested, patented worldwide and put through the production stage by a group of Doha-based scientists in cooperation with the Supreme Committee for Delivery & Legacy (SC) and Aspire Zone Foundation (Aspire). More units have now been ordered with the objective to incorporate them for the coming summer

period across SC projects.

"We were approached by the SC and Aspire with a challenge, and our objective was to reduce heat stress and heat strokes among workers in Qatar and the region during the summer months. This type of body-based cooling technology has been used before in US sports for training purposes in hot states. Now, we have now developed this innovative solution for the construction sector and we believe it has the potential to revolutionise the construction industry in hotter areas of the world," said Dr Saud Abdul-Aziz Abdul-Ghani, Professor at the College of





Mexico and the USA and the countries having hot climates where this technology can help to reduce heatstroke and regulate body temperatures for construction workers significantly. Once we have finished development we can roll this out to the region and to other hot areas as part of legacy of this tournament,” added Dr. Saud. “This is an important initiative and we are proud to be involved in the development of this technology,” said Abdulaziz Al-Mahmoud, Deputy President for Sports Projects at Aspire Zone Foundation. “Our participation in this project is a demonstration of our AZF’s vision to become the reference for sports excellence world-wide by 2020, and in line with our work values of innovation.”

Engineering at Qatar University. The researcher has been working on the project since two years alongside a group of students from Qatar, Jordan, Greece and Egypt, and is cooperating closely with the SC and Aspire on the project in order to implement it on construction sites for the 2022 FIFA World Cup Qatar. While explaining functioning of the technology in helmet in high temperatures in a working environment, he elaborated, “Our concept is to use a solar-powered fan to blow air over a cooled material at the top of the helmet, which will then come down over the front of the person’s face and provide a cooler micro-climate for the worker.” “We are confident that this technology will create more comfortable and safer working conditions, and there is just a minimal increase in weight to the helmet. By reducing the temperature of the head and face, the rest of the body will naturally follow and ensure that workers have a constant flow of cooler air to refresh them throughout a day.” An additional weight of just 300 grams and a small solar panel attached to the helmet ensures that the new product is both safe and effective.

“As we continue to place workers’ welfare as a top priority across all our construction sites, we are working hard to find and develop the most innovative and advanced solutions in our preparations for the 2022 FIFA World Cup in Qatar,” said Engineer Hilal Jeham Al Kuwari, SC

Chairman – Technical Delivery Office.

“While this technology is developed and designed in Qatar and will be first used on our sites, we believe it can have a legacy which extends to many other parts of the world which have hot summer climates. This development also confirms

o u r
commitment
to utilising the
impetus of the
World Cup.”
A d v a n c e d
testing has
already taken
place on the
cooled helmet
and the
developers
have pointed
to a number of
regions where
the technology
could also be
applied once it
goes into
m a s s
production.

“This type
of innovative
c o o l i n g
technology will
be ideal for the
Middle East,
Asia, Australia,

“We have worked closely with our partners from the Supreme Committee and Qatar University to enable a live environment that allows us to apply this technology across different projects. This technology will provide more comfortable and safe working conditions for workers.



SOLAR-POWERED, COOLED HELMETS

How do they work?

Researchers at Qatar University, working with the Supreme Committee for Delivery & Legacy (SC) and Aspire, have developed an innovative solar-powered, cooled helmet.

- It can reduce temperature for construction workers in hot working environments by up to 10 degrees centigrade.
- The cooled helmets will be rolled out across SC construction sites for the coming summer.

www.sc.qa @roadto2022

undertaken by Qatar University including testing the system in climatic chambers, analyzing the amount of sweat per hour and adding the effect of sun, air, wind and measurement of the amount of heat that passed through the head. Further, considerations in the development process were the weight and price of the cooled helmet with as little weight and cost as possible being added in order to keep the innovative technology accessible. "The material we use inside the helmet is Phase Changing Material (PCM) contained in a pouch, and this increases the total load of the helmet only by 300 grams. This provides cooling in hot conditions for up to four hours straight. People when working in the sun will get cool air coming down in the front of their faces. When they go for a break, they keep it into a refrigerator and pick up a cold pack and put it into their helmets," concluded Dr Saud. "We did research on the best areas to lower body temperature, and it was the head and face. The additional cost is just twenty dollars in comparison to a normal passive helmet, but the results are felt immediately in terms of less lost time on site due to heat-related complaints."

(Source: Supreme Committee for Delivery & Legacy) ■

The partnership with SC comes as part of a series of joint initiatives in order to provide all the support for an historic World Cup that leaves behind an inspiring

legacy in all fields including the field of technology," Al-Mahmoud added.

During the testing and development phases, a number of detailed studies were

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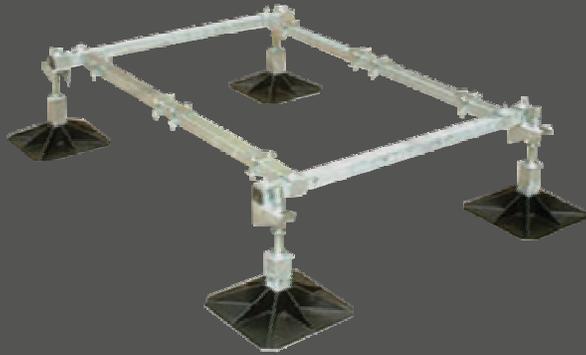
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“We lack effective cold chain”



Gubba Cold Storage is an 11.8 million cubic feet company known for its passion for preservation. With 29 years of expertise and experience, Gubba has innovated and engineered the first of its kind rack supported cold storage in India. It is handled by state-of-the-art material handling equipment, preserves seed in 1.2 ton jumbo bags. In an exclusive interview with **Cooling India**, **Gubba Nagender Rao, Managing Director of Gubba Cold Storage Limited** says the government can charge electrical tariff as equivalent to that of agriculture...

How do you envisage the growth of Indian cold storage industry?

It is good news for the industry. The government's this initiative will help to cover four corners of the country for serving the farming community. Really speaking, it's an encouragement to the industry.

What are the bottlenecks in the Indian cold chain infrastructure as compared to the global cold chain industry?

We lack effective cold chain. As a result, products cannot be preserved in desired condition till reaching to the right consumer. Even after development in the industry, it has become a dire necessity to add a lot of cold storages and cold chain vehicles.

What kind of role National Centre for Cold Chain Development, National Horticulture Board has been playing for the industry for helping entrepreneurs in investing in the cold chain industry?

Though NHB is supporting by giving subsidies, the challenge lies in releasing funds in need of the hour.

What are services offered by Gubba

Cold Storage for preserving products?

Gubba Cold Storage preserves perishables in a controlled environment maintaining temperatures from -20 degrees centigrade to +25 degrees centigrade and moisture from 10% to 50%. The perishables include seeds, vegetables, flowers, fruits, pharmaceuticals, frozen food, processed food, meat, dairy etc.

Gubba Germplasm Bank is a unique project which preserves valuable genetic material of seeds to be made available for future generations. The germplasm of the seed is stored at -20 degrees centigrade and can be preserved up to 50 years.

What technological innovations have been incorporated to make the services energy and cost efficient?

We have used waste heat of condenser for regeneration of dessicant in dehumidifier, thus, saving at least 20 KWH per cold storage. Gubba Cold Storage will be first cold storage having data loggers which are 21CFR certified. We have automated three cold storages.

Do you offer tailored Engineered Project Consulting for the industry? If 'yes', please elaborate.

Gubba Cold Infrastructure is an outcome of 30 years of expertise in cold storage construction and operations. We provide cold storage consulting services and turnkey projects in the field of cold storages.

What are the precautions taken by the company for storage of pharma products, seeds, horticulture products etc? Do you have any expansion plans?

We are planning for a cold storage exclusively for pharma industry. This will be certified for the usage of the pharma industry.

What steps do you expect from the government in terms of policy or financial aid for the industry in order to bring it back on growth trajectory?

Power plays a major role in the cold storage industry and cold storage has been declared as a priority sector. Considering this, the government can charge electrical tariff as equivalent to that of agriculture. It will really make a huge difference. It will help the industry to grow in a big way. ■

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THE HEART OF FRESHNESS

Hermetically Sealed Refrigeration Systems

Hermetic basically means fully sealed or air tight. Conventionally, the compressor, receiver, filter drier and valves used to be fitted to the pipelines through flanged nut and bolt connections or threaded connections. With these units, there was always a limitation on the low pressure that the unit could work on...

One of the limiting characteristics of a refrigerant is its ability to be able to achieve the least temperature and maintain the same without going into negative pressure. From the PT chart

Figure 1, we can notice that various refrigerants cease to be at positive pressure and go into vacuum conditions at various temperatures. For example: R22 (HCFC) starts to go into vacuum at below

-40 degrees C, R134a (HFC) starts to go into vacuum at below -25.6 degrees C. R 410a (Blended HFC) starts to go into vacuum at below -55 degrees C .

This implies that the minimum temperatures which can be reached by these refrigerants R22, R134a and R410a are -40, -25.6 and -55 degrees C respectively.

What happens if these refrigerants attain temperatures below these threshold limits? The pressure will go into vacuum i.e., there is negative pressure created in the system. What harm is there if there is negative pressure in the system? There is always a possibility of air ingress due to collapse failure of the gaskets at joints. Along with air there will be ingress of moisture. And as everybody would admit, air and moisture are the two biggest enemies of refrigeration. We have to keep air and moisture out of the system at any cost. We must prevent occurrence of negative pressure in the system.

How do we do it? By stopping the compressor by cutting off through the operation of low pressure switch. In fact, that is the primary purpose of L P cutout - to switch off the compressor motor electrically at a specified low pressure, when the load is minimal. That means it helps us to maintain a minimum positive pressure in the system, especially on the compressor suction side.

Some of the system manufacturers are promising minimum temperatures lower than the above mentioned threshold limits of temperatures using various refrigerants.

Carrier is able to promise temperature of upto -29 degrees C using R134a as refrigerant for its latest Thinline Container Units, even though the lowest temperature



Refrigerant Pressure Temperature Chart

Temperature		Refrigerant					Temperature		Refrigerant				
°F	°C	R-22	R-410a	R-407c	R-134a	R-404a	°F	°C	R-22	R-410a	R-407c	R-134a	R-404a
-60	-51.1	11.9	0.9	16.0	21.6	-	27	-2.8	51.2	91.6	44.7	23.7	66.2
-55	-48.3	9.2	1.8	13.7	20.2	-	28	-2.2	52.4	93.5	45.9	24.5	67.7
-50	-45.6	6.1	4.3	11.1	18.6	-	29	-1.7	53.7	95.5	47.1	25.3	69.2
-45	-42.8	2.7	7.0	8.1	16.7	-	30	-1.1	54.9	97.5	48.4	26.1	70.7
-40	-40.0	0.6	10.1	4.8	14.7	4.9	31	-0.6	56.2	99.5	49.6	26.9	72.1
-35	-37.2	2.6	13.5	1.1	12.3	7.5	32	0.0	57.5	101.6	50.9	27.8	73.8
-30	-34.4	4.9	17.2	1.5	9.7	10.3	33	0.6	58.8	103.6	52.1	28.6	75.3
-25	-31.7	7.5	21.4	3.7	6.8	13.5	34	1.1	60.2	105.7	53.4	29.5	76.9
-20	-28.9	10.2	25.9	6.2	3.6	16.8	35	1.7	61.5	107.9	54.8	30.4	78.5
-18	-27.8	11.4	27.8	7.2	2.2	18.3	36	2.2	62.9	110.0	56.1	31.3	80.2
-16	-26.7	12.6	29.7	8.4	0.7	19.8	37	2.8	64.3	112.2	57.5	32.2	81.7
-14	-25.6	13.9	31.8	9.5	0.4	21.3	38	3.3	65.7	114.4	58.9	33.1	83.5
-12	-24.4	15.2	33.9	10.7	1.2	22.9	39	3.9	67.1	116.7	60.3	34.1	85.2
-10	-23.3	16.5	36.1	11.9	2.0	24.6	40	4.4	68.6	118.9	61.7	35.0	86.9
-8	-22.2	17.9	38.4	13.2	2.8	26.3	41	5.0	70.0	121.2	63.1	36.0	88.6
-6	-21.1	19.4	40.7	14.6	3.7	28.0	42	5.6	71.5	123.6	64.6	37.0	90.4
-4	-20.0	20.9	43.1	15.9	4.6	29.8	43	6.1	73.0	125.9	66.1	38.0	92.2
-2	-18.9	22.4	45.6	17.4	5.5	31.7	44	6.7	74.5	128.3	67.6	39.0	94.0
0	-17.8	24.0	48.2	18.9	6.5	33.7	45	7.2	76.1	130.7	69.1	40.0	95.8
1	-17.2	24.8	49.5	19.6	7.0	34.7	46	7.8	77.6	133.2	70.6	41.1	97.6
2	-16.7	25.7	50.9	20.4	7.5	35.7	47	8.3	79.2	135.6	72.2	42.2	99.5
3	-16.1	26.5	52.2	21.2	8.0	36.7	48	8.9	80.8	138.2	73.8	43.2	101.4
4	-15.6	27.4	53.6	22.0	8.6	37.7	49	9.4	82.4	140.7	75.4	44.3	103.3
5	-15.0	28.3	55.0	22.8	9.1	38.8	50	10.0	84.1	143.3	77.1	45.4	105.3
6	-14.4	29.1	56.4	23.7	9.7	39.8	55	12.8	92.6	156.6	106.0	51.2	115.3
7	-13.9	30.0	57.9	24.5	10.2	40.9	60	15.6	101.6	170.7	116.2	57.4	126.0
8	-13.3	31.0	59.3	25.4	10.8	42.0	65	18.3	111.3	185.7	127.0	64.0	137.4
9	-12.8	31.9	60.8	26.2	11.4	43.1	70	21.1	121.5	201.5	138.5	71.1	149.3
10	-12.2	32.8	62.3	27.1	12.0	44.3	75	23.9	132.2	218.2	150.6	78.6	161.9
11	-11.7	33.8	63.9	28.0	12.6	45.4	80	26.7	143.7	235.9	163.5	86.7	175.4
12	-11.1	34.8	65.4	29.0	13.2	46.6	85	29.4	155.7	254.6	177.0	95.2	189.6
13	-10.6	35.8	67.0	29.9	13.8	47.8	90	32.2	168.4	274.3	191.3	104.3	204.5
14	-10.0	36.8	68.6	30.9	14.4	49.0	95	35.0	181.9	295.0	206.4	113.9	220.2
15	-9.4	37.8	70.2	31.8	15.1	50.2	100	37.8	196.0	316.9	222.3	124.1	236.8
16	-8.9	38.8	71.9	32.8	15.7	51.5	105	40.6	210.8	339.9	239.0	134.9	254.2
17	-8.3	39.9	73.5	33.8	16.4	52.7	110	43.3	226.4	364.1	256.5	146.3	272.5
18	-7.8	40.9	75.2	34.8	17.1	54.0	115	46.1	242.8	389.6	274.9	158.4	291.9
19	-7.2	42.0	77.0	35.9	17.7	55.3	120	48.9	260.0	416.4	294.2	171.1	312.1
20	-6.7	43.1	78.7	36.9	18.4	56.6	125	51.7	278.1	444.5	314.5	184.5	333.4
21	-6.1	44.2	80.5	38.0	19.2	57.9	130	54.4	297.0	474.0	335.7	198.7	355.6
22	-5.6	45.3	82.3	39.1	19.9	59.3	135	57.2	316.7	505.0	357.8	213.5	379.1
23	-5.0	46.5	84.1	40.2	20.6	60.6	140	60.0	337.4	537.6	380.9	229.2	403.7
24	-4.4	47.6	85.9	41.3	21.4	62.0	145	62.8	359.1	571.7	405.1	245.6	429.6
25	-3.9	48.8	87.8	42.4	22.1	63.4	150	65.6	381.7	607.6	430.3	262.8	456.8
26	-3.3	50.0	89.7	43.6	22.9	64.8	155	68.3	405.4	645.2	456.6	281.0	484.8

Italics indicates vacuum (inches of mercury)

Standard font indicates pressure (pounds per inch gauge)

Figure 1: Refrigerant PT Chart

possible with R 134a working under positive pressure is -25.56 degrees C.

How are they able to do it? - By using **HERMETICALLY SEALED UNITS!**

Till recently, we only heard about Hermetic Expansion valves and Hermetic Compressors.

Hermetic basically means fully sealed or air tight. Conventionally, the compressor, receiver, filter drier and valves used to be fitted to the pipelines through flanged nut and bolt connections or threaded connections. With these units, there was always a limitation on the low pressure that the unit could work on. One had to be doubly cautious not to allow the compressor to run in vacuum conditions,

especially, during maintenance work. There was a limitation of the minimum temperature which could be reached using a particular refrigerant.

Hermetically Sealed Compressors do not have any access to maintenance of internal parts. Repair is not possible, only replacement is possible. They have one suction pipe connection going into the compressor and one discharge pipe connection coming out from the compressor. There is one electrical terminal box. Even the suction and discharge pipes themselves have brazed connections. So, there is no chance of any air ingress into the compressor through the inlet or outlet connections.

Hermetically Sealed Expansion Valves do not permit access to the internal parts of the Expansion Valve. They have brazed connection for the inlet, outlet and the external equalizing pipes. No adjustment of the internal setting of the expansion valve is possible or permitted. These are more commonly used in refrigerated containers and reefer cargo ships. If found defective, they need only to be replaced by de-brazing the three connections and re-brazing them.

Hermetically Sealed Refrigeration Units

The EU F Gas Regulations provides a precise definition of the term 'hermetically sealed' as quoted below.

"Hermetically sealed system means a system in which all refrigerant containing parts are made tight by welding, brazing or a similar permanent connection which may include capped valves and capped service ports that allow proper repair or disposal and which have a tested leakage rate of less than three grams per year under a pressure of atleast a quarter of the maximum allowable pressure;"

In other words, Hermetically Sealed Refrigeration Units do not have any joints

PERFORMANCE SPECIFICATIONS ThinLINE®



Cooling Capacity: Ambers @ 38°C (100°F) with Industry Standard Carrier (SC) Reciprocating Compressor, HFC-134a

Temperature	Watts	Btu/hr
2°C (35°F)	10,350	35,000
-18°C (0°F)	6,010	20,500
-29°C (-20°F)	3,100	10,600

Specifications are subject to change without notice.

Figure 2: Performance Specs of Carrier ThinLINE Container Units



Figure 3: Hermetically Sealed Compressors



Figure 4: Hermetically Sealed Expansion Valves

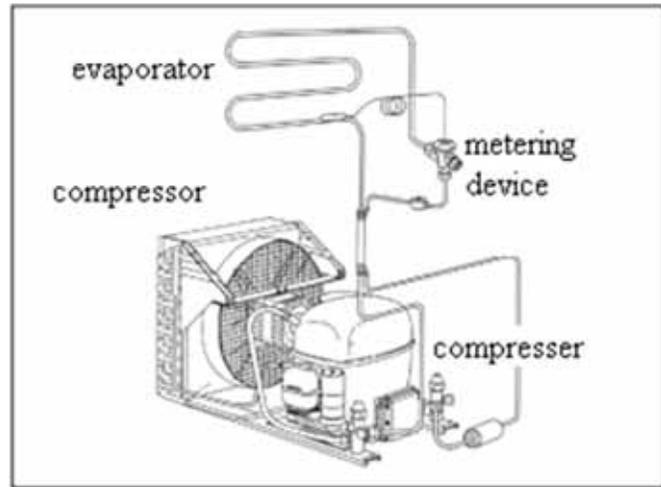


Figure 5: Hermetically Sealed Refrigeration System

or flanges. The entire pipeline system is in single piece and all the individual component and pipes have only brazed connections. So, there is no chance of any ingress through the connections. The compressor can run in vacuum, but still there is no chance of air ingress.

Advantages

1. No chance of air ingress under any circumstances.
2. More reliable operation.
3. Units are designed to run under low and vacuum suction

pressure, hence lower temperatures can be achieved. The new generations of container refrigeration units are hermetic or completely sealed. ■

Chilukuri Maheshwar
Faculty Member,
Anglo Eastern Maritime Academy,
Karjat, Mumbai



Addressing Water, Energy Challenges

Johnson Controls has developed a unique, innovative and industry-leading solution – the BlueStream™ Hybrid Cooling System – to help customers address water and energy challenges in facilities through more efficient cooling tower operations.

BlueStream features a groundbreaking technology – thermosyphon hybrid cooling – to reduce water consumption in traditional cooling tower systems by 25 to 80 percent compared to all-evaporative heat rejection systems. It also maintains peak process output and energy efficiency on the hottest summer days. Like fanning away sweat on a hot day, open cooling towers reduce the temperature of water heated in chillers, industrial processes, data centers and other high-heat practices. Through a wet process, the warm water is sprayed over the fill in a cooling tower to increase the contact area, and the heat is removed through evaporation.

A constant supply of water is needed to replace the water evaporated from the cooling tower, but in many regions, continuing droughts and increasing competition for this essential resource limit water availability. Additionally, some water is continuously bled from the system to reduce the buildup of undissolved solids as water is evaporated. This generates a large wastewater stream, often containing many additional water treatment chemicals.

The BlueStream system offers dry cooling through a thermosyphon process in which refrigerant circulates naturally, with no need for a pump or compressor. Intelligent, web-connected controls coordinate the operation of both the wet and dry system components and adjust in

all weather and thermal load conditions for optimum efficiency, utilizing wet cooling when it's hot and dry cooling when it's not. "Johnson Controls is concerned about the world's water resources and how energy and water – the energy-water nexus – are closely linked," said Clay Nesler, Vice President, Global

Energy and Sustainability, Johnson Controls. "Water costs are becoming an increasingly larger component of a heat rejection system's total operating cost. Drought and water availability can pose a risk for plant and process operations. BlueStream offers a cost-effective way to reduce water use while simultaneously reducing operating costs in heat rejection systems." ■



Description:

- Stand alone / BMS Compatible range of BACnet/MODBUS thermostat.
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- Input Signal for occupancy sensor & energy saving mode.
- Thermostat with Co₂ sensor connectivity and ventilation controls.
- BMS Compatible range of BACnet/MODBUS VAV Controller.
- Suitable for pressure Dependent/Independent VAV boxes.
- Complete range of WiFi Thermostat & RF Wireless Thermostat.



BACnet/MODBUS Room Thermostats and VAV Controller



FCU Thermostat



Room Thermostat



I-colour Touch Screen Thermostat



Pressure Dependent / Independent VAV Controller with Room Thermostat



WiFi intranet Thermostat for Hotels



Co₂ / Fresh Air Controller



Stand Alone Thermostat



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“Indian Government is helping to create demand for green buildings”

The **US Green Building Council (USGBC)** is committed to transforming the way buildings are designed, constructed and operated through LEED – the top third-party verification system for sustainable structures around the world. **Mahesh Ramanujam, President and Chief Executive Officer, USGBC** talks about potential of green buildings concept, services offered by USGBC in India, challenges, opportunities generated due to the Government’s smart cities initiatives and much more in an exclusive interview with **Supriya Oundhakar...**

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

I believe that India is positioning itself to become a global leader in sustainability. The concept of sustainability is not new to India – it’s a mission grounded in the core beliefs of Indians everywhere.

At USGBC, we work towards market transformation

for the built environment through the globally recognized Leadership in Energy and Environmental Design (LEED) program. A global, regional and local green building rating system, LEED is a market transformation tool that helps us build green, healthy and sustainable buildings and communities.

LEED is a key solution to India’s current environmental challenges and a tool that improves human health. India has shown tremendous leadership in the green building movement and is now the third largest market for LEED outside the US. There are a number of companies in India that are looking to LEED as a way to dramatically reduce their water and energy use, reduce the carbon footprint of their business practices and impact their triple-bottom line.

While LEED is an important transformative tool that has been widely adopted in India, there is still work to be done in order to ensure a sustainable future for all and continue to scale up the number of green buildings. India must adopt smart city and



smart grid policies, implement technologies that improve the performance of our cities, continue the transition from the concept of green buildings to green cities, and incorporate wellness and sustainable sites into city planning and development.

USGBC has LEED services hub in India. What kind of services is it offering to Indian green building market?

This year, we announced the incorporation of Green Business Certification Inc. (GBCI), the premiere organization independently recognizing excellence in green business industry performance and practice globally, in India. The new GBCI office, located in Gurgaon, will serve to facilitate the global growth of GBCI and its sustainability programs. We will be able to continue our efforts to green the built environment in India and across the globe, with new added support and on-the-ground capabilities. GBCI exclusively administers project certifications and professional credentials and certificates of LEED, WELL, PEER, Parksmart, SITES, GRESB and other sustainability programs.

What are the challenges faced by you in Indian markets? How do you overcome the same?

We have been in India for a long time – more than 14 years. Even with that level of commitment, there are still challenges that we face. The biggest challenge has been distance. As the green building industry has grown, the competition has intensified. It can be hard for anyone to compete locally from half a world away. To overcome that challenge, we incorporated GBCI in India. In doing so, we addressed concerns not only about distance, but also about local market commitment, rating-system relevance, customer service and even currency exchange rate. Our being here demonstrates our commitment to India in every respect. We are here to contribute and we are committed to India's future.

What are the opportunities generated for you with Indian

government's launch of '100 smart cities' project? Please elaborate.

USGBC has a strong vision of a sustainable built environment within a generation and we are transforming the communities where we live, work, learn and play. The vision is simple—that buildings and



While LEED is an important transformative tool that has been widely adopted in India, there is still work to be done in order to ensure a sustainable future for all and continue to scale up the number of green buildings.

communities will regenerate and sustain the health and vitality of all life. USGBC believes that vision is only possible through the development of smart cities at a global scale, and the Indian government's Smart Cities initiative is helping to facilitate much needed progress.

In support of our vision, we also recently released two new pilot certification programs – LEED for Cities and LEED for Communities – that asks a community or city to set goals, and implement strategies and plans to maintain and support the goals. The city or community then shares performance data to measure and track progress. LEED for Cities and LEED for Communities will support continuous progress towards better communities and cities, and a higher quality of life. They are very much in line with the Smart Cities objectives.

What are sustainable design considerations adopted during the construction of green buildings? How would you achieve the goal of energy efficiency during the construction of buildings?

We live in a resource-constrained world and in no area is this more evident than with regard to our energy system. Energy is a critical economic issue and a top priority for the government in India, and buildings are at the front line of this issue because they account for roughly 40 percent of the total energy used today.

To increase energy efficiency during the construction of buildings, you must first address the envelope of a building and minimize unwanted heat gain or loss, using the regionally appropriate amount of insulation for your building. Other strategies that can be used are incorporating natural daylighting, installing high-efficiency infrastructure such as efficient mechanical and lighting systems and utilizing renewable energy. Post-construction, it is important that you monitor and verify the performance of a building to ensure that the building systems are functioning as designed and support your project requirements.

What are the services offered by USGBC suiting to Indian geographical conditions and standards? What is the research involved to understand India requirements?

LEED is the only globally consistent green building rating tool. This consistency provides a platform to share the best practice in building around the world. However, because environmental and climate conditions, codes, standards and laws vary in different places, USGBC has developed Alternative Compliance Paths (ACPs) to recognize those differences while achieving the same credit intent and requirements.

ACPs increase the applicability of LEED for projects in India and around the world by providing additional pathways to demonstrate compliance with the LEED credits that are traditionally more challenging for projects outside of the US. By focusing on global and regional standards and solutions, these ACPs make LEED increasingly flexible and ensure a common language for all green buildings.

Green buildings concept costs more than conventional buildings. So, developers usually do not adopt the latest green technologies? What is the way through which this technology can be incentivized?

The economics of building green have

changed dramatically and in ways that are very favorable to green builders. Unlike 10 or even five years ago, green building is happening on such a scale that, when properly planned, the up front costs are more often lower than they are for conventional projects. And this is due to the fact that over the last two decades, LEED certification has become a symbol of leadership, signifying that a project is saving energy, resources and water.

Leaders in India and across the globe also understand that LEED is a powerful market tool that works. These leaders recognize that LEED enhances a company's triple-bottom line, helps organizations manage their business operations and creates a more sustainable, energy-efficient built environment. What we are hearing from many of our clients is that over the life of a building, costs are recouped as quickly two to three years.

Any building project or developer can access the latest and most innovative technologies. I think that people working on green projects pay more attention to details related to building performance and environmental impact. If people do their homework and plan properly, they can incorporate products and strategies using the latest technologies that produce significant cost savings, dramatically



reduce environmental impacts and encourage energy efficiency.

What are your expectations from the Indian Government for supporting the green building concept?

India is a booming market for green building, and that's largely because of programs put in place by the Indian Government. Prime Minister Modi launched the Smart Cities Initiative himself, which was a remarkable demonstration of support. The Indian Government is really

helping to create demand for green buildings and we predict this growth will continue. Green building in India are projected to grow by 20 percent over the next three years.

LEED has been a part of the Indian green building movement since its earliest days. The first green building in India was a LEED certified building. So, I would say our expectations for growth are very high, but we do not take our relationship with India lightly nor do we take it for granted. We are strongly committed to India. ■

New Energy Efficiency Standard by ASHRAE

ASHRAE and the Illuminating Engineering Society of North America (IES) have announced their newly published 2016 energy efficiency standard, which contains numerous energy savings measures resulting from industry input. ANSI/ASHRAE/IES Standard 90.1-2016, Energy Efficiency Standard for Buildings Except Low-Rise Residential Buildings, contains 125 addenda published since the 2013 standard which currently serves as the commercial building reference standard for state building energy codes.

This 2016 version is the 10th edition published since the original standard was first published in 1975. "It is the

overall goal of each version to create a consensus standard that saves energy and is technically feasible and cost effective," said Drake Erbe, chair of the Standard 90.1 committee. "The 2016 version has a new format that we believe will be easier for users, a new way of incorporation of reference material from other standards starting with climate data, and a performance path for compliance that rewards designs for achieving energy cost levels above the standard minimum."

The mandatory provisions include the addition of envelope verification in support of reduced air infiltration and increased requirements for air leakage to overhead coiling doors. Chilled water plant metering — For the first time, the standard is

requiring large electric driven chilled water plants to be monitored for electric energy use and efficiency.

DOAS requirements — Dedicated outdoor air systems were introduced over 25 years ago but there were no rating or efficiency requirements with which to comply. For the first time, this product class does have both efficiency and rating requirements with which they have to comply.

Economizer diagnostics — The standard is implementing requirements that air cooled DX cooling units with economizers have a monitoring system to determine that the air economizer is properly working. ■

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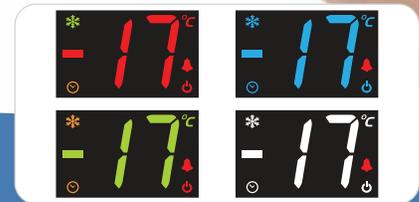
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Once we established with the customer that we are willing and able to help them and earn their trust through the words, tone and friendliness of our greeting, then we can begin to listen to them to determine why they called. To truly listen, you must perform “active” listening when interacting with the customer...

Exceeding Customer Expectations



Why do customers call us? What do they want? Customers call us for one reason, they want our help! They need service, they are uncomfortable, they feel unsafe, they have a question, they need a part (filter, water panel, etc.), they need HELP! Are we helping our customers or are we making it hard for them to get the assistance they need to make their family safe and comfortable at home?

Your customer wants to know that they are getting a fair price and priority service. They want to know we will let them know all the things they need to know when they need to know them. They want happy, eager, willing individuals who are ready to meet their needs. They expect us to be consistent, to be there when they need us, to always use quality products and perform quality service with a professional image. Deliver when we promised and

know what we are doing. Understand their needs and give them our uncompromised commitment to be available for them, no matter what. Keep in mind, they keep us in business, pay the bills and have the power, just as a board of directors does to elect to use our services, to re-order from us or to tell a friend about our services.

So, how do we exceed customers' expectations? Be friendly and helpful. When we perform our job with empathy and show them how much we truly care, the customer will help us help them.

Booking Calls

When a customer calls, you must determine their needs quickly and be prepared to book the call properly in your computer system while they are on the line. To determine the customer's needs, you need to begin by “being” who the customer needs you to be. Meaning,

having the attitude of helpfulness and a true desire to make a difference in the customer's life. They called us... not one of our competitors. They have chosen to give us the opportunity to earn their business and we had better be up to the challenge.

First: our greeting. What does it say to the customer? Are we saying “how may I help you?” A receptionist asks this in order to know who to transfer the call to. Try this: “It's a great day at XYZ Heating and Air Conditioning, my name is Mike, I can help you.” Now you are telling the customer that you can take care of their every need and will only transfer the call when you have exhausted every avenue for you personally to take care of their needs.

Once we established with the customer that we are willing and able to help them and earn their trust through the words, tone and friendliness of our greeting, then

we can begin to listen to them to determine why they called. To truly listen, you must perform “active” listening when interacting with the customer. Active listening means to be quiet and focus totally on the caller. When listening, you will not interrupt the customer, assume they know what is wrong, or make judgements about the customer or their situation. When we act with empathy and truly listen, we then will have all we need to properly book a call that reflects the need of the customer.

Generating Leads

Customer Service Representatives generating leads? “That’s not my job!” Oh, yes it is! When you ask the right questions and determine that the customer has a 20 year old air conditioner and a furnace that is at least that old, it is your job to help the customer understand that keeping that old dinosaur will cost them more than they should be paying in energy and repairs. When armed with the right information, you will be able to help customers in many ways by educating them about their comfort system. Like you, your customer makes decisions to take care of their family based on what they know. Sometimes, they have a solution in mind, like get the furnace fixed, until they are educated about the benefits to a different solution, possibly replacement. It is up to you and your center team to get you, the CSR, the information you need on old equipment and energy costs and role-play using the proper words to be able to convey this valuable information to the customer.

Generating Maintenance Agreements

When we receive a call from a non-agreement customer, we need to educate them about the benefits of the agreement. The hardest part is to bring up the subject in what that the customer says, “yes. I want to hear more.” Well, you’ve been waiting for a “Silver Bullet.” Here it is: simple ask, “Do you pay full price or do you qualify for a discount?” Think about it. Is your customer more interested in getting their furnace tuned up or saving money? We are a nation obsessed with discounts. We will drive across town to save a buck-fifty on a simple household item spending \$5.00 on gas in the process. Your customers want discounts. Try referring to your maintenance agreement as your “Discount Program.” You’ll be pleasantly surprised at the results.

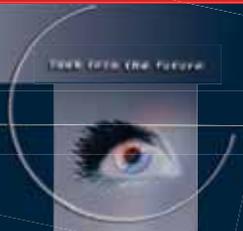
You want to really generate maintenance agreements? Have your technicians ask the same question when presenting the price of the repair. It works, guaranteed.

A customer service representative’s job description should read: To be of service to customers. Your entire focus must be the customer and their needs. Decisions on how to take care of the customer must, of course, include long-term profitability for the company as determining factors in the process but when “the customer comes first” is our motto, the customer will know that we care. ■

Mike Treas
HVAC Business Coach specialising in residential replacement sales, sales management, customer service and maintenance agreements, United States and Canada









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Grameen Fridge

Grameen Fridge provides an easy option for storing and preserving the harvest for a period of 7-8 days without any loss in quality. It is more beneficial during summer season to store perishable agriculture produce and maintain shelf life up to seven days...

Food preservation is an important issue in the desert zone of Rajasthan. Most of the fruits and vegetables are rotten within three days. In present situation, it has been realized that in the absence of proper storage facility for perishable products, farmers are either selling their vegetable product to local market on daily basis at local rates or transport their harvest to nearby district vegetable market on every alternate day where they face considerable stress on desired price. In case of excess availability of a particular product in the vegetable market, farmers have to spend two to three days in these mandies to sell off their products. 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. Keeping these circumstances in view, a low cost model (Grameen Fridge) of short term storage system has been designed which provides an easy option for storing and preserving the harvest for a period of 7-8 days without any loss in quality. It is more beneficial during summer season to store perishable agriculture produce and maintain shelf life up to seven days. Grameen Fridge does not need electricity to function but keeps the maximum

temperature up to 10-11 degree celsius even during hot summer. It works on evaporative cooling principle. The working of grameen fridge is described as below:

The grameen fridge consists of two brick wall. A layer of sand, bricks and pebbles is kept in between these brick walls. Water is used as refrigerant. The sand acts as a medium to retain water required for evaporative cooling. Two ducts of around 4" each are kept at bottom for aeration. A window of 2'x2' is kept at the top for loading and unloading of agriculture produce inside the fridge. The poured water will fill voids present in the sand. The outer brick wall being porous allows water to permeate through it by hydraulic conductivity. Water absorbs heat from inner chamber and inner wall itself. Due to this process of continuous absorption of heat from the water inside the chamber, in a few hours, this chamber becomes cool (Figure 1).

Feature of a Gramin Fridge

- Indigenous technique with low cost development.
- No electricity required.
- No loss in nutritive value of produce.
- Minimize perishable losses
- Produce difference in temperature about 15-17°C from ambient.
- Ease in construction.
- Maintain relative humidity in between 80-95%.
- Useful for vegetable, milk, butter and paneer.

Benefits

- Minimization in losses of vegetable that ultimately increases profit.
- Saving of time which may be used in some other productive work.
- Reduction in cost of transportation, electricity etc
- Eco-friendly

Constructional features

Grameen fridge is constructed with

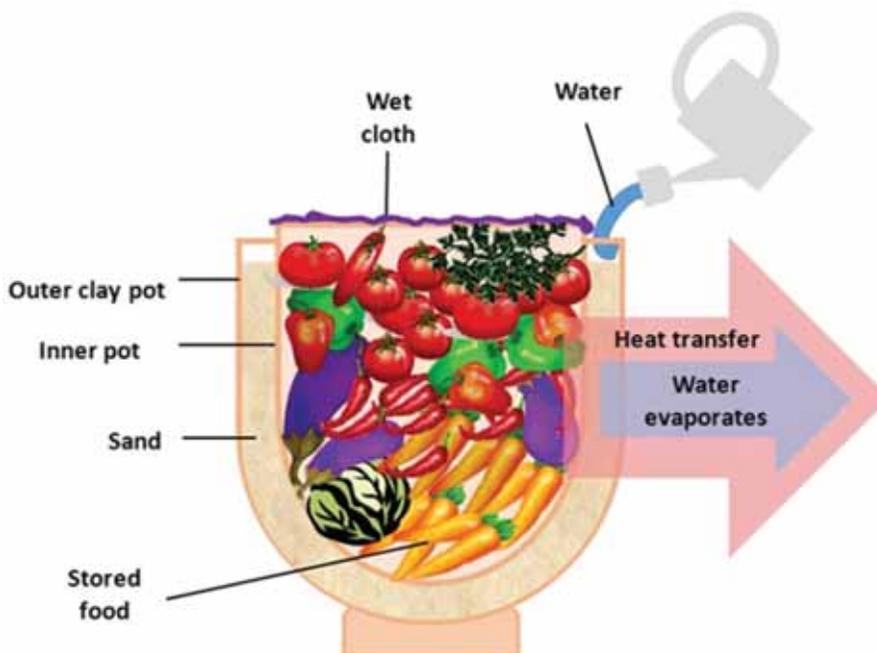


Figure 1: Principle of Evaporative Cooling Refrigerator

Sr. No.	Name of Material	Unit	Quantity	Rate	Total (Rs.)
1	Cement	50 kg bags	2	280 per bag	560
2	Sand	Cuft.	57	Rs. 21 per cubic feet	1197
3	Bricks (9" × 4.5" × 3.5")	No.	350	Rs. 5 per brick	1750
4	Kota stone 2" thickness	Ft.	10.91	Rs. 50 per sq. ft.	545.5
5	Gate-Size 1.5 ftx1.5ft.	No.	1.00	Rs. 200 per gate	200
6	Green Grass	Sqft.	10.91	Rs. 20 per sq. ft.	218.2
Total					4470.70 Say 4500

locally available sand, bricks and cement. Following quantity of material is required for construction of a two quintal capacity grameen fridge. Cross section of a two quintal capacity grameen fridge is shown in Figure 2. It can be constructed by a skilled mason. A total of Rs 1,000 approximately is charged by a mason including labour for its construction.

Field Trial

Jamna Lal Kani Ram Bajaj Trust (JKBT), Sikar (Rajasthan) is working towards sustainable livelihood enhancement of rural community through various developmental interventions with support from various agencies, partners and government departments involved in rural development. Over the past three year, JKBT has constructed a total of 75 grameen fridge units in Sikar district. All units are working satisfactorily for the last two to three years. NABARD and other government agencies helped for technical guidance, construction and its operation. JKBT organizes camps on grameen fridge technology in order to create



Figure 3: Demonstration of Grameen Fridge to group of farmers

awareness about the fruitful technology as well as to create awareness about its operation and maintenance (Fig.3).

Local Innovation

For continuously pouring water over the sand or pebbles layer, a drip system with water tank kept on the top of the structure was arranged. Due to continuous and minimal supply of water ultimately lowers and maintains the temperature inside the cabinet. Lawn grass has also been grown on the top of its roof to lower down the inside temperature. A small roof prepared with local grass to minimize the impact direct sunrays on it.

Conclusion

There is an investment of Rs 5,500

approximately for construction of two quintal capacity grameen fridge. A farmer can store their farm produce in a grameen fridge for minimum 4-5 days. In between these days, he may contact for the best offer from mandi merchants and transport their produce once or twice in a week. There is no need to sell his produce on alternate day. Hence he may get a fair price of his produce and saves his transportation charges. Payback period of above mentioned grameed fridge is depends on quantity of farm produce and their market rates. After collecting may reviews, it is concluded that cost of a grameen fridge can be easily returned within 6-7 months. ■

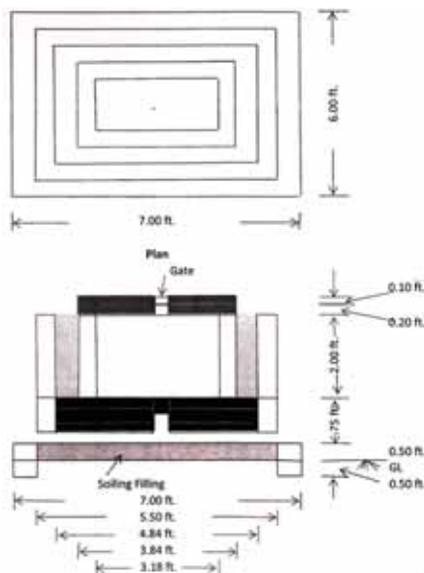


Figure 2: Cross Section of Grameen Fridge



Surendra Rajoria
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Trust, Sikar



Er Kapil K Samar
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Project Manager
Biogas Development and
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Enhancing Performance of Cooling Tower

The dearth of water in power generation is a major concern. This has forced to design the recent power generation units with closed cycle cooling water system. Further, the quality of available water at different sites largely varies and leads to deterioration in the cooling system performance. The various causes of water quality parameters and the remedial measures to restore the water quality for optimized cooling tower performance is described in this paper...

In an evaporative cooling water system during the process of cooling, water evaporates leaving the dissolved solids originally present in the water. The dissolved solid remains will increase, is not controlled to lead to corrosion, scale, deposition or biological fouling. This will affect the heat transfer and durability of system components.

Corrosion: Corrosion is an electrochemical oxidation process. This will destruct the metals of the cooling system equipment such as copper, etc. If this is not controlled, this will lead to equipment failure, plugging of corroded passages in condenser resulting in decreased heat transfer and energy efficiency. Corrosion products deposit on heat transfer area acts a layer of insulator and decreases the thermal conductivity.

Scale: Scaling is a chemical process resulting of increase in dissolved salts concentration in cooling water. This increased concentration of dissolved salts exceeds its solubility limit and precipitates in the forms of salts of calcium or magnesium. The insolubility becomes more with higher water temperature and prone to form deposits at cooling tower heat transfer surface such as fills. The

scale formation reduces and blocks the water and air flow path and thus reduces the air water interaction inside the cooling tower and reduces the performance. Further, due to the scale formation on the fill material increases the weight of the fill substantially over a period of time and thus leading to collapsing of the fill packs leaving void spaces inside the cooling tower.

Deposition: Deposition in any cooling system is a cause of carryover of air borne suspended matter from the surroundings of the site. This may be due to process such as leakage of oil from coolers and suspended matters in the makeup water. The effect of this deposition will be similar to scaling, reduces the thermal insulation leading to poor heat transfer and less efficiency.

Biological Fouling: Slime and algae formations in heat transfer area such as fill and other structures of cooling tower may reduce heat transfer, promote corrosion, and harbor pathogens such as Legionella. This too will act similar to the above discussed scale and deposition.

Some of the water quality parameters and its impact on cooling system are given in the Table 1:

Water Quality Improvement

Corrosion and Scale Control

The specific measures required for corrosion and scale control vary from system to system and are largely dependent on the following:

- i. Chemistry of the makeup water
- ii. Metallurgy of the heat transfer devices in contact with the recirculating water and piping
- iii. Operating temperature of the cooling water system.

Control

Scale can be controlled or eliminated by application of one or more proven techniques.

Typical measures taken to control scale are:

- i. Controlling cycles at a set level.
- ii. Chemical scale inhibitor treatment.
- iii. pH adjustment by acid addition.
- iv. Softening of cooling water system makeup.

Controlling cycles at a set level

In normal conditions, the blow down or bleed which continues flow of a small portion of the recirculating water to drain is sufficient enough to control the concentration of dissolved solids and in turn to control scale and corrosion. Further installation of a high quality system for automatic blow down based on conductivity or metered makeup will control the cycles.

Chemical Scale Inhibitors

Most of the system requires chemical scale and corrosion inhibitors which raise the allowable level of dissolved solids without the risk of scale and corrosion. Chemical scale inhibitors function by

Table 1: Water quality parameters and its impact on cooling system

Water quality parameter	Impact on cooling water system
Hardness	Scale formation Calcium in the form of CaCO ₃ , Magnesium with high silica level will lead to formation of Magnesium Silicate.
Alkalinity	Scale formation Important parameter to predict formation of CaCO ₃ potential.
Silica	Scale formation
Total Suspended Solids	Scale and Corrosion. Suspended solids can adhere to biofilms and cause under-deposit corrosion.
Phosphate	1. At higher concentration level above 20 mg/l with calcium > 1000mg/l leads to Calcium Phosphate scaling 2. Nutrient for biofilms. 3. At concentration level below 4 mg/l and controlled pH from 7 to 7.5 acts as corrosion protection.
Ammonia	1. Enhances biofilms on heat exchanger and cooling tower fills. 2. Corrosive to copper alloys at concentration as low as 2 ppm.
Iron	1. Specialised polymers used for inhibition of calcium phosphate scaling will be deactivated. 2. Along with phosphate, it will form foulants.
Chloride	Corrosive to most metals.
Zinc	1. At levels between 0.5 to 3.0 mg/l is beneficial. 2. At level above 3.0 mg/l lead to deposits.
Heavy Metals such as Copper, Nickel and Lead	Cause localised galvanic corrosion that can rapidly penetrate thin steel heat exchanger tubes.
Algae	1. Provide a nutrient source for bacterial growth. 2. Deposit on surface contributes to localized corrosion process. 3. Loosened deposits can block and foul pipework and other heat exchange surfaces.
Fungi	Proliferate to high number and foul heat exchanger surfaces
Bacteria	1. Some types of pathogenic bacteria, such as Legionella, may cause health hazards. 2. Sulphate reducing bacteria can reduce sulphate to corrosive hydrogen sulphide. 3. Cathodic depolarization by removal of hydrogen from the cathodic portion of corrosion cell. 4. Acid producing bacteria produce organic acids, which cause localized corrosion of deposit laden distribution piping and also provide the potential for severe pitting corrosion of heat exchanger surface.

either selective adsorption on growing scale crystals, converting the crystal structure into a non-scaling type which does not form a hard scale, or through chemical reactions with the scale forming ions, converting them into non-scale forming materials.

pH Adjustment

Control of scale with pH adjustment by acid addition functions via chemical conversion of the scale forming materials to more soluble forms. Thus, calcium carbonate is converted to calcium sulphate (using sulphuric acid for pH adjustment), a material several times more soluble. Normally, it is not desirable to add sufficient acid to convert all of the scale forming materials due to a substantial increase in

the corrosivity of the cooling water if this is accomplished. Addition of excessive acid to the cooling water results in depressed pH values and extremely rapid corrosion of all system metals.

Makeup Softening

Scale can be completely eliminated by softening all cooling system makeup water. Using softened makeup water for scale control is the safest, most cost effective method available for obtaining high cycles, or zero blowdown, with hard makeup water. Normally, the added cost of softened makeup water is balanced by the decreased chemical and water usage resultant from the increased cooling system cycles made possible by the soft water.

Controlling of corrosion and scale can be achieved by maintaining the following water parameters given in Table 2:

Chemical treatment requirements

Chemical treatment needs the following:

- Compatibility of the chemicals to be used with the materials of construction, pipes, heat exchanger, etc. of the cooling system.
- Automatic feeders must be used to introduce chemical scale and corrosion inhibitors into the circulating water system. The feeding point should be such a way that it ensures total mixing and dilution before reaching the cooling equipment. Widely preferred location in a cooling system is at the discharge side of the circulating pump. As these

Table 2: Recommended water quality parameters for control of corrosion and scale

Property of Water	Recommended Level
pH	6.5 to 9.0
Hardness as CaCO ₃	30 to 750 ppm
Alkalinity as CaCO ₃	500 ppm maximum
Total Dissolved Solids (TDS)	1500 ppm maximum
Conductivity	2400 micromhos
Chlorides	250 ppm maximum Cl (410 ppm maximum as NaCl)
Sulphates	250 ppm maximum
Silica	m maximum



chemicals can severely damage areas directly contacted, these should not be batch fed directly into the cold water basin or water distribution system.

- iii. If chlorine is being added to the system it must be ensured that it does not exceed 1 ppm as exceeding this limit may accelerate corrosion.

Deposition Control

Measures taken to control deposition depend on the cause of the problem. Process contamination problems are best corrected by elimination of the process leakage, while most suspended solids deposition can be controlled by addition of dispersant/surfactant chemicals to the cooling water. These materials function by charge neutralization of the suspended particles and emulsifying binding agents, breaking up existing deposits and preventing agglomeration of the particles to form new deposits.

Heavier concentration of suspended solids deposition can be treated with a combination of chemical dispersants or surfactants and an element filter, hydrocyclone or media filter in a side stream configuration. 2 to 35 microns range of suspended solids in recirculating water is not difficult to control. Below 2 microns dispersants are the effective

control for deposits. Above 35 micron level, simple sedimentation of hydrocyclones is effective. Automatic backwashing filters are most effective for removal of suspended solids in the critical range of 2 to 35 microns. If a cooling system need to be operated at over six cycles of concentration, bypass filtration is required. In heavy dusty atmospheric conditions, such filtration is required regardless of the chemistry or cycles of concentration at which the cooling system is being operated.

Biological Fouling Control

Formation of anaerobic areas under the biological fouling layer results in a substantial corrosion rate increase. Widely used biocides classified in two major classes (i) oxidizing and (ii) non-oxidizing.

Oxidizing Biocides

Cellular structure of the bio fouling organism is effectively destroyed and killed by chemical oxidation by oxidizing biocides. As this is a destructive form of action, it is impossible for any organism to show, or develop, significant immunity to an oxidizing biocide. Oxidizing biocides are usually quite cost effective due to their low unit cost, rapid effect on the target organism, and low effective dosage. Oxidizing biocides have the following disadvantages:

- i. Some of them can decrease cooling water pH in an uncontrolled manner.
- ii. Most of them increase the corrosive nature of the cooling water.
- iii. Oxidizing biocides such as chlorine produce undesirable by-products from an environmental viewpoint.
- iv. Some corrosion and scale control

chemicals can be inactivated by contact with specific oxidizers.

- v. None of the oxidizing biocides have any dispersant effect for removal of deadmicrobiological growth.

Non-oxidizing biocides

Non-oxidizing biocides are generally quite costly due to the high effective dosage, long contacttimes, and often high unit cost.

Non-oxidizing biocides do have advantages over the oxidizing biocides:

- i. No effect on corrosivity is evident from their use.
- ii. Do not interfere with corrosion and scale control chemicals.
- iii. Specific type of organism can be targeted and treated.
- iv. Definite dispersant effect for removal of dead microbiological growth.

Conclusion

Cooling water quality plays a vital role in maintaining the performance of the cooling tower and associated equipment. Poor cooling water treatment and control increases facility costs via destruction of expensive equipment, damage to the facility, increased costs for water and sewerage, and increased energy use and cost. A proper water treatment program, administered under the supervision of a competent water treatment specialist, is an essential part of routine maintenance to ensure the safe operation and longevity of evaporative cooling equipment, as well as other system components. Selection of a cooling water management program and knowledge of the chemistry and controls required will increase the probability of obtaining reliable equipment cooling with maximum heat transfer efficiency at the lowest total cost. Those facilities that devote sufficient time and resources to this vital area will be reaping the benefit of lowered costs and more reliable operation. ■

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“We intend to introduce Wi-Fi CPU controllers”



Cruise Appliances is one of the few companies offering innovative air conditioning products based on extensive experience, research and understanding of the Indian climatic conditions and consumer needs, helping them to create their own niche in the Indian market. Roshan Sirohia, Director, Cruise Appliances sheds light on Indian HVACR market, products, challenges and much more in an exclusive interview with Supriya Oundhakar...

What are the trends in Indian HVACR market?

Across the HVAC industry, energy savings is the main reason to use adjustable frequency drives in HVAC systems today. The growth trend is 35% and it is moving more towards variable refrigerants flow systems. Due to sluggish growth trends in the real estate and infrastructure sectors, the HVAC market may not register a higher growth.

What are the products offered by the company? What are the innovations adopted in your products to make them more energy-efficient and cost-efficient with the emphasis on zero carbon footprint?

Currently, we are into light commercial product range starting from 1.5 ton to 8.5 ton unitary system. They also range from cassette AC to ductable air conditioning units. As for environmental support, we are moving towards non-CFC gases and also opting for higher energy efficiency compressors.

What kind of opportunities do you look forward for your company with the government's roll out of '100 smart cities' project?

As a part of 100 smart cities project, we intend to introduce Wi-Fi controlled CPU

controllers in our machines whereby the air conditioning of the desired areas can be remotely controlled.

What are your views on the growth of HVACR keeping in mind rising need for cooling due to global climate change?

HVAC industry needs to come out with more eco-friendly solutions of refrigerant gases and much higher efficiency compressors. We also need to look at alternate cooling solutions that are not dependent on refrigerant gases.

What are the growth drivers of your business? Which sector does generate the maximum demand for your products?

The input costs and localisation of critical components along with the infrastructure and real estate sector that adds to the growth of the business.

What are the main challenges faced in Indian HVACR industry? How do you overcome the same?

In India, it is often seen that the projects are not executed properly with the first time right concept. The focus on lifecycle cost is overlooked. Research to have a cutting edge technology and training to hone skilled manpower is not given its due importance. Proper guidelines or standards tropicalized for India seldom exists. The

consumers are opting for cheaper solutions by compromising on the quality, eco-friendliness and energy efficiency due to cost viability of the projects. We intend to conduct a series of trainings and seminars for our customers and trade partners to increase the level of awareness for the above concerns.

How many manufacturing plants do you have in India? How will the government's campaign 'Make in India' help you in expanding your manufacturing facility?

At present, we have two manufacturing plants in India. A developing country like India is known for intellectual skill set and this is attracting all investments from each and every corner of the globe. With 'Make in India' campaign we got the required boost to grow and expand. The policies and formalities to conduct operations have been eased, which has helped in faster movements and quick developments.

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

We see a growth rate of about 20% during this time.

What is your advice to potential clients?

To look for quality, eco-friendliness and efficiency level in the products made available. ■

Tools for Detecting Damp Spots & Structural Defects

Paul Sevink of Klussenbedrijf Contact relies on the FLIR MR160 imaging moisture meter and FLIR C2 compact thermal imaging camera....



Paul Sevink's handyman service, based in Soest (NL), can handle any job. Sevink sees making good use of the available technology to get the job done right as simply as a matter of professionalism and customer service. The new test and measurement equipment from FLIR, the MR160 moisture meter and C2 thermal imaging camera, have already become indispensable.

There are few jobs Paul Sevink will not take on. In addition to providing general maintenance and renovation services, Sevink also installs and maintains vacuum cleaning systems and infrared heat panels and he is a certified wood refurbishment specialist. Sevink says you can recognize a professional handyman by his tools. In his case, he really depends on them to be able to offer his wide range of services. In addition, he is also an editorial assistant

for trade journal KlusVisie, a magazine specifically aimed at handyman and maintenance companies.

Indispensable technology

'I often have the opportunity to use new tools so I can review them for KlusVisie,' said Paul Sevink. 'So I regularly have the opportunity to discover new things I can use for my handyman service too. This is how I learned about the latest



The FLIR MR160 combines a moisture meter with a thermal imaging camera, making it the first of its kind.

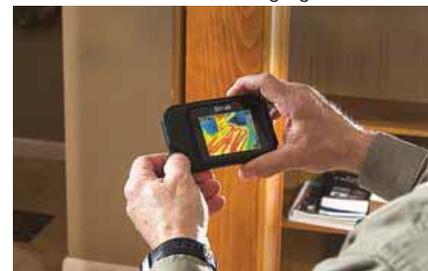
test and measurement equipment from FLIR. In the past, equipment like thermal imaging cameras were generally unattainable for most people, but today they have actually become very accessible and even indispensable.'

Sevink is referring to the continuing trend for thermal imaging technology to get ever smaller, easier to use and therefore also less expensive. And that has led to more and more handymen to add these cameras or test and measurement devices to their toolbox. Paul Sevink is completely convinced of the benefits of his latest acquisitions, namely the FLIR MR160 moisture meter with thermal imager and the pocket-sized FLIR C2 thermal imaging camera.

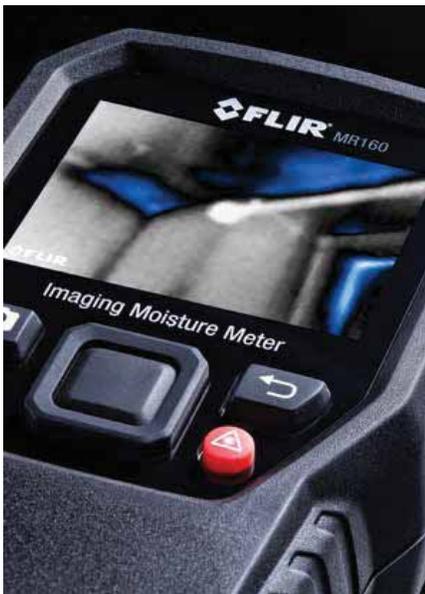
Reliable moisture measurement

Construction professionals, typically, use moisture meters that measure electrical resistance between two pins set a fixed distance apart. The lower the resistance, the higher the moisture content of the measured surface. A potential problem with the use of these devices is that it often takes a bit of searching to locate the spot where the moisture measurement should be taken. This is a problem for which the FLIR MR160 imaging moisture meter offers an excellent solution.

The FLIR MR160 combines a moisture meter with a thermal imaging camera in a



The FLIR C2 is the first pocket-sized thermal imaging camera specially designed for construction and industry.



Making use of Infrared Guided Measurement (IGM) technology, the FLIR MR160 visually guides the user to the location where reliable moisture measurements can be taken.

single unit and can clearly see where the problem must be measured. Making use of Infrared Guided Measurement (IGM) technology, the FLIR MR160 visually guides the user to the location where reliable moisture measurements can be taken. Moisture in floors or walls can then be detected and examined further with the built-in sensors.

Tracking down 'accumulated moisture'

'The FLIR MR160 served me well on a job where the laminate flooring on a landing had suddenly bulged up,' said Sevink. 'Because there was no way to get a good look without causing damage, I chose to have a leak detection performed. It turned out there was no leaking water pipe or drain. Poor caulking and grouting proved to be the cause. The FLIR MR160 showed me a pattern that appeared to indicate water was present that had not been found during the leak detection. My first thought was an 'old moisture' problem.

Accumulated moisture is moisture that wicks into a wall through a joint and is then virtually unable to evaporate because the surface is mostly covered with tiles and 3 mm thick grout. The problem with poorly sealed grout lines and/or caulked

seams only becomes apparent once the wall is saturated with water. As it turned out in this case, some tiles had also developed cracks caused by stress that built up in the wall as the moisture caused it to expand.

'After removing a few tiles at the client's request, the FLIR MR160 again confirmed my suspicion. It was clearly accumulated moisture, and not a leak. Based on this information, I could advise my client to run a construction dehumidifier for few days, after which I would replace the damaged tiles.'

Moisture Meters for Wood Renovation

Paul Sevink has also already used his FLIR MR160 for detecting moisture spots in a wooden door frame: 'Sometimes wood rot is not so easy to see with naked eye, but the MR160 gives you a clear picture of the situation, both with and without measuring pins.'

'What I really appreciate about the FLIR MR160 is that you can save and transfer your measurements and results. With the supplied FLIR Tools you can create beautiful reports that you can offer as proof to your clients, which in my case are often insurance companies. It is also handy to be able to show your client the moisture problem while on site, based on the thermal image.'

Looking For Pipes With Thermal Imager

Paul Sevink also uses the FLIR C2, the world's first full-featured, pocket-sized thermal camera specifically designed for experts in construction and industry. With this camera tucked in a pocket, users can take a thermographic recording any time. You can easily detect structural defects, find hidden heat patterns that may indicate energy loss, check underfloor heating and much more.

'After the moisture measurements with the MR160 I used also as my FLIR C2 to confirm my findings. The C2 showed me the bathroom pipes very clearly in the thermal image. Particularly, the MSX function, which displays the visual

contours as a line drawing on the thermal image, is very convenient. Everything was beautifully displayed on the thermal image. I saw no hidden do-it-yourself pipes or drains, which was very reassuring to me.'

For Paul Sevink, using FLIR cameras and measuring equipment is also a matter of saving time.

'FLIR equipment not only makes a professional impression, it also saves your time. You can use it quickly to make contactless measurements.

Devices require little explanation – you can get started with them straight away and begin taking measurements in no time – and they also fit perfectly in your pocket. So there is no reason not to always have the FLIR MR160 and FLIR C2 with you.'

Infrared Guided Measurement

Many industry and building professionals today rely on test and measurement tools for electrical and mechanical repairs, industrial plant maintenance, and HVAC troubleshooting and moisture detection. With new Infrared Guided Measurement (IGM) technology from FLIR, these jobs will become safer and a lot more productive.

Although many test and measurement products have become indispensable for today's maintenance professional, using a tool to find and pinpoint a problem quickly can be hard. Moisture and electricity problems don't always show up clearly to the naked eye, and therefore, finding the exact location of a moisture problem or electricity problem might require quite some guesswork.

IGM adds thermal imaging technology FLIR and allows maintenance professionals to work smarter and more efficiently by visually guiding them to temperature problems invisible to the naked eye. This way, IGM allows them to focus on troubleshooting and see which spot may require further testing and investigation.

IGM makes use of FLIR Lepton®, a revolutionary longwave infrared (LWIR) sensor. The portfolio of IGM featured test and measurement tools includes IGM moisture meters, clamp meters, multi-meters and spot meters. ■

New Trends in HVAC

Heating, ventilating, and air-conditioning (HVAC systems) account for 39% of the energy used in commercial buildings. Consequently, almost any business or government agency has the potential to realize significant savings by improving its control of HVAC operations and improving the efficiency of the system it uses...

Innovative technologies are taking the HVAC industry by storm. As high-tech gadgets and the latest innovations continue to improve our lives, revolutionary HVAC technologies that could change how we heat and cool our homes, offices, industries etc. Many of these HVAC technologies are still on the drawing board,

but there are some you can take advantage of now to boost your ambient comfort levels. From smart watches and Google glasses to 3D printing and 4K televisions, the world has seen many technological advances over the last decade. The HVAC industry has been hard at work too, developing new functions, features and

systems designed to improve your indoor comfort while slashing energy expenses to a minimum. Whether you need a heating or air conditioning replacement or you want to upgrade an outdated system, investing in a new HVAC installation gives you the opportunity to take advantage of the latest and greatest high-tech advancements.

Heating, ventilating, and air-conditioning (HVAC systems) account for 39% of the energy used in commercial buildings. Consequently, almost any business or government agency has the potential to realize significant savings by improving its control of HVAC operations and improving the efficiency of the system it uses.

Airports are one of the major energy consuming sectors for HVAC. Every one



degree of temperature setting results in saving of 3% in energy consumption.

The use of high performance HVAC equipment can result in considerable energy, emissions, and cost savings (10%–40%). Whole building design coupled with an "extended comfort zone" can produce much greater savings (40%–70%). Extended comfort includes employing concepts such as providing warmer, but drier air using desiccant dehumidification in summer, or cooler air with warmer windows and warmer walls in winter. In addition, high-performance HVAC can provide increased user thermal comfort, and contribute to improved indoor environmental quality (IEQ).

Movement-Activated Air Conditioning

The modern technologies have come up with a new air conditioning design that utilizes sensors along Aluminum rods hung from the ceiling. Movement then activates these sensors. In other words, the air conditioner only kicks on when people are present.

A motion-activated (PIR) system seems like such a simple, ingenious idea that it's almost baffling it hasn't been tried before now. However, this kind of prototype is just one example of how future HVAC systems are going to be more compact and portable, helping to reduce both energy and utility costs.

Thermally Driven Air Conditioning

Another design that's recently been implemented is thermally driven air conditioning. An Australian company named Chromasun has produced a low-cost alternative to traditional A/C units. It isn't a widespread technology yet, and it will likely be several years before this kind of design becomes widely available in the United States. However, thermally driven air conditioning is a system that uses solar energy and is supplemented by natural gas, making it a highly efficient and effective system.

In fact, the double-chiller design provides more cooling capabilities than

any other system so far, and it eliminates electricity costs altogether.

On-Demand Hot Water Re-circulator

A US-based company out of Rhode Island has designed an "on command" pump for a home's water lines, which allows cool water to be circulated back into the water heater upon activation.

This product was engineered to be a solution to a major problem to which all of us contribute: Each year, the average home wastes 12,000 gallons of water just waiting for that water to warm up. Re-circulating this otherwise-wasted water back into the system is an eco-friendly solution that's bound to play a huge part in future homes.

Ice-Powered Air Conditioning

Air conditioners seem to be prime systems for tweaking and making better. That's why MERC has encouraged an ice-powered A/C system called the Ice Banking. The Ice Banking essentially works by freezing water in a tank overnight during off peak hours of the electrical energy demand, so the ice can help cool a building the next day. So far, the design has been able to provide enough cooling which offset appreciable part of conventional cooling load of the peak

demand during peak electricity demand hours i.e. office hours. An article has been contributed by me in earlier issues of Cooling India with actual case study.

Sensor-Enhanced Ventilation

Each year, several products debut at technology expos all across the country, and 2015 was the year of the Ecovent. This ingenious product consists of sensor-driven vents that replace a home's existing ceiling, wall, or floor vents. The best part? A smartphone app can control the Ecovent, providing precise, room-by-room temperature control.

Additionally, the system utilizes sensors to monitor a home's temperature, air pressure, and other indoor air quality factors. Even though this system design is brand new, it's been well tested and has already hit the market. Therefore, this is one piece of technology you can take advantage of today.

Dual-Fuel Heat Pumps

Another US-based company has come up with the dual-fuel heat pump concept. The argument is that heat pumps tend to be more efficient and provide the maximum amount of comfort when using a combination of fuel. In this case, the system is a combination of an electric heat pump and a gas furnace.



At low temperatures, the pump draws on gas heat to maximize efficiency. When the temperature rises above 35 degrees, electricity takes over. The initial costs associated with a dual-fuel heat pump are more than a conventional system, but the amount of money you can potentially save over the next several years more than makes up for the costs.

Geothermal Heat Pumps

Along those same lines, geothermal technology is a major investment that promises to save you much money over its lifetime. Geothermal heat pumps have been around since the 1940s, so they're not exactly a new technology. Nevertheless, these products haven't really caught on until recently.

With more homeowners waking up to the importance of going green, geothermal heat pumps have grown in popularity. A geothermal heat pump gets its energy directly from the earth through an underground looped pipe that absorbs the heat and carries it into the home. When cooling is needed, the process occurs in reverse, with the pump removing warmth in the home. A major bonus of having a geothermal heat pump is the availability of free hot water. Therefore, if you're considering having geothermal technology installed in your home, ask your technician about this valuable perk.

Smart Homes

Everything is getting smarter these days. From the cars we drive to the televisions we watch, just about every piece of tech you can imagine has been outfitted with smart technology. It's only natural, then, that our homes would be next.

Connected systems and phone apps now allow us to control our home's lighting, heating, cooling, security systems, surveillance, and entertainment at the push of a virtual button. It's a no-brainer that these "smart" technologies will continue to evolve and become integrated into our homes, allowing us to control a home's comfort levels down to the last detail. Since many of these innovations are already available on the

market, this movement toward a smarter home has changed how HVAC engineers and designers approach the next big thing, which is good news for those of us who appreciate high-tech solutions.

Fully Automated Homes

As if owning a smart home wasn't convenient enough, fully automated homes will soon become a reality. There are already technological solutions on the market that are allowing companies to experiment with automated appliances and other products. Therefore, it's only natural that HVAC systems will one day be directly tied into other systems in your home, making adjustments according to the status of the rest of the house.

3-D Printed Air Conditioners

It may seem a little far-fetched, but 3-D printing has advanced rapidly over the last few years, so expecting products like 3-D printed A/C systems could very well be a reality one day.

In fact, a company called Emerging Objects has already created a 3-D printed "brick" that draws moisture out of an area to cool it. While this simple innovation can't be used in extreme temperatures, and we're still a far cry from 3-D printed air conditioners, it's just one example of the power of such a simple technology. We never know what tomorrow may bring.

Harnessing Heat from a Computer

If you own a laptop and have ever used it for several hours in one setting, you know how much heat it begins to generate. One innovator named Lawrence Orsini, founder of Project Exergy, has seen how efficient computers are at generating heat. This is why he's theorised they can be used for powering heating systems.

Consider this: How many times have you thought of how great it would be if you had to use your stationary bike or treadmill to power your television? It may not be a serious thought, but it's something almost everyone has considered at one time or another. Harnessing heat from a product you already use every day draws upon the same principle. At the end of the day, why

waste all that excess energy when you don't have to?

It's fun to speculate about the future of HVAC technology, but only time will tell which systems will make the cut and catch on with most homeowners. If you're interested to learn which high-tech systems are available now, contact Bill Joplin's Air Conditioning & Heating at 888-414-4655.

Say 'solar energy' and most people instantly think of those large panels that go on the tops of homes or vast structural arrays outside of buildings that are designed to collect the rays of the sun. The chemistry, engineering and nanotechnologies behind these materials and systems often play an important part in their cost, availability, and effectiveness — something many of the individuals on this list of solar and renewable energy instructors already know about. This is a driving factor in looking for more effective solutions, processes and materials, and in disseminating any new found knowledge through instruction, shared research, or publication — so that others can make advances.

Nanotechnology, by the way, is an examination of materials or science on a very small scale, including through atoms and molecules. That said, there are many different manifestations of green energy systems and sustainable energy, whether that's HVAC, solar, wind power or something else unique. This list examines that broad range, hitting on instructors who are involved in research, but also others who engage in hands-on teaching and/or work with students through energy laboratories and institutes. Many have a degree in engineering, but others work in related science fields, such as chemistry. This just goes to show there are many facets to renewable energy careers and that's true whether you are looking at a start though an associate-degree level program (with HVAC as a possibility) or seek to advance your knowledge through upper-level education.

When it comes to heating and air conditioning in the home, advancements within the components themselves are

making units more energy efficient than ever. HVAC systems are increasingly communicating between the indoor and outdoor controls while also reducing heat loss and maximizing dehumidifying processes. The systems also run quieter and are easier to use with touch screen, programmable thermostats with multiple settings.

While there are some definitive changes in the HVAC components and controls themselves, some external technologies are also helping to take that efficiency to even another level. A driving force behind these advances are the ever-expanding capabilities of smartphones, allowing users to basically control and monitor their home or business from anywhere in the world.

The driving forces behind these technological advancements are 1) improving efficiency or reducing utility bills, 2) lessening the strain on both the grid and the environment, and 3) increasing the comfort of rooms in a home or building. What's making this possible is the fact that interconnection is at an all-time high between both people and machines and only improving on basically a daily basis.

Perhaps the best example of how HVAC technologies are changing the game is NEST and its Learning Thermostat. In short, the NEST Learning Thermostat is almost like a virtual butler as it educates itself on what temperatures you like and automatically adjusts the room to those settings based on time of day and occupancy. NEST turns itself off when you leave the room and is controllable via Wi-Fi which means you can perform tasks like warming up the bathroom before heading in for a morning shower — if NEST hasn't already done so.

While NEST is a remarkable advancement, the concept of a programmable or even teachable thermostat isn't necessarily new. That should change in the near future since Google purchased NEST for \$3.2 billion and will only continue to improve on these technologies. That being said there are numerous other HVAC concepts that are a

reality now or will be sooner than imagined.

Utility Sales

One thing that NEST incorporates that will benefit the function of all grid members is the ability to remotely shut off during peak demand. This program is already somewhat existent with 'demand pricing' in which utility companies offer lower rates for those customers who can manage their electricity usage when demand is at the highest. On very hot summer days, for example, there is only so much energy to go around, so those customers who 'help out' the utility company by temporarily turning off their air conditioning get a kickback with lower overall rates. The problem is not knowing when the peak demand starts or if the temperature is hot enough to be considered such a situation. Technology will make this process more automated, offering notifications or even automatic shutdown of utilities as local demand rises.

Self Diagnostics

For the most part, consumers are at the mercy of HVAC technicians when their air conditioner or furnace goes out. In some cases, this can be a harrowing time especially in extreme hot/cold temperatures or when the repair company is experiencing a backlog of calls. The ability for HVAC components to self-diagnose and repair much like a computer could be a game-changer to get consumers heat or air back online. While repair personnel may worry about their jobs being nonexistent, those technologies could go to a next level and send them a notification when their clients are experiencing issues — after all, somebody still has to perform parts replacements.

Variable Refrigerant Flow

One of the biggest energy losses occurs when an entire house is being warmed or cooled and only one room calls for the HVAC system to kick in. A great example is a home that sits in the shade on one end and in the direct glare of the sun on the other side. Variable refrigerant flow (VRF) allows users to simultaneously heat and cool different parts of the building

to various temperatures while maintaining energy efficiency.

These innovations are only the tip of the iceberg when it comes to the changing face of HVAC technologies. Eventually, smartphones will be even more connected with the furnace and air conditioner with more zoned heating and cooling options and even further control if that's possible. Repairs may soon be electronically guided by the system itself as the smart home becomes more and more abundant.

Either way what this means is that ratty old furnace that barks and squeals for three minutes before starting up will soon be a thing of the past.

HVAC technology is constantly changing due to new discoveries and influences outside the industry. As recently as this century, central, indoor climate control was available to only a privileged few. Today, even central air-conditioning in homes is common in the US. Improvements occurred through a number of factors such as technical, market changes, energy and environmental concerns, and political decisions. Changes continue to occur and they benefit of our customers and are our part of our future.

Environment

The environment has possibly had more influence on HVAC technology than has energy. The environment will continue to impact the industry into the foreseeable future. Policies regarding climate change have also directly impacted our industry. As we design and operate more energy-efficient equipment and systems, we use less energy, energy that in many cases comes from burning CO₂-producing fossil fuels. The environment will continue to impact the industry. The industry has proven that it can respond in a timely way. As new environmentally friendly products are developed, those products are also more energy efficient. Adopting new technologies and supporting research will help our industry meet the challenges of the future.

User-Friendly Controls

While smart, Wi-Fi-connected thermostats promise significantly

increased energy efficiency, the real draw for homeowners seems to be how easy the interfaces are to operate. Take the Nest Learning thermostat, for example. It is programmed by the user to remember his preferred temperature settings. If the user prefers the thermostat to kick in a faster, warmer temperature, on cold, wintery mornings, the Nest thermostat will store that information and adjust the temperature accordingly. The thermostat also monitors temperature with humidity and activity sensors, and it can determine regional climate by the user punching in their zip code. Wireless-controlled thermostats present HVAC data in a language that contemporary consumers understand. Homeowners are accustomed to easily digestible, visual representations of information and data. The reporting tools that smart systems include take the mystery and obscurity out of an industry that has been thriving on overall complacency from its customers.

DEVap Air Conditioning

The National Renewable Energy Laboratory (NREL) developed the DEVap (desiccant-enhanced evaporative air conditioner) in 2011 and estimates that it reduces air conditioning energy usage by 40-90 percent. So far, DEVap is found primarily in commercial buildings, and the technology is so new that it's difficult to find for residential use. But, given how promising the innovation seems, and how cost-effective it has already proven to be, and is anticipated great gains in the future.

Zero Energy Buildings

Zero-energy buildings that produce energy instead of just using large quantities will gain traction with companies that target eco-friendly employees and consumers. Many businesses are already headed in this direction with geothermal heating and cooling, solar-powered systems, and white roofing. If HVAC manufacturers can work to design structures that are both energy efficient and comfortable for their residents, we're sure to see some fresh companies take on the challenge.

Variable Refrigerant Flow Systems

A popular trend in Eastern markets, variable refrigerant flow (VRF) is the future of the HVAC industry. Though US market have yet to reach the demand experienced abroad, VRF systems are establishing their place as in-demand items for housing and commercial cooling needs. Simple and elegant in design, VRF systems connect an outside condensing unit to several fan coil units throughout the building. Each coil and evaporator in the system can be controlled individually to reduce waste from over-allocated resources. The shift will stimulate job growth and overall economic development throughout the HVAC sector that will continue well into the coming years.

Career Trends

Current industry trends indicate a future growth rate of nearly 28% nationwide. This trend is predicted to continue until 2018, a total period of researching and studying 10-year industry trends beginning in 2008. Studies have revealed that once the results of that research and those studies are complete, there will be nearly 395,000 individuals who make their living in the HVAC industry, and choose to make this their lifelong career choice. The rate of change in our industry will be exponential. Some changes will be caused by improvements in technology whereas others will be the result of influences outside our immediate control. As engineers, we have an obligation to be proactive in encouraging changes that are of benefit to the society we serve. This in turn will have direct benefit to our industry and to each of us individually.

Geothermal Heat Pumps

No matter how low the thermometer dips in Fredericksburg and the surrounding communities during the winter, the temperature beneath the earth's surface remains consistently warm. Geothermal heat pumps tap into that reliable source of heat to move comforting warmth into your home in cold weather and transfer heat out

during the summer. While they cost more to install than other types of heating and cooling options, the savings they offer is substantial. Operating costs can be up to 70 percent lower than conventional systems.

Radiant Floor Heating

Radiant flooring systems take advantage of a simple law of physics: heat rises. By embedding electric wires or loops of pipes circulating warm liquid beneath your flooring, you get comforting warmth from the ground up. Instead of heating your home with hot air, the system generates radiant heat, effectively eliminating uncomfortable swings in temperature. Depending on your home's level of insulation, radiant flooring can be up to 30 percent more energy efficient than forced-air heating systems.

Ductless HVAC Systems

Most HVAC systems supply conditioned air through a hidden maze of ductwork, but ducted systems aren't your only option when you're on the hunt for a heating or air conditioning replacement or new HVAC installation. Ductless systems use point-of-use air handlers to deliver conditioned air directly into individual rooms or zones, and they run at up to 40 percent better efficiency than central heating and cooling systems as well. Installation is simple and non-intrusive. The only alterations made to your home are small holes drilled behind the air handlers to connect them to the outdoor unit.

High-Tech Features and Functions

From traditional systems to unconventional alternatives, the best of today's modern HVAC systems come loaded with features engineered to save you money and enhance your comfort:

- Scroll Compressors Instead of conventional piston-driven compressors, many heat pumps and air conditioners now feature scroll compressors that pressurize refrigerant faster using less energy. One spiral-shaped scroll remains stationary while

a twin scroll revolves around it. Scroll compressors not only last longer than their piston counterparts but operate more quietly too.

- Variable-Speed Motors HVAC systems equipped with variable-speed fan motors automatically adjust air flow according to your comfort needs, blowing air more slowly when heating or cooling demands are low. The result is an even delivery of air that reduces temperature swings in your home. The systems use less energy too, allowing you to keep more of your hard-earned dollars in your pocket.
- Dual-Heat Exchangers Heat exchangers are the components in furnaces and boilers that extract heat from the burning fuel. Modern condensing heaters have a second heat exchanger that condenses the water vapor found in exhaust gases to capture additional heat. This allows them to use less fuel without compromising your comfort.
- Smart Controls Sensors in advanced HVAC equipment allow the system to

monitor everything from the temperature and air flow in a room to its humidity level. They can work as communicating centers too, notifying you when you need a heating repair or air conditioning maintenance. Some systems even have Wi-Fi, so you can adjust or program settings from your computer, smart phone or tablet.

Summary

Building Management Systems and air-conditioning controls systems will develop to become:

- Intelligent self-learning systems that measure the performance characteristics for the building and its systems for different ambient and occupancy conditions and using thermal modelling technology are able to operate the buildings systems to provide the required conditions whilst minimizing energy consumption and plant wear and tear.
- Self-checking systems that are able to eliminate the fly by wire problems that

many systems suffer from, which the head end computer is thinking one thing is happening, however, in the field the actuality is very different.

- Self-diagnosing systems that are able to determine fault conditions analyses the cause and report or even rectify the condition, systems that are able to recognize fault situations that are resulting in excess energy consumption or unacceptable equipment wear and report.
- Systems with seamless remote access, diagnosis and control functionality.

Systems with the flexibility to take advantage of wireless technology and the onboard intelligence that is already starting to be installed in items of central plant. ■

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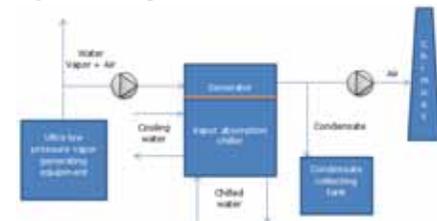
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 Air Curtains
 Laminar Flow Bench
 Clean Rooms
 Air Shower
 Fan Filter Units
 Air Cooling
 Air Filters
 Pass Box

Water Vapor Driven Vapor Absorption Machine

Ultra-low pressure water vapor can be utilized as a heat source to drive the vapor absorption chiller for catering to the chilling requirement...



Cycle diagram



Applications

Food Processing Industries

(Potato / Noodles / Savories Fryer)

Potato contains around 75% moisture so when they are fried the moisture is released in the form of vapor. The frying process being atmospheric, the water vapor leaves the fryer as a mixture with air and also has trace quantities of the entrained frying oil. These vapors are then simply taken to the chimney and vented out to the atmosphere. This leads to loss of not only valuable energy but also water.

These water vapors are now taken to vapor absorption chiller by blower and used as a heat source to cater chilling requirement.

Textile Industries

Continuous polymerization (CP) is a process which is used to produce polyester. The raw material used here is Terephthalic acid & Mono Ethylene Glycol which is continuously fed to the reactor and the polymer is continuously removed. During this process, high temperature water vapors are generated during the heating process of polymers along with some organic solvent. Normally, the vapors which are coming out of Process Column are condensed by an Air/Water cooled condenser. Here, we can provide ultra low pressure vapor absorption chiller to recover these water vapors instead of air or water cooled condenser. Hence, we can produce chilling for air conditioning and also reduce power requirements for

Generally in Food and Beverage processing and some other industries, water vapor is generated (at just above the atmospheric pressure) and vented to the atmosphere as waste. This ultra-low pressure water vapor can be utilized as a heat source to drive the vapor absorption chiller for catering to the chilling requirement.

Since these processes are mostly exposed to atmosphere, the mixture of

water vapor and air (non-condensable gases) are coming inside generator tubes (heating portion of machine) and condense. This non-condensable gas plays crucial role in the system for achieving the capacity. We have a well-developed system for removing the non-condensable gases from the chiller. Condensed water is transferred back to the process for re-circulation.



condenser and electrical chiller.

Refineries & Petrochemicals Industries

In Refineries and Petrochemicals Industries, CO₂ is let out along with high temperature water vapor. Ultra low pressure vapor absorption chiller can fit exactly for this kind of application also to recover the waste heat (water vapor along with CO₂ gas).

Advantages

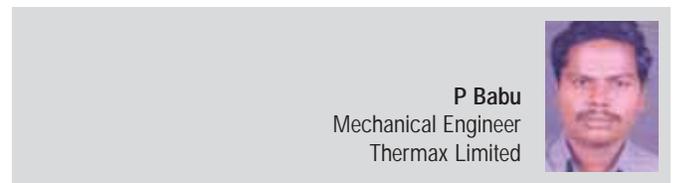
- Reduction in power saving for replacing electrical chillers
- Reduction in CO₂ emission for replacing electrical chillers
- Utilization of water vapor to cater chilling requirement
- Condensate recovery water can be re-circulated for process

Case Study

A typical case for supplying absorption chiller for air-

conditioning application utilizing the waste heat in the form of potato fryer vapours is as how below:

S. No.	Description	Units	Data
1	Cooling capacity	TR	500
2	Chilled water inlet / outlet temperature	°C	12 / 7
3	Heat Source	-	Water vapor from Potato Fryer
4	Water vapor generation	kg/hr	4000
5	Power savings for replacing Electrical chiller	MW / Annum	1900
6	Reduction in CO ₂ emission	Tons / Annum	4000
7	Amount of Condensate water savings	m3 / Annum	28000



Cut Cooling Cost up to 99%

Harness **waste heat** from DG set jacket water to produce **chilled water** for low cost process cooling and air-conditioning.....

Arg-Air Adsorption Chiller

The magical link between waste heat and chilled water

- Harnesses waste heat for energy-efficient cooling
- Results in up to 99% reduction in electricity cost for chilling
- Environment friendly, with ultra-low energy consumption
- Life expectancy: Over 20 years
- Noise-free operation with minimal maintenance
- Almost no moving parts

ARG-AIR (ASIA) PVT. LTD.
INDIAN & FOREIGN CEMENTS

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Hot water in 80°C to 180°C Chilled water out 5°C to 10°C

LIFE EXPECTANCY

ARG-AIR GROUP
(Established in 1986)

REFRIGERANTS

Past, Present & Future

Refrigerant development throughout the history, took place due to different reasons, such as safety, stability, durability, economic or environmental issues, thus giving rise to new research and equipment improvement in terms of safety and efficiency. The refrigerants can be classified into different generations...

Refrigeration is an old technology that started a long time ago. Refrigeration is the process of removing heat from an enclosed space or from a substance in order to maintain a lower temperature than the surroundings. Before 1830, food preservation methods like salting, spicing, smoking, pickling and drying existed. Evaporative cooling was practised in India and Egypt. It was discovered that adding chemicals like sodium nitrate or potassium nitrate to water caused the temperature to fall. Before

mechanical refrigeration systems were introduced, people cooled their food with ice transported from the mountains, and ice was stored by using snow cellars, pits that were dug into the ground and insulated with wood and straw. Refrigeration using stored ice was the important method until the beginning of the 20th century.

Refrigerants

Refrigerants are the working medium used in refrigerating systems which

evaporates by taking the heat from the space that is to be cooled, thus producing the cooling effect. Refrigerant development throughout the history, took place due to different reasons, such as safety, stability, durability, economic or environmental issues, thus giving rise to new research and equipment improvement in terms of safety and efficiency. The refrigerants can be classified into different generations. Different generations of refrigerants and their behaviours have been shown in figure 1.

First Generation Refrigerants

Beginnings of mechanical refrigeration, starting from early 19th century were characterized by use of natural refrigerants. Water and air were the first refrigerants considered for use in mechanical refrigeration systems. Refrigerators that were built in the late 1800s to 1929 used the first generation refrigerants like methyl chloride, ammonia and sulphur dioxide. The common refrigerants for the first hundred years included whatever worked and whatever was available. Nearly all the



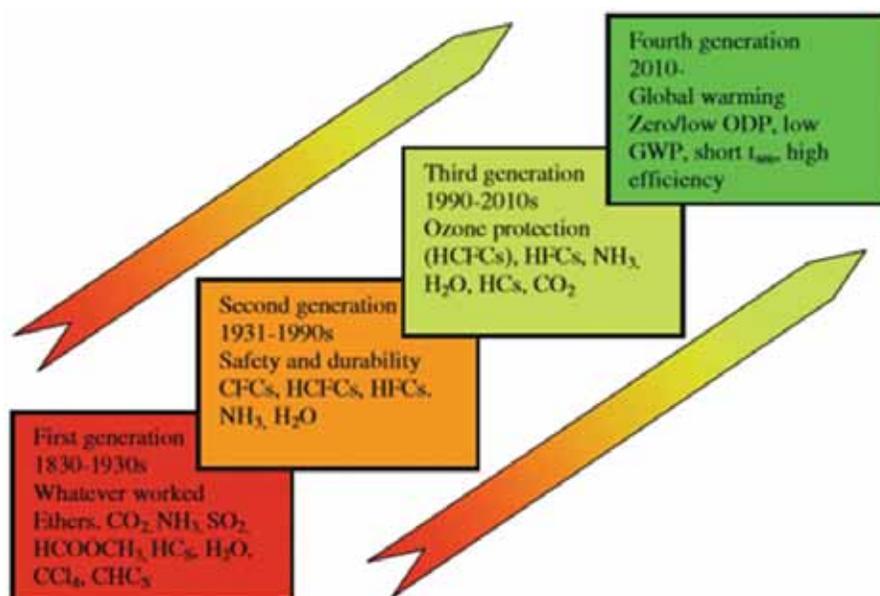


Figure 1: Different Generations of Refrigerants

first generation refrigerants were flammable, toxic or both and some were also highly reactive. The characteristics of some of the first generation refrigerants are discussed below.

Water

Water is one of the oldest refrigerants being used for refrigeration applications down to about the freezing of water. When water is coupled with protective solutions to prevent freezing (i.e. propylene or ethylene glycol), it can be used well below water's normal freezing point in applications such as ice slurries. Water is easily available and has excellent thermodynamic and chemical properties. Besides these advantages, there are technical challenges that result from its high specific volume at low temperatures. These challenges include high pressure

ratio across the compressor and high compressor outlet temperatures.

Ammonia

It is denoted as R717 and is also a very old refrigerant used in vapour compression and absorption refrigeration systems. The advantages of R717 are that they have a lower molecular weight, wide range of working temperature because of its high critical point, high latent heat of vapourization and easy leak detection. However, R717 also has some disadvantages. It is highly toxic, highly irritating and flammable. Ammonia has high affinity to water, thus it is difficult to keep ammonia dry. When it contains water, it is corrosive to copper and most copper alloys. At high discharge temperatures generated by ammonia, it has the tendency to dissociate giving nitrogen and hydrogen.

When these gases enter condenser, their pressures are added to the condensing pressure, thereby, increasing total pressure head and power consumption.

Sulphur Dioxide

Sulphur dioxide is one of the most used refrigerants in 1920s and 1930s, having been replaced first by methyl chloride and later by more desirable fluorocarbon refrigerants. It is highly toxic but non-explosive and non-flammable. It is non-corrosive in pure state but when it combines with moisture it forms sulphurous acids and sulphuric acids which are highly corrosive.

Methyl Chloride

Methyl chloride was first used in 1878. Methyl chloride is a colourless extremely flammable gas with a mildly sweet odour. Methyl chloride is a halocarbon of the methane series and it has many of the properties desirable in a refrigerant, which accounts for its wide use in the past in both domestic and commercial applications. Methyl chloride is corrosive to aluminium, zinc, magnesium and the compounds formed in combinations with these materials. In the presence of moisture, methyl chloride forms a weak hydrochloric acid, which is corrosive to both ferrous and non-ferrous metals. It is also explosive. There were numerous fatal accidents that occurred in the 1920s when methyl chloride leaked out of refrigerators. This has led to the discovery of the next generation refrigerants. Few first generation refrigerant and their properties have been shown in table 1.

Table 1: Properties of first generation refrigerants

Substance	R Number	Chemical formula	M (kg/kmol)	NBP (oC)	CRT (oC)	CRP (bar)	Safety group	ODP	GWP
Carbon dioxide	R-744	CO ₂	44.01	-55.6	31.6	73.77	A1	0	1
Ammonia	R-717	NH ₃	17.03	-33.3	132.25	113.33	B2	0	0
Sulphur dioxide	R-764	SO ₂	64.06	-10.0	157.49	78.84	B1	0	0
Ethyl ether	R-610	C ₄ H ₁₀ O	74.12	35	194.0	36	-	0	0
Dimethyl ether	R-170	C ₂ H ₆ O	46.07	-25	126.9	53.7	A3	0	0
Methyl chloride	R-40	CH ₃ Cl	50.49	-24.2	143.1	66.77	B2	0.02	16

R Number: Refrigerant Number, M: Molecular Mass, NBP: Normal Boiling Point, CRT: Critical Temperature, CRP: Critical Pressure, ODP: Ozone Depletion Potential, GWP: Global Warming Potential.

Table 2: Properties of second generation refrigerants

Substance	R Number	M Kg/kmol	NBP (°C)	CRT (°C)	CRP Bar	Safety Group	ODP	GWP
Trichlorofluoromethane	R-11	137.4	23.71	197.96	44.1	A1	1	4000
Dichlorodifluoromethane	R-12	120.91	-29.75	111.97	41.4	A1	1	8500
Chlorotrifluoromthane	R-13	104.5	-81.3	29.2	39.2	A1	1	11700
Chlorodifluoromethane	R-22	86.47	-40.8	96.15	49.9	A1	0.055	1700
R-22/R115	R-502	111.6	-45.3	80.73	40.2	A1	0.33	5600

Second Generation Refrigerants

The second generation refrigerants were distinguished by a shift to chlorofluoro chemicals for safety and durability. Thomas Midgley and his associates studied the property tables of elements of periodic table. They disregarded compounds that are unstable, toxic, yielding insufficient volatility and inert gases based on their low boiling point. In 1928, Midgley and his colleagues made critical observations regarding flammability and toxicity of compounds containing elements like carbon, nitrogen, oxygen, sulphur, hydrogen, fluorine, chlorine and bromine. Their first publication was on fluorochloro refrigerants and it showed how the variation of chlorination and fluorination of hydrocarbons influences boiling point, flammability and toxicity of the refrigerants. Thus CFC refrigerants made the second generation of refrigerants. CFC is a non-toxic, non-flammable gas with relatively high mass. It is a good refrigerant because it can be compressed easily to liquid and carries away lots of heat when it evaporates. It is very stable that only UV rays can break it down. In fact, it's well suited to a variety of applications because it doesn't react with anything; it works well as a solvent, a blowing agent, a fire extinguishing agent and an aerosol propellant. Because it is a single

molecule, not a mixture, it doesn't separate out at different pressures or temperatures. Some of the refrigerants of this generation are presented here along with their thermodynamic properties and applications.

R-11

R-11 is considered to be safe refrigerant as it is non-flammable and non-explosive. It is used in the applications like air conditioning of small buildings, factories, departmental stores, theatres etc. It can be used in the applications where the refrigeration load ranges from 150 to 2000 tons along with the centrifugal compressor. R-11 refrigerant is also used as the solvent and the secondary refrigerant. The problems that have restricted the use of this refrigerant are low operating pressures and high potential to deplete ozone layer. Since R11 has highest potential to cause the depletion of ozone layer, as per the Montreal Protocol, its use and production had to be stopped completely. R-11 is now being replaced by other environment friendly refrigerants, of which the most common is R-123.

R-12

R-12 is a highly versatile refrigerant that is used for wide range of refrigeration and air conditioning applications. Refrigerant R12 is used in domestic

refrigerators and freezers, liquid chillers, dehumidifiers, ice makers, water coolers, water fountains and transport refrigeration. R12 is non-toxic, non-flammable, and non-explosive. This makes it highly popular for the domestic as well as the commercial applications. R12 is highly stable CFC and it does not disintegrate even under the extreme operating conditions. It is suitable for wide range of operating conditions. Unfortunately, it is the CFC and it has unusually high potential to cause the depletion of the ozone layer. R12 is being replaced by other refrigerants and some of the suggested replacements for R12 are: R-134a, R-401a, R-401b.

In the 1970s, after decades of dumping about a million tons of the stuff into the air each year, scientists learned that CFC isn't harmless after all. In 1973 Prof James Lovelock discovered Freon to be harmful to the ozone layer. The CFC molecules are destroyed by the sun's ultraviolet rays in the stratosphere. When the chemical bonds are broken, the chlorine atoms drift free, and they become a catalyst that breaks unstable ozone molecules (O₃) into oxygen molecules (O₂). The chlorine is not consumed in the reaction, so it continues ruining ozone for years. This is a big deal, because stratospheric ozone is the shield that protects all living things on the planet

Table 3: Properties of third generation refrigerants

R number	M Kg/kmol	NBP (°C)	CT (°C)	CP Bar	Temp. glide (°C)	Safety Group	GWP
R-32	-52.02	-51.65	78.11	57.8	0	A2L1	580
R-134A	102.03	-26.07	101.06	40.6	0	A1	1300
R-404A	97.6	-46.6	72.14	37.4	0.46	A1	3800
R-407C	86.2	-43.8	86.05	46.3	5.59	A1	1600
R-410A	72.59	-51.6	70.17	47.7	0.1	A1	1900
R-507	98.86	-47.1	70.75	37.2	0	A1	4000
R-508A	100.1	-87.4	11.01	37.0	0	A1	13000

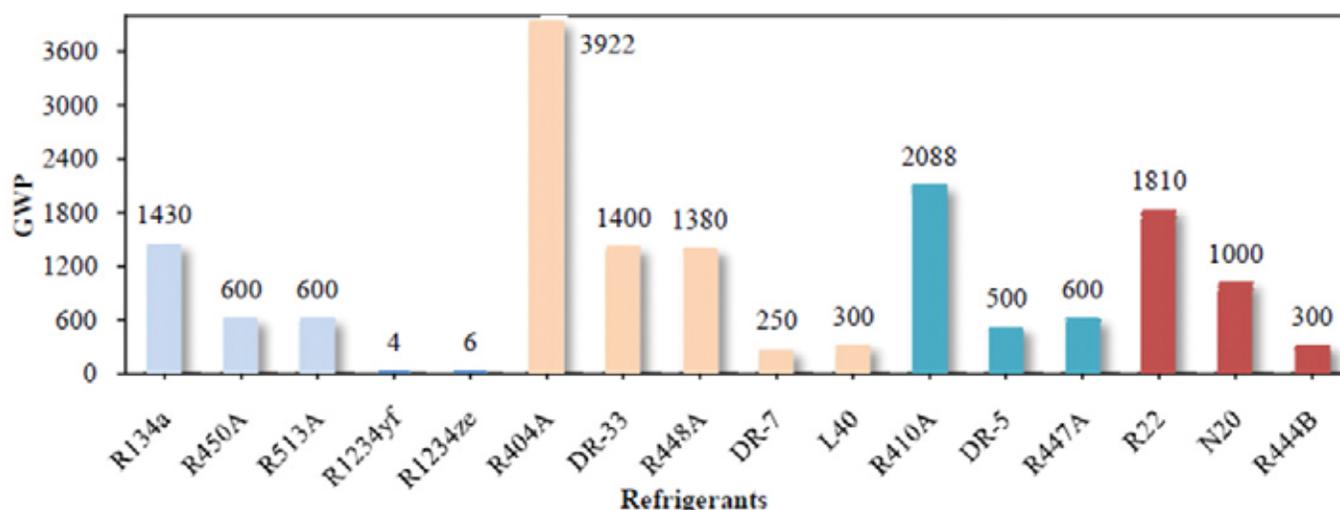


Figure 2: Representation of GWP for various refrigerants

from the Sun's ultraviolet radiation. In 1987, the Montreal Protocol limits the production and consumption of CFCs. January 2010 marked the end of global production of CFCs under the Protocol. In 2009 the Montreal Protocol was universally ratified by 196 nations. Few second generation refrigerant and their properties has been shown in table 2.

Third Generation Refrigerants

The third generation refrigerants based on hydro chlorofluorocarbon (HCFC) and hydro fluorocarbon (HFC) have been developed to replace second generation refrigerants. These offer most of the same advantages as CFC without damaging the Earth's ozone shield, but they were developed before the environmental impact of fluorine was fully understood. This impact has been termed as Global Warming Potential (GWP). Roland and Molina predicted that emissions of HFCs could damage Earth's atmosphere by the catalytic destruction of ozone in the stratosphere. The hypothesis has been proven in 1985 by measurements which have shown the destruction of the ozone layer over Antarctica. Therefore, HCFC and HFC gasses are on a schedule to be phased out by 2030. Properties of different third generation refrigerants are listed in table 3.

Another new class of fluorocarbon refrigerants called hydrofluoro-olefin (HFO) with potential for reduced GWP have been developed. Their primary advantage, other

than their low GWP, is that they can be used with existing refrigeration system designs. This is good for the industry and their customers, but it is still a fluorinated gas. There is growing political pressure to regulate it out of production and force the industry to develop an even lower-impact refrigeration technology. So the search continues. Various hydrofluoro-olefins are R-1234yf (2,3,3,3-tetrafluoropropene), R-1234ze(E) and (Z) (1,3,3,3-tetrafluoropropene), R-1233zd(E) and (Z) (1-chloro,3,3,3-trifluoropropene), R-1243zf (3,3,3-trifluoropropene). Figure 2 represents GWP values of some third generation refrigerants.

Natural Refrigerants

Natural refrigerants are easily available, and long experience exists with their application dating far into the beginning of mechanical refrigeration. Many new refrigerants have come into picture to overcome the disadvantages of using natural refrigerants but the "circle" is now somehow closed as we already returned to natural refrigerants, but now with new technologies and with a lot of experience behind us. Natural refrigerants divide conveniently into hydrocarbons, ammonia and CO₂ and have been discussed here.

Hydrocarbons

The dominant characteristic of the hydrocarbon refrigerants is their high flammability. Provided precautions are taken to mitigate the consequences of

their flammability, hydrocarbons make excellent refrigerants in practice. They are miscible with mineral oils and have relatively high critical temperatures.

Propane (R290) and propylene (R1270) have normal boiling points below -40°C and are, therefore, suitable for general refrigeration applications. Butane (R600) and isobutane (R600a) have much higher boiling points but they also have high critical temperatures, which tends to make them very efficient in operation. The greatest success of hydrocarbons has been in the application of R600a to domestic refrigerators.

Propane and blends containing propane could safely be used in window air conditioners provided appropriate precautions were taken and provided they were used in fully sealed systems. Propane could also be used, with an acceptable degree of risk, for car air conditioning, again provided that appropriate precautions were taken. R1270 is a refrigerant similar in performance to propane but much more expensive and therefore unlikely to find general favour. Hydrocarbons would not appear attractive for large-scale air conditioning applications but they will certainly appear as a refrigerant for window air conditioners of low charge.

Carbon Dioxide

Carbon dioxide is present in the atmosphere and it is non-flammable and non-toxic. Despite the high pressures associated with its use, carbon dioxide

has been used as a refrigerant since 1862. It is odourless, non-toxic, non-flammable, non-explosive and non-corrosive. Carbon dioxide continued to be in use in marine refrigeration as a non-toxic alternative to ammonia and to methyl chloride. However, the advent of halocarbons in the 1930s led to the abandonment of the much less efficient carbon dioxide, which finally went out of use in the 1950s. The reason for poor efficiencies obtained when using carbon dioxide as a refrigerant is that it has a low critical temperature. There are several ways in which this defect can be overcome. As a result of modern methods and developments, carbon dioxide is coming back into use as a refrigerant in systems which have efficiencies at least as great as the efficiencies of halocarbon and ammonia systems. It is an ideal refrigerant. If properly applied it is very efficient to use.

Desirable Properties Of New Refrigerants

Careful selection of refrigerant has significant impacts on the safety, reliability

and energy consumption of the system. A refrigerant must satisfy a number of requirements related to safety, chemical stability, environmental properties, thermodynamic characteristics and compatibility among materials.

Thermodynamics Properties: The thermodynamic characteristics most importantly normal boiling point, critical temperature and heat capacity must match the application for the system to operate efficiently.

Chemical Stability: A refrigeration system is expected to operate many years, and all other properties would be meaningless if the refrigerant decomposes or reacts to form something else.

Safety and Impact on Health and Environment: The ideal refrigerant should have low toxicity and be non-flammable at the same time should have zero ODP and lowest GWP.

Thermo-physical Properties: Favourable transport properties like low viscosity and high thermal conductivity have an impact on the size of the heat

exchangers and thus cost of the overall system. A final set of practical criteria relate to materials and impact the long-term reliability of a system. The refrigerant must be compatible with common materials of construction, including metals and seals.

Next Generation Refrigerants

The alternative refrigerants have been categorized as transitional refrigerant or HCFC/HFC partly chlorinated refrigerants and into medium and long term refrigerants (Fig 3). HCFC/HFC (partly chlorinated refrigerants) such as R22 and R134a are on the way to phase-out due to environmental concern. Under medium and long term refrigerants like HFC chlorine free and their blend, low GWP refrigerant (R1234yf, R1234ze) and halogen free refrigerant (natural refrigerant) are at present looking as the viable options for future refrigerant.

Low Global Warming Refrigerant

Recently, R1234yf

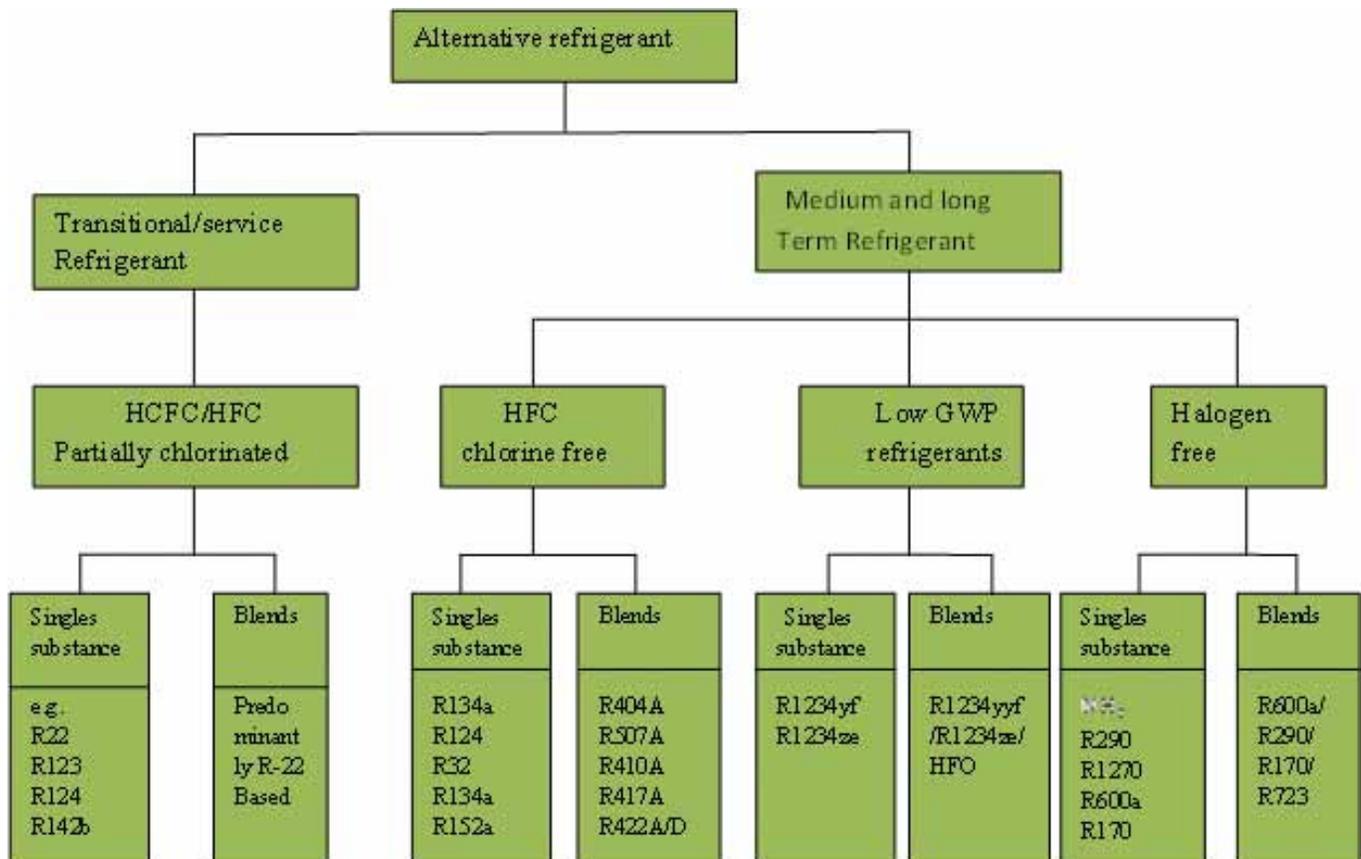


Figure 3: Classification of Alternative Refrigerant

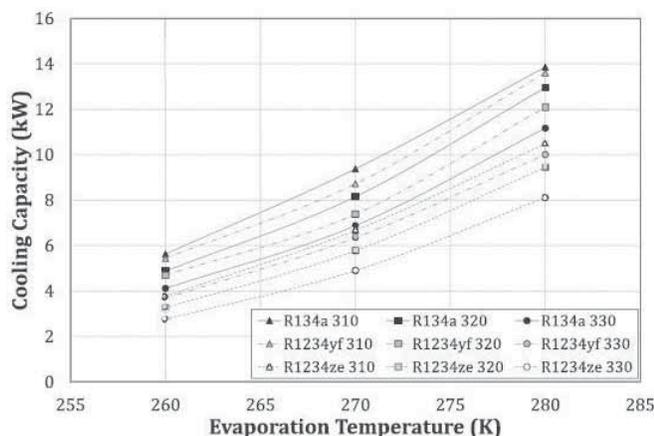


Figure 4: Cooling capacity versus evaporation temperature

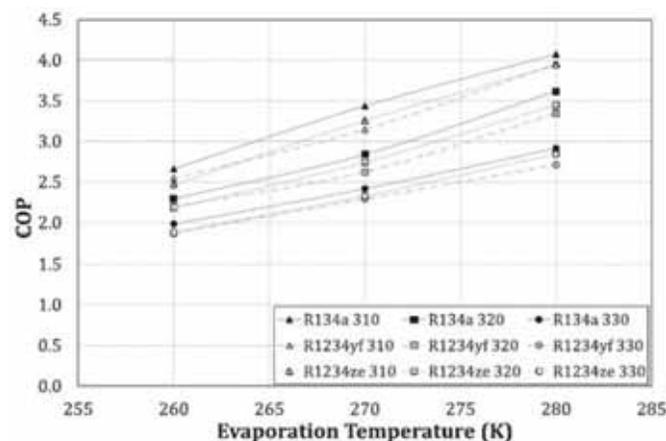


Figure 5: COP versus evaporation temperature

(2,3,3,3-Tetrafluoropropene) having chemical formula $\text{CH}_2=\text{CFCF}_3$ has been proposed as a possible alternative refrigerant for HFC134a. R1234yf has zero ODP and excellent life cycle climate performance (LCCP) as compared to HFC134a. HFO-1234yf has the lowest switching cost for automakers among the currently proposed alternatives, although the initial cost of the product is much higher than that of R-134a. Another HFO based refrigerant HFO 1234ze (trans-1,3,3,3-Tetrafluoroprop-1-ene, $\text{CF}_3\text{CH}=\text{CHF}$) is an energy-efficient alternative to traditional refrigerants in air-cooled and water-cooled chillers for supermarkets and commercial buildings as well as in other medium temperature applications such as heat pumps, refrigerators and CO_2 cascade systems in commercial refrigeration. Refrigerant HFO-1234ze is the best medium pressure, zero ODP and low GWP refrigerant on the market when considering the balance of all properties. A unique characteristic of this refrigerant is the absence of flammable mixture with air under 30°C of ambience.

The performance of vapour compression refrigeration system with two next generation environment-friendly refrigerants was investigated and compared with the performance of the system with R134a, a third generation refrigerant. Comparison has been made between R1234ze, R1234yf and R134a and it was found that those two environmental friendly refrigerants gave slightly lower performance than that of the

R134a. Difference in cooling capacity was calculated between R-134a and both R1234ze and R1234yf. It was found to be 3% - 12% less for R1234yf within the experimented temperature range, whereas this difference was calculated to be less by 4% - 6% for R1234ze. Similarly, COP of the system was also found to be slightly lower for the new refrigerants compared to R134a. Though the performance of the system degraded slightly with these two new refrigerants, they have far less environmental impact compared to R134a. So, those two can replace the existing refrigerant R134a in near future. The variations of cooling capacity and COP with evaporator temperature for the above said three refrigerants have been shown in Figure 4 and Figure 5 respectively for different condenser temperatures.

R-449A is a non-ODP; lower GWP hydro-fluoro-olefin (HFO) based refrigerant replacement for R-404A/R-507, R-407A/F and R-22. R449A is designed for use in positive displacement direct expansion low and medium temperature commercial and industrial applications. It has a GWP of 1397, which is a 65% reduction and provides energy consumption 8-12% lower than R-404A/R-507. R-449A is presently the best choice to replace 404A for stationary refrigeration systems.

Refrigerants R-513A, DR-55, R-452A are non-ODP, low GWP HFO based refrigerants. R-513A is developed to replace R-134a in positive displacement, direct expansion, medium-temperature commercial and industrial, including

centrifugal chillers. DR-55 will be the leading low GWP replacement for R-410A as it is easily convertible from R-410A designs while offering the optimal balance of energy performance.

HFC/HCFC Blend

R-407F is a non-ODP replacement for R-22 and lower GWP (1825) replacement for R404A in various air-conditioning applications particularly in low-temperature applications. Since it is a close match to R-22, it also serves as a retrofit fluid in applications where R-22 is used. R-407F contains HFC-32, HFC-125, and HFC-134a. R-409A (a HCFC blend) containing HCFC-22 (60%), HCFC-124 (25%) and HCFC-142b (15%) is an interim replacement for R-12 in stationary positive displacement air-conditioning and refrigeration systems such as walk-in coolers, beverage dispensers and supermarket systems. Its ODP is 0.046 and GWP is 1909. R-401B may act as an interim replacement for R-12 in low-temperature commercial refrigeration systems, for transport refrigeration, low temperature retrofits, retrofits including air conditioners and dehumidifiers. It is made up of HCFC-22 (61%), HFC-152a (11%) and HCFC-124 (28%). The ODP and GWP values for this mixed refrigerant are 0.036 and 1288 respectively. R-422D is a non-ozone depleting replacement for R-22 in low- and medium-temperature commercial refrigeration systems suitable for direct expansion evaporators. It contains HFC-125 (65.1%), HFC-134a (31.5%), and HC-600a (3.4%) and has a GWP of 2729.

Benefits Of Alternative Refrigerants

Modern refrigerants are more beneficial financially and environmentally over commonly used old refrigerants. Hydrochlorofluorocarbons (HCFCs) and chlorofluorocarbons (CFCs), the commonly used refrigerants in the 20th century, are phasing out in more recent years because of their harmful effects on the ozone layer. Similarly, these fluorocarbons such as CFCs add harmful greenhouse gases to the atmosphere. Such gases are thousands of times more harmful than carbon dioxide and continue to increase global warming. With modern-day energy standards increasing, new methods of refrigeration are being implemented and are continuing to be

developed to provide residential refrigeration with less emission.

Alternative refrigerants such as R-32 and R-410A are phasing out the older refrigerants (more harmful and less efficient). R-22 is harmful to the ozone layer and was discontinued for use in new AC units in 2010 which is then replaced by R-410A. R-410A is an HFC (hydro fluorocarbon) that does not contribute to ozone depletion and will be the new standard for US residential AC systems as of 2015 because R-410A can absorb and release more heat than R-22. R-410A also functions at a higher pressure than R-22, so new compressors are built to withstand greater stresses, reducing the chance for cracking. R-32 is an even newer refrigerant that will likely gain popularity over the next few years. R-32 efficiently conveys heat; it

can reduce electricity consumption up to approximately 10% compared to that of AC units using R-22. Compared to R-22 and R-410A, R-32 has a global warming potential (GWP) that is one-third lower and is remarkable for its low environmental impact.

The next generation refrigerants should be developed based on zero ODP and low GWP. In the future further research, regulation changes, the design of new systems suitable for the use of newly developed and natural refrigerants and the optimization of the system can be expected. There cannot be any ideal refrigerant but it is very important that the refrigerants should do less harm to the environment. The return to natural refrigerants at a new, high technology level should not be forgotten. ■

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Demonetisation taking a toll on potatoes

Federation of Cold Storage Association of India (FCSAI) has said that the huge stocks of potatoes in cold storages across the country have started rotting due to slump in sale following demonetisation. "In the wake of demonetisation which has led to currency crunch the middlemen in mandis (wholesale markets) are not buying potatoes from farmers," FCSAI President Mahendra Swaroop told reporters.

As a result of this, the farmers were not lifting potatoes from the cold storage and many of them are not in a position to clear their dues for preserving them in such facilities, he added.

Swaroop said roughly 1.50 crore sacks weighing around 50 kg each were stuffed in the storage. Now new produce is being harvested, he added. A big portion of the lakhs of tonnes of potatoes has started rotting in the cold storages, he said. ■



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Next Generation REFRIGERANTS

The next generation refrigerants are presented in this article with special focus on R32 and R1234yf. All of these refrigerants have some individual merits and demerits. Hence, it not correct to say that the searching of suitable refrigerants is at the end and these refrigerants will serve forever...

Selection Criteria of Refrigerants

Selection of suitable refrigerant for specific application is very critical as it depend on various factors, which can be broadly categorized as: (i) Environmental and personal safety, (ii) Thermodynamic properties, (iii) Chemical and physical properties, and (iv) Cost and system compactness. Environmental and personal safeties are the primary issues to select refrigerant. Under increasing pressure to address global warming concerns, the industry is spending more effort to understand the environmental impact of air conditioning systems using different refrigerants and technologies. The environmental performance of air conditioning or heat pump systems is partially defined by life cycle impacts on

The refrigeration and air conditioning industry has made tremendous progress over the past two decades in reducing the use of ozone depleting refrigerants. The original targets of the Montreal Protocol, established in 1987 to reduce emissions of ozone depleting substances, are being met and exceeded. Another consequence of these initiatives is that during the 1990s and the early part of

the present century, there was considerable uncertainty regarding future refrigerant options. Now a new path has started to appear, defined by the global agenda on climate change and global warming. Energy security, miniaturization, cost and social demands have also become emerging issues for the refrigeration and air conditioning industry.



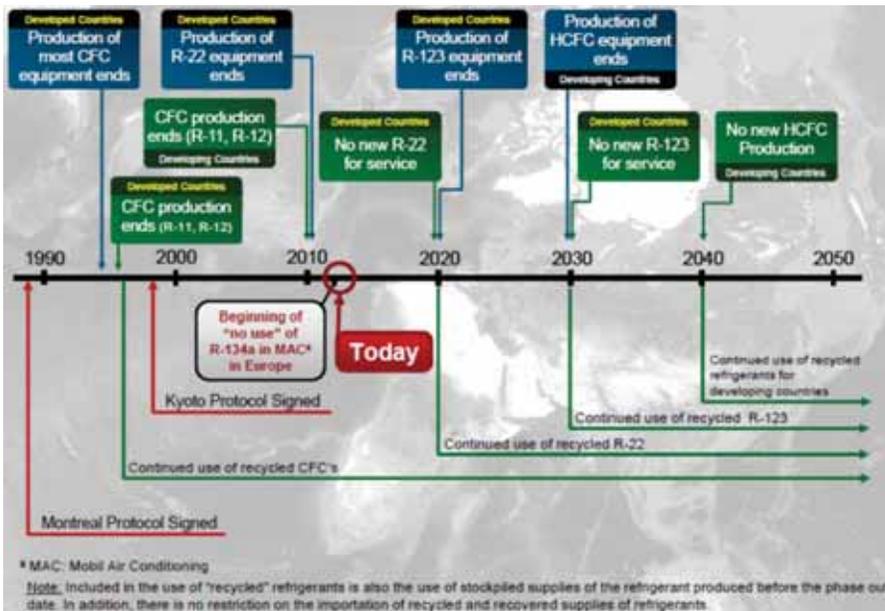


Figure 1: Phase-out schedule of various synthetic refrigerants

climate, including the direct impacts of refrigerant emissions, the indirect impacts of energy consumption used to operate the heat pump system, and the energy to manufacture, transport, and safely dispose of the system, all expressed in terms of CO₂ equivalent emissions. Two environmental impacts, ozone layer depletion (measured by ODP) and global warming (measured by GWP) had made nearly all the conventional synthetic refrigerants unfit for long term use. Details of phase-out schedule of various synthetic refrigerants are shown in Figure 1. Personal safety is mainly related to toxicity and flammability. Detail of personal safety classification is shown in Figure 2.

As discussed, there are many criteria to be considered in the selection of an appropriate refrigerant for use in a refrigeration or heat pump system. Briefly, the refrigerants are expected to meet the following conditions:

- ozone- and environment friendly,
- low boiling temperature,
- low volume of flow rate per unit capacity,
- vaporization pressure lower than atmospheric pressure,
- high heat of vaporization,
- nonflammable and nonexplosive,
- non-corrosive and non-toxic,
- non-reactive and non-depletive with

- the lubricating oils of the compressor,
- non-acidic in case of a mixture with water or air,
- chemically stable,
- suitable thermal and physical properties (e.g., thermal conductivity, viscosity),
- commercially available,
- easily detectable in case of leakage, and
- low cost.

Next-Generation Refrigerants

As discussed earlier, the selection of suitable refrigerant for long term use in any refrigeration, heat pump or air-conditioning

application may be governed by many parameters, which are graphically represented in Figure 3. However, the next generation refrigerants (future refrigerant for long term use) have been selected mainly based on environmental criteria; those refrigerants, which have (i) zero ODP (Ozone layer Depletion Potential) and (ii) low GWP (Global Warming Potential). Limit for low GWP refrigerants is not well defined; according to most of the literatures, the low GWP range is up to 150; however R32 (having GWP of 675) has been also considered as low GWP refrigerant. Properties of next generation refrigerants for vapor compression system are shown in Table 1, which can be classified as (i) Inorganic natural refrigerants, (ii) Organic natural refrigerant, (iii) Hydro-Fluoro-Carbons (HFCs) and (iv) Fluorinated ethers (HFOs). Within listed refrigerants, the new refrigerants R32, R1234yf and R1234ze have introduced very recently. Main advantages of these refrigerants compared to others are mild flammability (better than HCs), mild toxicity (better than R717) and comparable performance (better than R744). Many reputed manufacturers have recently launched various new refrigeration and air-conditioning products based on R32 and R1234yf. Table 2 summarizes the various past, present and future applications of next generation refrigerants for compression refrigeration and heat pump

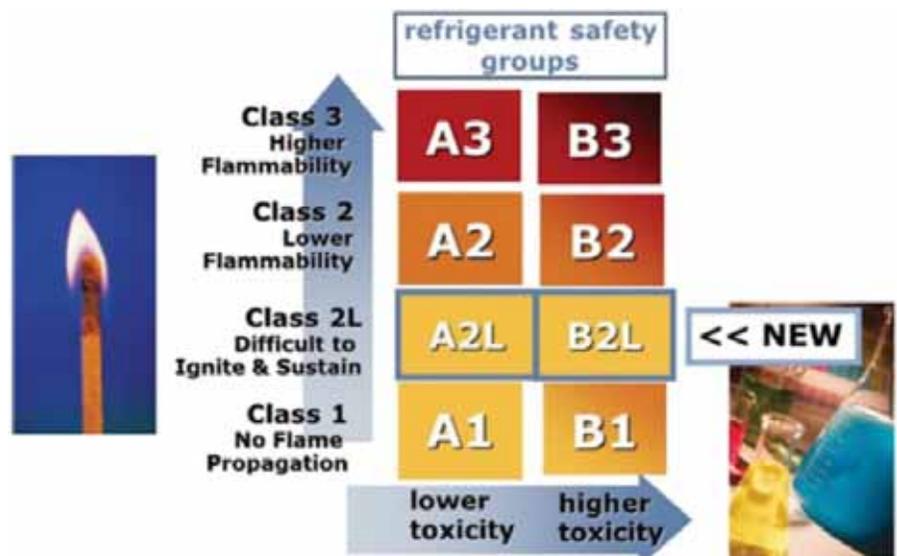


Figure 2: Safety classification of refrigerants



Figure 3: Various governing parameters for refrigerant selection

systems. New refrigerants R32 and R1234yf are discussed in details in the proceeding sections.

Characteristics of R32

R32 is difluoromethane (methylene fluoride) and it is an HFC type refrigerant. R32 has been used for many years as a component of both R407C and R410A; however, it has been introduced as pure refrigerant recently. It is flammable on its own, but not when mixed with the other components of these blends.

The relative merits of R32 can be

summarized as:

- Zero ODP
- One third of R-410A GWP.
- Considerably lower refrigerant cost than R410A and potentially better affordability
- Available now in high volumes globally since it is 50% of R410A composition
- Lower vapor density and lower mass flow rate, hence lower pressure drop expected
- Required less charge as it has a 20% higher volumetric capacity.
- Similar saturated pressure and

pressure ratio hence development is easier.

- Higher critical temperature hence higher COP.
- Single component of gas, therefore it is easier to be produced and managed.
- Better heat transfer properties at same mass flux, hence lower evaporator and condenser size
- No glide and potential to optimize heat exchanger with smaller volume for charge reduction

The disadvantages are cited below:

- A2L mild flammability rating (difficult to find a Low-GWP A1 non-flammable fluid)
- Higher compressor discharge temperature from higher vapor specific heat
- New oil likely required since existing polyolester (POE) oil is not miscible with R32

Overall, R32 seems to offer more advantages than disadvantages. Its lower cost provides incentive for investing development time for mitigating its disadvantages through compressor and system design optimization. R-32 can reduce electricity consumption up to approximately 10% compared to that of air conditioners using refrigerant R-22.

Characteristics of R1234yf

R-1234yf, a new environmentally-friendly refrigerant, has received final approval from the US Environmental Protection Agency (EPA) in 2011. R-1234yf stands for a specific compound: 1 – double bond, 2 – hydrogens, 3 –

Table 1: Physical and environmental properties of next generation refrigerants

Refrigerant	Formula	NBP (°C)	CT (°C)	GWP	Flammability	Safety class	
Natural Inorganic	R717	NH3	-33.3	132.3	0	No	B1
	R744	CO2	-56.5*	31.0	1	No	A1
Natural HCs	R290	C3H8	-42.1	96.7	20	Higher	A3
	R1270	C3H6	-47.7	92.4	3	Higher	A3
	R600a	C4H10	-11.7	134.7	3	Higher	A3
HFCs	R152a	C2H4F2	-24.1	113.3	140	Lower	A2
	R32	CH2F2	-51.7	78.1	650	Mild	A2L
HFOs	R1234yf	C3H2F4	-29.5	99.7	4	Mild	A2L
	R1234ze	C3H2F4	-19.0	109.4	6	Mild	A2L

Note: NBP - Normal boiling point; CT - Critical temperature; *Triple point

Table 2: Applications of next generation refrigerants

Refrigerant	Compression refrigeration and heat pump applications
R717	Industrial and commercial reciprocating compression system, Ice plant, Packing plant, Cold storage, Food refrigeration
R744	Heat pump water heater, Supermarket refrigeration, Mobile air-conditioning
R290	Domestic refrigerator, Domestic heat pumps and air conditioners, Packaged terminal air conditioners, Commercial refrigerators, Vending machines
R1270	Domestic refrigerator, Commercial chillers
R600a	Household refrigerator, Commercial refrigerators and freezers, Retail food refrigeration, Vending machines
R152a	Domestic refrigerator, mobile air-conditioning system
R32	Commercial refrigerator, Residential air-conditioning, Packaged terminal air conditioners, Food refrigeration, Supermarket refrigeration
R1234yf	Mobile air-conditioning system
R1234ze	Chillers for supermarkets and commercial buildings. Heat pumps, Refrigerators, Vending machines, Beverage dispensers, Air dryers

carbons, 4- fluorines, yf – position of the fluoro atoms. The biggest benefit of R1234yf is that it breaks down faster in the atmosphere than R-134a, leading to negligible GWP value. It is considered mildly flammable and has thermodynamic properties similar to R-134a. It has best balance Of properties and performance.

Relative advantages of R1234yf:

- Excellent environmental properties (Very low GWP, Zero ODP, Low TEWI, Favorable LCCP, Atmospheric chemistry determined and published)
- Low toxicity, similar to R-134a (Low acute and chronic toxicity, Significant testing completed, Has a favorable ATEL (Acute Toxicity Exposure Limit) value
- Mild flammability (significantly better than 152a), which is manageable
- COP and Capacity are very similar to

R-134a, Operating pressures and refrigerant characteristics are pretty close to R134a, Better COP than R152a & CO2

- Thermally stable and compatible with R-134a components, similar compressor wear
- Complying to European and US Norms, Suited to all climates across the world

R1234yf Implementation issues:

- Flammable and may require additional safety measures during implementation and use
- R1234yf is a more complex and costly refrigerant gas to produce than R134a.
- Additional part (internal heat exchanger) is required to match the performance
- Many components have to be re-developed (New oil type, New ports)

Conclusions

The next generation refrigerants are presented in this article with special focus on R32 and R1234yf. All of these refrigerants have some individual merits and demerits. Hence, it not correct to say that the searching of suitable refrigerants is at the end and these refrigerants will serve forever. Any major demerit may be detected with some of these refrigerants in future (which, we are not able to understand today) and have to be banned. One the other hand, some new refrigerants may be introduced in future. It is a never-ending process. ■

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Optimal Use of Available Resources in Industries & Agriculture

Now-a -day all industries and utilities prefer maintenance-free, cost-effective, green and clean technology in every process as they realize importance of water and energy...

In today's highly competitive markets, many industries and organizations have already taken initiatives to implement new technology and wise use of all available natural resources of water and energy. They make plans with local utilities to reduce their demands for energy and water to save costs and improve the long-term sustainability of their business.

For potable water we don't compromise. But for many routine industrial and commercial applications, treated recycled water is the effective way to reduce the demand for valuable fresh water resources. It is also a recognized

green building practice.

In ground water, river, deep wells, tap water where oxygen content is low, the iron or manganese-bearing water is clear and colorless. Iron and manganese are in dissolved form. When exposed to air, iron and manganese are oxidized and change from colorless dissolved forms to colored solid forms.

Due to oxidation of softened iron grains in water convert iron particles into white, then yellow and finally convert it into red brown solid particles that settle down in water and remaining suspended iron particles leave the water with a red color.

Manganese, generally, is dissolved in water, although some shallow wells contain colloidal manganese (black color). These sediments are responsible for the discoloration properties of water containing high concentrations of iron and manganese. These residues may be severe enough to block water pipes hence try to solve problems from its grass root level. Therefore, understanding of various parameters that play direct or indirect vital role in water is necessary.

Various Parameters

Iron and manganese can disturb flavor and color of food and water. They may react with coffee, tea and some alcoholic beverages to produce a black sludge, which affects both taste and appearance.

Manganese is intolerable in water even when present in smaller concentrations than iron. Iron will cause reddish-brown stain of dirty washing, ceramic tiles and floor and



dishes, utensils and even glassware.

Manganese acts in a similar way but causes a brownish black stain. Soaps and detergents do not remove these stains, and use of chlorine bleach and alkaline builders (such as sodium and carbonate) may intensify the stains.

Iron and manganese deposits will form step by step layers in pipelines, pressure tanks, water heaters and water softeners. This reduces available quantity and pressure of the water supply. Iron and manganese accumulations become an economic problem when water supply or water softening equipment must be replaced. It also leads to increase in energy costs from pumping water through constricted pipes or heating water with heating rods coated with iron or manganese mineral deposits. Due to these reasons, some water softeners plants and RO plants do not prevent blocking of pipes and equipment. But it only removes few minerals and gets effect of soft water. That means water softener may control total dissolved solid particles. But, it is less effective in controlling hardness due to calcium and magnesium. It is all due to iron or manganese. These non-pathogenic (not health threatening) bacteria occur in soil, shallow storage tank, and some surface waters. The bacteria feed on iron and manganese in water. These bacteria form red-brown (iron) or black-brown (manganese) fungus or slime in toilet tanks and can clog water systems.

Various Parameters with reference to industrial applications (Cooling Towers)

Cooling towers are widely used in all industries, hotels and commercial buildings for dissipating heat in open recirculating cooling systems. They are designed to provide close air or water contact. Heat removal is mainly by evaporation of part of cooling water. Some sensible heat loss (direct cooling of water by air) also occurs. But, it is only a minor portion of total heat rejection.

An open recirculating cooling system uses same water again and again to cool process equipment. Heat absorbed

from the process must be dissipated to allow reuse of water. Cooling towers spray ponds, and evaporative condensers are used for this purpose.

Open recirculating cooling systems save a lot of make up or fresh water as compared to the unconventional method, once through cooling. The quantity of water discharged to waste is greatly reduced in the open recirculating method, and advance E water Descaling treatment is more economical.

In open recirculating cooling systems, it needs more treatment with respect to problems:

- Due to cooling by evaporation increases the soften solids absorption in water, raising corrosion and deposition tendencies the relatively higher temperatures significantly increase corrosion potential.
- Long preservation time and boiling water in an open recirculating system increase tendency for natural growth of ground gases such as sulfur dioxide, ammonia or hydrogen sulfide that can be absorbed from air, causing higher corrosion rates.
- Germs, nutrients, and possible foulants can also be absorbed into water across tower.

Hardness

Combination of calcium and magnesium deposition, calcium and magnesium both can lead to scale formation.

- Calcium is the most difficult as certain calcium salts does not soluble in water.
- Magnesium does not create much problem unless silica levels are also high. This could result in magnesium silicate scale in heat exchangers. Most salts are easily soluble with increasing temperature, but calcium carbonate becomes less soluble with increasing temperature. So, the best way is to break the bonding of calcium and carbonate and also magnesium and carbonate to reduce hardness.
- Advance E-water Descaler treats above processes conveniently with energy efficient and eco-friendly manner without adding any chemical.

This reduces maintenance cycle up to 80 % and saves lots of money, machine and manpower.

pH Alkalinity (Water's ability to neutralize acids)

- Bicarbonates generally represent main part of measured alkalinity, amounts of carbonate and hydroxide alkalinity.
- Alkalinity is an important mean of predicting probable. Calcium carbonate scale. High alkalinity means acidic water has a pH < 7; alkaline water has > 7.
- Health effect of pH on drinking water depends upon where pH falls within its range. The US Environmental Protection Agency recommends a pH between 6.5 and 8.5 for drinking water.
- A high pH leads to excessive calcium and other ceramic like deposits.
- pH of cooling water becomes acidic because of atmospheric elements or infiltration of process elements, a pH lower than six will destroy this protective coating in a few months. Engineers and manufacturers then have to apply expensive coatings and repair damage that may have occurred. If the repair process is extensive, costly process interruptions may be required.

Silica

- Silica is difficult to remove scale deposits. Pre-treatment like silica filter or side stream filtration is often required if the silica levels are above 120 ppm (as SiO₂).

TSS Total Suspended Solids (undissolved material such as sludge, sand, fine clay, and vegetation.)

- Unlike (TDS) Total dissolved solids, not all suspended solids enter the cooling system with make up water. Some might be generated as corrosion and scale by-products or from air or water contact. Suspended solids can transform to biofilm and cause under deposit corrosion. TSS can be controlled through pretreatment, filtration etc.

Ammonia

- Provides platforms, an ideal nutrient for many bacteria. It can promote

biofilm development and growth in heat exchangers and cooling tower block up. It is also tremendously corrosive to copper alloy, you can find lot of case study. Ammonia can reduce or deny some non-oxidizing biocides such as glutaraldehyde. (Bromine is a more cost-effective biocide than chlorine if ammonia is present.)

Phosphate

- At higher concentrations (calcium greater than 1,000 mg/l and phosphate greater than 20 mg/l) there is a potential for calcium phosphate scaling in heat exchangers, especially, at high heat loads and low cooling water flow rates. Therefore, close monitoring of blow down is required. Phosphate can also act as a nutrient for biofilms.

Chloride

- It can be corrosive to most metals, especially, mild steel. A chloride limit of 300 ppm is often used for stainless steel, but limits for other metals may go as high as 1,000 ppm.

Iron

If it combines with phosphate to form undesirable foulants, it may also deactivate specialised polymers used to inhibit calcium phosphate scaling. Recycled water may have a high concentration at 0.12 to 0.32 of iron. Specialised treatment of iron is expected to be required for this concentration.

Biological Oxygen Demand (BOD)

It reflects the organic content for biological organisms and the associated demand for oxidizing biocide in addition to the amount used for bio fouling control.

Nitrates and Nitrites

Nitrates and Nitrites can provide additional mild steel corrosion control at levels above 300 mg/l in the concentrated cooling water. It can contribute to reductions in stainless steel cracking and pitting erosion. Nitrates do not attack copper alloys or protect them from corrosion.

Zinc

Zinc can assist phosphates and

nitrates in reducing mild steel corrosion rates and pitting tendencies. Levels in cooling water above 0.5 mg/l are beneficial, but levels above 3.0 mg/l can contribute to deposits.

Organics

Organics can act literally as fertilizer for micro-organisms. Water-soluble cationic polymers can react with some anionic treatment biocides, as well as some scale and corrosion inhibitors.

Fluoride

At 10 ppm or more can combine with calcium to cause scale formation.

Heavy Metals (e.g. Cu, Ni, and Pb)

Copper and nickel can plate out on steel, causing localized galvanic corrosion that can rapidly penetrate thin steel heat exchanger tubes.

Conductivity (A measure of dissolved solids)

Conductivity is an approximate measure of ionic concentration. As water



For Validation and improving make up water quality initiative taken by Chief engineers of world's state of art "Akshardham" Temple Gandhinagar, they are using ample recycled water successfully with this advance E-water technology.



India's State of art Biggest Luxuries Resort -Madhubhan Resorts and Spa is using heavy recycled good quality E-water for makeup/ Feed water in cooling tower and swimming pool.

quality constituents contributing ions change, conductivity settings used for system control have to be adjusted.

Calcium Hardness pH (as CaCO₃)

The concentration of calcium increases, so does its probability of precipitating out of solution. Potential scaling can be controlled through the use of pretreatment, scale inhibitors or deposit control agents

Partial Softening of Makeup Water

Partial softening of the makeup water prior to its introduction to the cooling tower is an effective pre-treatment method to increase cooling tower efficiency. Partial softening reduces water hardness, alkalinity and silica. In this method the water is treated with lime or a combination of lime and soda ash to precipitate the ions contributing to hardness and alkalinity. The precipitate is treated physically which saves lots of chemical treatment. Partial softening is used to treat water with

moderate to high hardness and alkalinity in the range of 150 to 500 ppm as CaCO₃.

Conclusion

Water treatment technologies are really endless.

- RO plant and softener plant have their own advantages. But limitations are wastage of lots of water in which we cannot debate. However, if you prefer cost-effective solution with aim to save water and environment, then usage of recycled water reduce wastage of water. Reusing water is possible with some advance E-water technology.
- Rinse water continuously as per desired applications and check its parameter and replace it with fresh water after one week, two week or as per usage containing nearly no detectable levels of ions. However, with low in TDS may be corrosive and may need corrosion inhibitors. This water source can be used by itself or can be mixed together with water that

has a high TDS concentration to give up an intermediate TDS concentration.

- Adequate testing, control, and performance monitoring must be maintained in order to assure good system operation and protection. The use of recycled water depends on the final water quality in the cooling system, the systems metallurgy, the levels of nutrients present, and the operating conditions in the cooling components. Recycled water can contribute to corrosion, but the presence of phosphates and nitrates can provide mild steel corrosion control. All increased corrosives, except ammonia, can be reduced or eliminated with water treatment chemicals under good control. ■

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Daikin Applied Sets New Standards

Daikin Applied are pleased to launch the EWAD-TZ B chiller range. The TZ B is the next generation of air cooled chillers with inverter screw compressor technology. An upgrade from the market leading TZ and CZ ranges, the TZ-B now covers cooling capacities from 170kW up to 1.1MW, offering outstanding energy performance across the range, with EER values up to 3.9 and ESEER values of up to 5.7.

“The upgraded TZ-B chiller builds on what is already a market leading product range offered by Daikin Applied. With the product developments we can offer even greater cost savings both in terms of reduced capital expenditure and energy usage for the end-user” says James Henley, Chiller Product Manager.

Building on its predecessor – the EWAD-TZ launched in 2013 – the TZ-B range combines a screw compressor design and integrated inverter technology

with Variable Volume Ratio technology (VVR) along with the latest micro-channel condenser coil technology, pushing the boundaries of chiller design in order to meet the challenges of green building efficiencies and new legislation. The new highly advanced Daikin Applied TZ-B chiller adds to the extensive portfolio of market leading HVAC products, designed to meet a full range of applications while offering solutions that are more efficient, quieter and greener than ever seen before. Since the introduction of the first inverter driven chiller to the market, more than a decade ago, continual innovation has improved end-user efficiencies, while offering even greater flexibility.

With ever-tightening legislation on energy efficiency and CO₂ emissions, business owners face a number of challenges when replacing cooling and

climate management systems. Our challenge has been to deliver systems that are competitively priced and more versatile. As a manufacturer of both compressors and chillers Daikin Applied delivers optimum designs to meet the needs of the many different applications from comfort-cooling to process-cooling.

The unique screw compressor design with refrigerant cooled inverter technology has been combined with VVR, which maintains the highest compression efficiency. This advancement together with component selection optimisation and improved control logic offers even more advantages and greater reliability. The range has options for three efficiency levels and three sound levels enabling customers the ability to choose a bespoke solution that suits their needs ■



Achievements of Ministry of Food Processing Industries

The Ministry of Food Processing Industries has implemented a number of Central Sector Schemes for promotion and development of food processing sector in the country since 12th Plan...

The major achievements of the Ministry during 2016 are as follows:

- The Government has allowed 100% FDI for trading including through e-commerce, in respect of food products manufactured or produced in India. 100% FDI is already permitted in manufacturing of food products through automatic route. This will provide impetus to the foreign investment in food processing sector, benefit farmers immensely and will create vast employment opportunities.
- The following additional fiscal concessions have been granted for boosting the investment in the food processing sector :
 - a. Reduction in Excise Duty on Refrigerated Containers from 12.5% to 6%.
 - b. Reduction in Basic Custom Duty on Refrigerated Containers from 10% to 5%.
 - c. 5% Basic Customs Duty as

presently available under project imports for cold storage, cold room also extended for Cold Chain including pre-cooling unit, pack house, sorting and grading lines and ripening chambers.

- Under the Scheme of Mega Food Parks:
 - a. The Indus Mega Food Park, Khargone (Madhya Pradesh); Jharkhand Mega Food Park Ranchi (Jharkhand), and Jangipur Bengal Mega Food Park, Murshidabad (West Bengal) were made operational and inaugurated.
 - b. Foundation Stone of Punjab Agro Industries Corporation (PAIC) Mega Food Park Project in Ludhiana was laid.



- c. As such, eight Mega Food Parks have been made operational so far.
- d. A Mega Food Park is likely to benefit about 25000-30000 farmers apart from creating employment for 5000-6000 persons, especially in rural areas.
- e. The Mega Food Park projects at Satara (Maharashtra), Ajmer (Rajasthan), Rayagada (Odisha) and Agartala (Tripura) are at advanced stage for operationalisation by the end of current financial year.
- NABARD has sanctioned term loan of Rs. 427.69 crore to 10 Mega Food Park projects and 2 processing units under 'Food Processing Fund' of Rs. 2000 crore and out of this an amount of Rs 81.10 crore has been disbursed. The Ministry has notified 157 designated food parks in different States for the purpose of availing affordable credit from special fund with NABARD.
- Under the Scheme of Integrated Cold Chain and Value Addition Infrastructure:
 - a. 20 projects have been operationalised in 2016. With its operationalisation, the Ministry has created an additional capacity of 0.63 lakh metric tonnes of cold storage, 15 metric tonnes per hour of Individual Quick Freezing (IQF), 10.65 lakh litres per day of milk of processing or storage and 99 reefer vans during 2016.
 - b. During last two and half years, 54 integrated cold chain projects have been made operational taking the total number of cold chain projects to 91. The Ministry has so far assisted 135 cold chain projects having a capacity of 3.67 lakh metric tonnes of cold storage, 94.29 metric tonnes per hour of individual Quick Freezing (IQF) 37.93 lakh litres per day of milk processing or storage and 549 reefer vans.
 - c. The guidelines of scheme have been



- revised on the basis of feedback and experience of the Ministry to make them investor-friendly.
- d. On an average, each cold chain project benefits to around 500 farmers in fruits and vegetables sector and around 5000 farmers in dairy sector and creates employment for 100 persons.
- Ministry has invited EOIs to fill up vacant slots of Mega Food parks and Cold Chain projects. The Ministry has received 54 proposals against 8 vacant slots of Mega Food Parks and 308 proposals for 100 Cold Chain projects which stand testimony to the increasing interest of the investors in this sector.
- Under the Scheme of Setting up/ Modernization of Abattoirs, one project at Panji (Goa) has been operationalised.
- During the year, 10 Food Testing Labs have been completed.
- FSSAI has simplified product approval:
 - a. Approved a large number of new Additives harmonized with the International Codex Standards.
 - b. Notified an amendment to the regulations as a result of which non-standardized food products called proprietary foods (except novel food and nutra-ceuticals) that use ingredients and additives

approved in the regulations will no longer require product approval. This has provided considerable relief to the industry.

- A web-based on-line system has been operationalised for processing claims for release of grants-in-aid under the Schemes of Mega Food Parks and the Integrated Cold Chain and Value Addition Infrastructure.
- The National Institute of Food Technology, Entrepreneurship and Management (NIFTEM) at Kundli, Sonapat, Haryana and Indian Institute of Crop Processing Technology (IICPT) at Thanjavur, Tamil Nadu are being developed by the Government as the Centres of Excellence. The pass-outs of these institutes have got 100% placements.

The Ministry is also taking steps to implement a new scheme namely Scheme for Agro-Marine produce Processing and Development of Agro-clusters (SAMPADA) for overall development of food processing sector, for providing enabling infrastructure, expanding processing and preservation capacities, controlled temperature logistics and backward and forward linkages, with an allocation of Rs 6000 crore for a period co-terminus with 14th Finance Commission.

Launching Zero Energy School in US

Six school districts & two states are among first aiming to make zero energy schools mainstream...

As a part of the Obama Administration's effort to cut energy waste in America's buildings, the Energy Department launched the Better Buildings Zero Energy Schools Accelerator. Six school districts, two states and several national organizations are working collaboratively to develop zero energy design that is cost-competitive to conventional construction in the education sector and in local communities across the nation. A Zero Energy Building is an energy-efficient building, where on a source energy basis, the actual delivered

energy is less than or equal to the onsite renewable exported energy.

In conjunction with the launch, Energy Department officials joined other key stakeholders to tour Discovery Elementary School, a Zero Energy school located near the nation's capital in Arlington, Virginia, which officially opened its doors in September 2015. Discovery's engineering team expects to offset its energy usage with renewable energy and to potentially save about \$75,000 within its first year of operation. Discovery Elementary is one of 40 emerging Zero Energy ready schools in

the US, and was built with advanced next generation energy efficiency and renewable power features including solar rooftop and geothermal heating and cooling systems.

"Through the Better Buildings Zero Energy Schools Accelerator, partners commit to real savings," said Kathleen Hogan, US Department of Energy's Deputy Assistant Secretary for Energy Efficiency. "By using the most energy-efficient technologies, and engaging students and the local community, school districts can lead the way in saving taxpayer dollars and creating more resilient and first-in-class educational facilities."

Through programs like the Zero Energy Schools Accelerator, Zero Energy schools have the potential to save 65-to-80 percent in energy consumption, depending on



climate the zone. By aggressively pursuing energy efficiency opportunities, school districts could dedicate these savings toward other learning needs, including salaries for teachers, computers or books. Further, the number of K-12 schools continue to grow and can serve as a model for other new construction sectors. The education sector accounts for a substantial portion of the building construction and renovation industry, a figure that has grown consecutively over four years.

In addition to saving money for taxpayers, Zero Energy schools also make a difference in the learning environment for students. Improved ventilation and day lighting are used extensively in most Zero Energy schools and studies have shown that both these strategies help improve the learning environment. Teachers are also able to transform classrooms into 3D engagement opportunities with the student body by using energy dashboards and

new technologies as teaching tools.

The goal is to quickly make Zero Energy K-12 schools more mainstream. Partner school districts commit to developing their own zero energy plans for a district project within a year. They can also engage with fellow states and school districts, and leverage support from regional and national organizations, including the National Renewable Energy Laboratory, North-east Energy Efficiency Partnerships, the National Energy Education Development (NEED) Project, Southern California Edison, The Energy Coalition, New Buildings Institute, Rocky Mountain Institute, and the National Association of State Energy Officials.

The first participating school districts include:

- Hermosa Beach City School District (Hermosa Beach, California)
- LA Unified School District (Los Angeles, California)

- Arlington School District (Arlington, Virginia)
- Boulder Valley School District (Boulder, Colorado)
- Adams 12 – Five Star Schools (Thornton, Colorado)
- Douglas County School District (Douglas County, Colorado)
- State of Minnesota Schools
- State of California Schools

Better Buildings Accelerators are part of the broader Better Buildings Initiative which aims to make commercial, public, industrial and residential buildings 20 percent more energy efficient over the next decade. Through Better Buildings, public and private sector organizations across the country are working together to share and replicate successful strategies to drive energy efficiency. This means saving billions of dollars on energy bills, reducing greenhouse gas emissions, and creating thousands of jobs ■

USGBC's Ranking of Top 10 Countries for LEED

USGBC announced the Top 10 Countries for LEED, a list that highlights countries outside the United States that are making significant strides in sustainable building design, construction and market transformation. These countries represent the ever-growing international demand for LEED-certified green buildings. This year, China moved from second to first on the list as the largest user of LEED, with 34.62 million gross square meters (GSM) of certified LEED space. Canada, India, Brazil and the Republic of Korea rounded out the top five countries on the list, respectively.

"By recognizing these leading countries, we are showcasing the exponential growth of LEED in the global marketplace and an international commitment to the creation of a sustainable built environment," said Mahesh Ramanujam, President and CEO, USGBC. "As we pursue a worldwide effort to mitigate climate change, LEED and the green building industry have

created a path forward for market transformation while changing the way we think about how buildings, communities and cities are planned, constructed, maintained and operated."

Global green building is expected to double every three years, according to a Dodge Data & Analytics World Green Building Trends 2016 SmartMarket Report, to which USGBC was a contributing partner. Conducted in 70 countries, the report found that emerging economies like China, India and Brazil will be engines of green growth, with development varying from two fold to six fold over current green building levels. Increased consumer demand has also pushed the world's green building market to a trillion-dollar industry, a surge that has led to a corresponding increase in the scope and size of the green building materials market, which is expected to reach \$234 billion by 2019. LEED is the world's most widely used green building rating system. The analysis used to develop the list ranks countries in terms of cumulative LEED-

certified GSM space as of December 2016. LEED-certified spaces use fewer energy and water resources; save money for families, businesses and taxpayers; reduce carbon emissions; and prioritize environmental and human health. Currently, there are more than 82,000 commercial projects participating in LEED, totaling more than 1.4 billion GSM of space worldwide. 170,000 GSM of space achieves LEED certification every day in more than 162 countries and territories across the globe. As buildings currently account for an estimated one-third of global emissions, green buildings are solutions to climate change because they generate significant environmental, economic and societal benefits. Last year, USGBC joined 25 other green building councils from around the world to commit to scaling the use of LEED over the next five years to reduce greenhouse gas emissions and ensure that the building and construction industry plays its part in limiting global warming. ■

Thermal Storage for Shopping Mall

The need to conserve power, its high cost and undependable supply in many parts of the country has made HVAC design engineers study each new building project carefully to evaluate the possibility of maximum power savings...

Shopping Malls have now become the best destination for office goers where they get everything at a single location. The comfort atmosphere within the shopping malls attracts more and more crowd. But it is seen that the while providing this comfort atmosphere, the developer ends up with huge electricity bill. Hence, the need to conserve power, its high cost and undependable supply in many parts of the country has made HVAC design engineers study each new building project carefully to evaluate the possibility of maximum power savings.

Background

Air conditioning system consumes 65% of the total electrical load but this load varies from time to time. The ambient factors and the floating occupancy are the basic reasons for this varying load profile.

Building Load Profile

A study was taken up to understand the daily and yearly load profile of shopping malls.

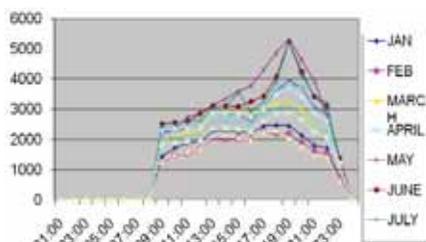


Figure 1: Yearly and daily load profile of a shopping Mall.

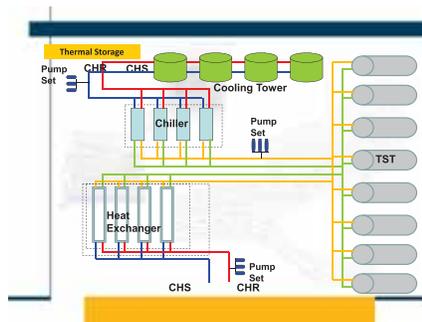


Figure 2: Thermal Storage system

Selecting the AC System

As seen in the profile, HVAC load is changing throughout the day and the diversity comes nearly 30%. Now, we have to select equipment which can cater to peak requirement and should also not waster energy in off peak hours. Thermal Storage system is the option in this regard.

As shown in the figure, chillers are connected with low side system as in case of any chilled water system but instead of normal chillers, Brine chillers have used for the same. Secondly, the chilled water line has routed through some storage tanks, which converts the ice balls into ice during charging mode. In normal mode, the chilled water again passed through the tank, where the chilled water rejects heat to the ice ball and reduces its temperature.

The interesting part is that, the chillers are basically of dual mode. They work as normal chillers during off peak hours and works as sub zero chiller during night time,

when the mall does not need cooling. Out of 12 hours of daily operation, peak load comes only for four hours, where the ice balls help in keeping the area cool by cooling the chilled water to the required temperature. Other time, chiller works on normal mode. Due to this, total connected chiller requirement goes down by 40%.

Advantages of Selecting the Thermal Storage Package

- Thermal storage system has the following advantages over the normal chilled water system.
- Total chiller load goes down by 40%.
- DG, transformer, cabling and panel cost goes down.
- Plant room sizes get reduced upto some extent.
- Electricity deposition amount reduces.
- Overall electricity cost reduces by 20%.

Conclusion

All we know that the electricity distribution is not same in day and night time. Because of the industrial and agricultural requirement, day time load requirement is more as compared to night time, where offices and industries normally don't work. Again, dual tariff is applicable in some states where there is a substantial cost difference between night time and day time. Night time cost is nearly 20% less than the day time unit cost. In that scenario, night time utilization of electricity and day time reduction of consumption will not only reduce the capital investment but also the running cost.

Firoj Jena
Clancy Global Consulting
Engineers,
Mumbai



The Emerson Cup 2016 Awards

The award is one of the most prestigious and recognized competitions of the Heating Ventilation Air Conditioning & Refrigeration (HVACR) industry - a platform for showcasing emerging trends and practices amongst its professionals. It is a vehicle to drive change.



The Emerson Cup 2016 Awards was an evening when the industry came together as one and celebrated the abundance of talent within its fold. The award is one of the most prestigious and recognized competitions of the Heating Ventilation Air Conditioning & Refrigeration (HVACR) industry - a platform for showcasing emerging trends and practices amongst its professionals. It is a vehicle to drive change.

The Emerson Cup 2016 was the 9th edition of the competition, which saw it build on a legacy of promoting innovative, energy saving technologies, and exploring outstanding environmentally responsible products and solutions. By awarding enterprises and professionals who have made a significant contribution to the industry, the competition has fanned the flame of innovation and creative enterprise.

The Emerson Cup 2016 had four award categories this year – New Projects, Retrofit Projects, Cold Chain Projects/ Product and Product Innovation in air conditioning & heating.

Sridar Narayanswami, Vice President & Managing Director, India, Emerson's Commercial & Residential Platform present on the occasion, was a picture of enthusiasm. He said, "One of the most vital cogs in the wheels of the green building movement is the air conditioning

& refrigeration industry. Here, the opportunities for improvement in areas such as energy efficiency, innovation and indoor air quality are tremendous. The only limitation is our imagination. The Emerson Cup, by recognizing and rewarding new technologies that further the Green movement - is the perfect catalyst for encouraging young talent."

The awards were selected by a distinguished panel of judges, bringing a wealth of diverse expertise to the competition. The jury comprised of highly recognized and influential members drawn from various fields like energy efficiency, engineering, architecture, education, cold chain and HVACR Design.

The New Project award category continued to witness the highest number of nominations. This year, the excellence award – Metropolitan cities was conferred on Infosys Ltd, for the Green Data Center at the Infosys, Bengaluru campus. While the excellence award for Emerging cities' category was tied between Divyajyoti Trust and Indian School of Business for their outstanding projects Divyajyoti Eye Care Hospital, Mandvi, Gujarat and Indian School of Business, Mohali Campus respectively. Keeping into account the quality of entries and recognizing how close the scoring for each nomination, the jury decided to award two Jury's Special Awards in the New project category to SKF India Ltd & Veratava Engineering Consultants LLP for their projects Corporate Office, Pune & Equinox, Infosys, Bengaluru respectively.

There was great enthusiasm for the Retrofit Project category award as well, with the excellence award being presented to Paharpur Business Center for their

Corporate Office. Recognizing the uniqueness of Godrej & Boyce E&Es - Restructuring of HVACR System project the judges presented the Jury's Special award. The Retrofit Project-Emerging Cities' category was won by ICICI Bank Ltd. for the project ICICI Branches & Offices for Energy Efficiency.

In the Cold Chain – Metropolitan Cities category, Thermal Energy Service Solutions Pvt. Ltd. won the excellence award for their Blochill & Blofreeze, Mumbai project. While the Cold Chain – Emerging Cities category saw Climate



Changers Technology Solutions as the clear winners for their project Packhouse Ripening Chambers, Theni, Kerala. In addition, two more corporates - Rinac India Ltd and Seepra Refrigeration Pvt Ltd won Jury's Special Mention Award for their Rack Assisted Cold Storage and Cold n Hold projects respectively.

This year the Product Innovation in Air conditioning & Heating category saw a tie. The award was jointly won by Johnson Controls – Hitachi Air Conditioning India Ltd. and NESSPAL Air Water Heaters Pvt. Ltd. for their products Zunoh & Kashikoi Series in Split AC Systems and Air Source Heat Pump respectively.

The Emerson Cup 2016 saw new benchmarks being made, new technologies being unveiled and new talent coming to the fore. With competitions like The Emerson Cup holding aloft the flag of innovation, the future of the HVACR industry looks bright. To know more about The Emerson Cup, the awards and the entries, connect with us online at Facebook, Twitter, Slide Share and Youtube. ■

For more details visit www.EmersonClimate.com/TheEmersonCup

Sustainable Cooling with R723

Society's awareness of the importance of a sustainable and environment-friendly use of resources is steadily increasing. More and more companies and institutions are coming to realize that there are environment-friendly alternatives worth looking into for their refrigeration systems. Natural refrigerants such as ammonia dimethyl ether help to protect the environment and improve sustainability...

According to an analysis by the Umweltbundesamt (German federal environmental agency) in 2014, refrigeration alone accounts for 14 percent of Germany's overall energy consumption, and is responsible for about five percent of direct and indirect greenhouse gas emissions. In consideration of national and international climate protection goals, it is imperative that climate-friendliness in the refrigeration sector be improved. An important contribution can be made by using natural refrigerants such as ammonia dimethyl ether (R723), which is particularly environment-friendly with an ozone depletion potential (ODP) of 0 and a global warming potential (GWP) of 8. It also offers great investment security for operators of refrigeration systems since the refrigerant bans of the EU regulation on fluorinated greenhouse gases don't apply to it.

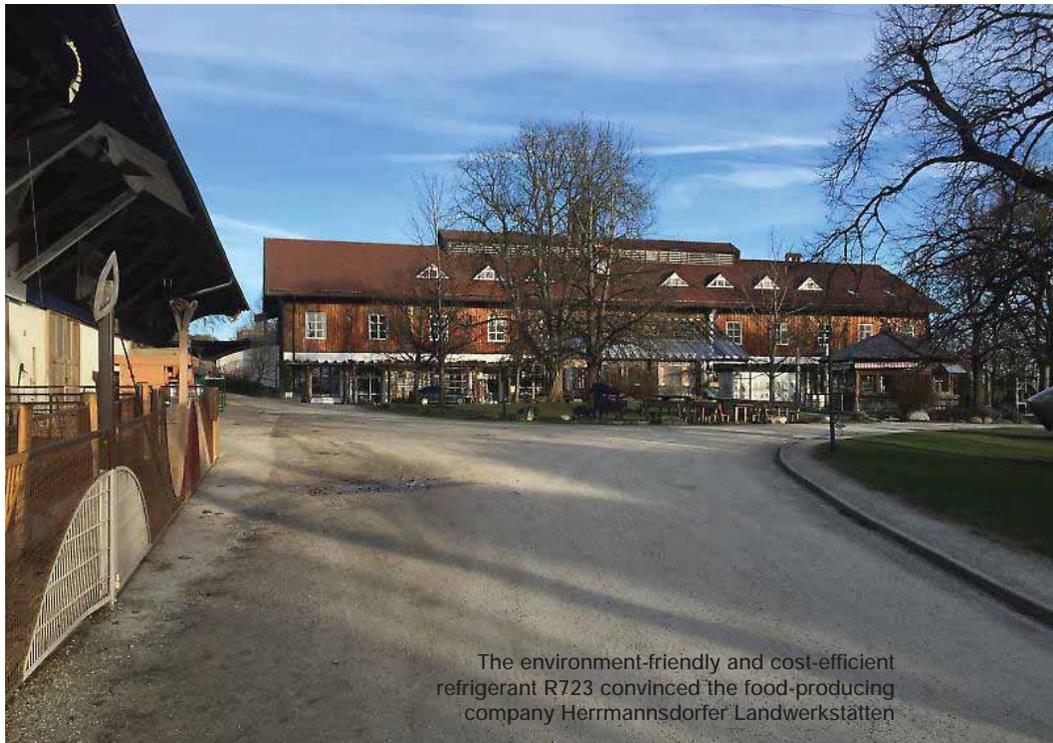
Efficient for low refrigerating capacity ranges

The refrigerant ammonia dimethyl ether consists of 60 percent (by mass) of ammonia (R717) and 40 percent of dimethyl ether (RE170) – a propellant gas whose refrigerant properties are similar to those of isobutane. Thanks to its azeotropic boiling behavior, the mixture can be used like a mono-refrigerant, i.e. there is no concentration shift during evaporation or condensation. R723 is particularly efficient in the low capacity range up to 100 kW. The circulating volume flow rate of the vapor phase is about 150 percent of that of ammonia, which means acceptable

pipe cross sections and flow velocities even for lower refrigerating capacities. Also, ammonia dimethyl ether has a higher volumetric refrigerating capacity than ammonia, so it is possible to obtain considerably higher refrigeration capacities with the same quantity of R723. In refrigerating systems tested with both ammonia and R723, the COP (coefficient of performance) improved by 7 percent when using the latter. Beside its energy efficiency, the azeotropic mixture also features a high performance coefficient and good oil solubility. "In principle, ammonia-based cooling systems can be filled and operated with R723. However,

the individual application must always be taken into consideration – this is why the conversion should always be clarified with the individual component manufacturers," explains Bernd Kaltenbrunner, member of eurammon and CEO of KWN Engineering GmbH. The energy efficiency of the azeotropic mixture is complemented by a high performance coefficient and a high level of oil solubility. A further great advantage results in the about 15 K lower compression end temperature. This allows that piston compressors reach a larger temperature stroke and enable the use of air-cooled condensers.

"R723 is also environment-friendly, cost-efficient, and readily available in sufficient amounts. R723 systems have been in use for many years. All components are available and sold as "ready to plug in" condensing units or chillers. Another advantage: The relevant authorities treat R723 cooling system like R717 systems, and therefore do not require more extensive safety measures," says Kaltenbrunner. Its low acquisition costs, along with being



The environment-friendly and cost-efficient refrigerant R723 convinced the food-producing company Herrmannsdorfer Landwerkstätten



eurammon member HKT Huber-Kälte-Technik supported the company ABC Foodmachinery s.r.o. based in Bratislava and contributed an R723 refrigeration unit for the construction of a new external refrigeration system.

future-proof and reliable, make the natural refrigerant a popular choice for planners and operators of refrigerating systems.

An environment-friendly add-on for existing systems

These aspects were also in the focus of a project realized by eurammon member Th. WITT Kältemaschinenfabrik GmbH for Herrmannsdorfer Landwerkstätten, a food-producing company. The family-owned business from Bavaria doesn't only set great store by organic farming and food processing, but makes a point of pursuing a holistic sustainable subsistence strategy. This is why the company, when planning a new refrigerating system, looked into environment-friendly alternatives that were not only durable and energy-efficient, but also used natural refrigerants. The idea was for a new cooling system to add to the capacity of the existing one, an ammonia-operated chilled-water system. Herrmannsdorfer Landwerkstätten also wanted their system to be reliable, safe, and easy to maintain.

Against this background, eurammon member Th. WITT Kältemaschinenfabrik GmbH installed a chilled-brine compact refrigeration unit, tailor-made for the specific requirements, charged with 20 kg of the natural refrigerant ammonia dimethyl ether. Using two reciprocating piston compressors, the system has a refrigeration capacity of 64 kW, and is equipped with an evaporator and two condenser fans. Thanks to the combination

of R723 as a refrigerant and air-cooled condensation with EC fans, the refrigeration unit can reach very high energy efficiency under both full and partial load. Despite being completely encased, the refrigerating system can be easily cleaned and serviced thanks to removable side parts. Equipped with a UMTS modem and a W-LAN connection, the entire system can be monitored via the internet.

Perfect cooling components for meat processing

The refrigerant R723 also played the leading part in a project of another eurammon member, HKT Huber-Kälte-Technik GmbH. The refrigeration engineering experts from Halfing, Bavaria, are currently supporting ABC Food machinery s.r.o., a company based in Bratislava, in a project for one of their clients from the meat-processing industry, and contributed an R723 refrigeration unit for the construction of a new external refrigerating system. The unit has a



eurammon member Th. WITT Kältemaschinenfabrik GmbH installed a chilled-brine compact refrigeration unit, tailor-made for the specific requirements of Herrmannsdorfer Landwerkstätten.

refrigeration capacity of 135 kW. At the same time, the cooling set is equipped with heat recovery as full condensation. Therefore, the maximum heating power is 180 kW. This performance is achieved with a fill quantity of merely 7.5kg R723 coolant. The condensers are operated with the fully synthetic alkyl benzene oil.

Regarding the conceptual design of the system, two aspects were of particular importance to the client: energy efficiency and low operating costs. Also, the new solution should use natural refrigerants, be long-lived and durable, and help to reduce CO2 emissions. A special challenge for the planners and fitters was to install the

system on the flat roof of the plant, because this required additional measures during assembly and installation. With this newly installed cooling system, the client now possesses the region's largest R723-based system for poultry production.

Economically sensible and climate-friendly

Efficient, environment-friendly, energetically advantageous, cost-efficient, and readily available in sufficient

amounts: The list of advantages for R723 is long and convincing. The natural refrigerant is especially efficient in the low and medium range of refrigeration capacity - a cooling solution for all kinds of requirements. R723 cooling systems are a good option to operate industrial cooling systems with a natural coolant. Together with R744 and the hydrocarbons, this gives us another option to use a more environmentally-friendly and climate-friendly system technology," sums up Kaltenbrunner. ■

Source
eurammon

Sustainable Buildings

The residential and commercial sector consumes more than a quarter of the total electrical supply usage of the country and major portion of this is utilized in the buildings. Commercial development is witnessing rapid growth. Malls, multiplexes, housing conglomerates are springing in cities. An effective environmental management of building provides the opportunity to reduce overall footprint of urban consumption...

Our personal choices about the level of comfort we want and the means of getting that comfort decides sustainability of our lifestyle. Our small decisions on -- how do we light and air condition our home, offices and shops, use water, dispose waste define livability.

Buildings are the core of all our demand -- water, energy and material. It also creates waste. But just by changing the design, material, and operations of our buildings we can make enormous difference, avert

environmental consequences and achieve green code of living.

This is a challenge in a growing economy that has escalated demand for residential, commercial and institutional space and is pushing the market towards high-end building structures with level of comfort that are resource intensive. Demand for housing and commercial space will explode in India and lock up enormous carbon and energy. The construction industry already 10 per cent of the GDP, is

growing at an outstanding rate of 10 per cent over the last ten years as against the world average of 5.5 per cent per annum. Buildings are one of the largest in terms of economic expenditure, use of raw materials and environmental impacts.

This demands strong public policy to promote efficient use of resources, give the right market signal to prevent guzzling and inefficiency, and promote building designs and structure that help to reduce demand for energy and water.

Break the insidious link between resource use and building Centre for Science and Environment's green building programme is designed to create policy and public awareness for aggressive steps to cut the resource imprint of the building sector.

Energy use in buildings

The energy demand for the building sector has already increased from 14 per cent in the 1970s to nearly 33 per cent in 2005 due to a near consistent 8 per cent





increase in annual building energy consumption growth. The residential and commercial sector consumes more than a quarter of the total electrical supply usage of the country and major portion of this is utilized in the buildings. Commercial development is witnessing rapid growth. Malls, multiplexes, housing conglomerates are springing in cities. An effective environmental management of building provides the opportunity to reduce overall footprint of urban consumption.

What must we do?

Set vision for energy efficiency in buildings: India aspires to reduce the energy intensity of its economy by 20-25 per cent by 2020 to strengthen energy security and to foster climate friendly growth. This in many ways will also set the terms of action in different sectors of economy including the buildings. There is considerable potential for energy savings in buildings. A conventional building in India typically has the energy intensity of 250 kWh/m²/year of energy. The official energy conservation building code for buildings expects to cut this to 140—170 kWh/m²/year. The very high performance buildings can achieve a target of even 75 kWh/m²/year. This programme will therefore push for effective policies to enable stringent targets as well as aim for extensive coverage of buildings under the official energy codes.

Push and track policy development for effective implementation: Green building policies have begun to take shape in India. The National Mission on Sustainable Habitat under the National Climate Action Plan has a significant focus on the energy efficiency of buildings. The Bureau of Energy Efficiency (BEE), under the Energy Conservation Act, 2001, has released the

voluntary Energy Conservation Building Code, 2006 (ECBC) that covers design, construction and operational energy requirements of large commercial buildings; The Environment Impact Assessment (EIA) procedures by the Ministry of Environment and Forests address large building construction projects. These policies are opportunity.

Water and buildings

The building sector represents the worsening demand side crisis clearly reflected in the fact that buildings are responsible for large shares of resource use and waste generation. Beside energy the second most critical issue concerning the building sector, governments, consumers and environmentalists today is possibly water. In fact, water use in buildings accounts for almost 20 per cent of the total water use, which is significant. Rampant lifestyle changes are accompanied by spiraling demand for water for existing uses along with new ones. Water guzzling rain showers, Jacuzzis, heating and cooling systems, swimming pools etc. are not anymore luxuries in the urban aspirations.

What is been done?

India in its National Water Mission document has made a commitment of increasing water use efficiency by 20 per cent in all sectors including domestic. Similarly National Mission on Sustainable Habitat has also emphasized on reducing leakages and improving water efficiency and water reuse in buildings. The growing scarcity of water has led to a renewed focus on reducing water use, recycling and reusing water apart from increasing its efficiency. The discussion on creation of a bureau of water efficiency on the lines of BEE is a reflection of the changing mindset. Buildings offer a huge opportunity for reducing water use and making it resource efficient. Just by replacing regular water fixtures with water efficient ones can reduce water consumption by 30-40 per cent. The inclusion of rainwater harvesting in the building bye laws of several cities is also seen as a step towards water conservation and reducing dependence on dwindling

pipied and groundwater supplies. Though water is still several notches behind energy in terms of policies and regulatory reforms, but has ample opportunities to learn from it too, quickly though.

Voluntary green rating programmes for buildings have also started. But scale of its application is still very limited. This programme aims to achieve mandatory energy efficiency requirements in buildings. As a first step the ECBC will have to be the defining parameter of the energy savings steps in the building sector. To enable this all concerned polices both at the national and state level will have to be harmonized and also aligned with the national building code for effective implementation and coverage. The scale can be achieved only if multi-stakeholder interest can be aligned and a larger consumer awareness programme can be enabled.

Awareness campaign to create demand for green buildings: Green building movement in India can be successful only if people understand the tangible benefits from resource savings that offset the costs of investment in resource efficient buildings. This programme is designed to create public and consumer awareness to build the critical mass of demand for green building. Enable consumer movement through an information network built around the strategies for fuel savings, availability, costs, financial incentives, energy efficiency labelling of the products, water auditing, environment friendly building designs, labelling of products based on efficiency etc.

Convene network of stakeholders for experience sharing and knowledge creation to enhance capacity for sustainable buildings: Energy management in buildings is relatively a new area of governance. A growing community of regulators, urban designers, planners, architect, building developers and financiers, are increasingly coming within the vortex of this. The programme creates and mobilizes networks for experience and knowledge sharing in the public domain to support and strengthen grass root action. ■

Source
Centre for Science and Environment

Terminologies in AC & Refrigeration

There are some common terminologies used by air conditioning and refrigeration professionals. However, these are not properly understood...

Air Conditioning and Refrigeration are two different technologies. Refrigeration is a process of cooling by moving or pumping out heat from a place where it is not wanted to a place where it is less objectionable.

So to achieve any temperature below ambient temperature we require energy. Refrigeration covers entire spectrum from ambient temperature to absolute zero temperature of minus 273.150C. Air conditioning, therefore, is a part of refrigeration covering a narrow band in the range of 190C to 260C where temperature is lowered to suit human comfort. It is therefore not different science but very much the part of refrigeration technology.

The other major areas of refrigeration technology, depending on specific requirements are

- Process air conditioning
- Commercial Refrigeration
- Industrial & Low temperature refrigeration
- Cryogenics

Enthalpy means sum of sensible and latent heat

In reality Enthalpy is the sum of both, internal energy (u) and the product of pressure and volume (pv) or flow energy.

$$H = u + pv$$

Vapour compression refrigeration and air conditioning systems are all in the category of flow processes, and therefore only flow energy is considered with any datum level.

Hence in refrigeration systems we call the total heat as enthalpy, which is the sum of sensible and latent heat. It is measured in BTU's or kcal/hr or Watt.

Technically anything above $-460^{\circ}\text{F}/-273.15^{\circ}\text{C}$ contains heat but we view it relatively. We should, therefore, address as how much heat energy substance contains rather than how hot or cold it is.

Entropy

We use this terminology when we talk of isentropic compression of refrigerant in the compressor, to determine discharge pressure

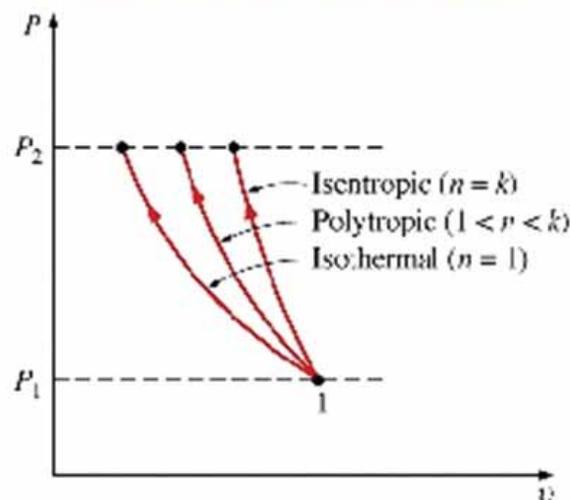
or temperature conditions at the end of compression process. However, the meaning of this terminology is not understood by majority of practicing professionals.

Entropy measures the molecular disorder of a system. The more mixed the system, the greater is the entropy, and conversely an orderly or unmixed configuration is one of low entropy.

The term entropy means transformation. It is thermodynamic property of a working substance, which increases with addition of heat, and decreases with its removal. It is comparatively easy to define change of entropy of a working substance. In a reversible process, over a small range of temperature, the increase or decrease of entropy, when multiplied by absolute temperature, gives the heat absorbed or rejected by the working substance. The

***P-v* Diagrams of Isentropic, Polytropic, and Isothermal Compression Processes**

P-v Diagrams of isentropic, polytropic, and isothermal compression processes between the same pressure limits



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heat absorbed (ΔQ) by the working substance is equal to:

$\Delta Q = T \times \Delta S$ or $\Delta S = \Delta Q/T$ or where T is absolute temperature and ΔS is increase or decrease in entropy.

IS standard 3615 defines entropy as ratio of the heat added to a substance to the absolute temperature at which it has been added.

Since in universe some activity is constantly taking place in all the processes such as mechanical work, electrical work or chemical work including lights and solar energy, and all these forms are finally converted into or generate heat which is the lowest form of energy, the law of thermodynamics states that entropy of universe is constantly increasing.

A simple understandable statement for entropy is a measure of energy unavailable for useful work or wasteful energy. A certain portion of energy added to a system at high temperature is later lost from the system to the surroundings at a lower temperature and this energy is unavailable for doing any useful work between the two temperature involved. Entropy is expressed as kJ/kgK. (Definition given in Automotive Design and Development in Annexure under definitions)

Thermal conductivity

Many professionals use either FPS system or SI system. When looking at the units of thermal conductivity, there is confusion with many users since the units in FPS are per inch thickness basis whereas in SI system they are per meter thickness, hence there is a difference as given below:

In FPS units, it is the rate of heat transfer in Btu per hour per square foot of area per degree Fahrenheit temperature difference per inch thickness.

In order to convert Thermal conductivity 'K' value in Btu.in/h.ft².°F, we need to multiply FPS value by 0.1442 to get 'K' value in SI system (W/m.K) as given in conversion tables.

How this has been worked out is given hereunder

Thermal conductivity, (K): $1 \text{Btu} / \text{h} \cdot \frac{\text{ft}^2}{\text{in}} \cdot ^\circ\text{F} (\times 0.1442) = 1 \text{W} / \frac{\text{m}^2}{\text{m}} \cdot \text{K}$

$$K = \frac{1 \times 1055.056 \text{ J} (\text{J} = \text{W} \cdot \text{s})}{\text{inch} \times 3600 \text{ s} \times (3.2808 \text{ ft} \times 12) \times \frac{1}{3.2808 \text{ ft}} \times \frac{1}{3.2808 \text{ ft}} \times \frac{1}{1.8 \text{ F}}}$$

$$\left[\frac{1055.056 \text{ J} (\text{W} \cdot \text{s}) \times 3.2808 \text{ ft} \times 3.2808 \text{ ft} \times 1.8 \text{ F}}{3600 \times 3.2808 \text{ ft} \times 12 \text{ in}} \right] = 0.1442$$

Hence, when we multiply thermal conductivity in FPS unit by 0.1442 we get Thermal conductivity in SI unit as W/m.K.

Please note the major difference between FPS and SI system. In FPS 'K' value is for per inch thickness where as in SI system it is per meter thickness, hence 'K' value in SI is not W/m².K, but W/m²/m.K = or W/m.K

Many engineers argue that the units indicated in SI units are incorrect and hence we have given this clarification.

Difference between saturation temperature and boiling point

Saturation temperature is another word for boiling point. Every substance has only one boiling point which is at atmospheric pressure whereas it has many saturation temperatures depending upon pressure. Saturation temperature goes up when pressure increases and saturation temperature reduces when pressure reduces. If we refer to refrigerant tables, we notice a small letter 'b' near the temperature and the pressure against the same is always 101.325 kPa, which is the boiling point of the refrigerant.

Heat flow and heat content

Heat flow depends on temperature of the substance and not the heat contained in the substance. If a 100kg metal ball at 99°C is kept with contact with 1kg of metal ball at 100°C, the heat will flow from smaller metal ball to larger metal ball although the heat content of bigger ball is much more.

If we relocate the refrigeration plant from lower climate temperature region to warmer areas, say from Bangalore to Delhi, the same refrigeration plant would operate at higher saturated discharge temperatures (SCT) as the compressor has to raise the energy level beyond ambient conditions so that heat will flow from condenser to atmosphere. Heat content is measured by the formula $Q = m \cdot c_p \times \Delta T$ where m is the mass of substance, C_p is the specific heat and ΔT is the temperature difference.

Difference between Air compressor and refrigeration compressor

In air compressors, the compressor

sucks ambient air and compresses it to desired pressure as warranted by the applications. Mostly the discharge pressure is either 7 bar or 10 bar. In other words, suction pressure is generally same as surrounding ambient conditions where the compressor is installed and working and the discharge pressure varies as per requirement.

In refrigeration compressor operation, it is just opposite. The discharge pressure is dependent on ambient temperature conditions, if it is air cooled application and depends on wet bulb temperature if it is water cooled application. The suction pressure is selected by the design engineer depending upon the application for which he intends to design the system.

In case of air conditioning applications or chilled water applications, suction pressure is high and thus compressor ratio is low. As we reduce temperature, the suction pressure starts falling. For cold rooms, it would be lower than air conditioning application, for -200C cold rooms it would be still lower and for blast freezer applications of -400C it would be very low. But in all these cases saturation discharge pressure remains same so long as we use the same refrigerant for all applications and same condenser cooling methodology i.e. either air or water cooled.

The compressor functions like water pump which raises water from lower level to a higher level. The compressor similarly raises the temperature level from saturated evaporating temperature to saturated condensing pressure so that refrigerant is able to reject heat to a medium which could be either air or water. In other words, compressor raises the energy level of the refrigerant.

A refrigeration compressor pumps a volume of gas. Once suction and discharge conditions at compressor are selected, then mass flow of refrigerant in lbs/hr or kg/hr can be worked out. The system designer should ask for the accurate volume or mass flow rates at specified conditions from the compressor manufacturer. The designer should realize that a refrigeration compressor pumps a required volume of gas, and not

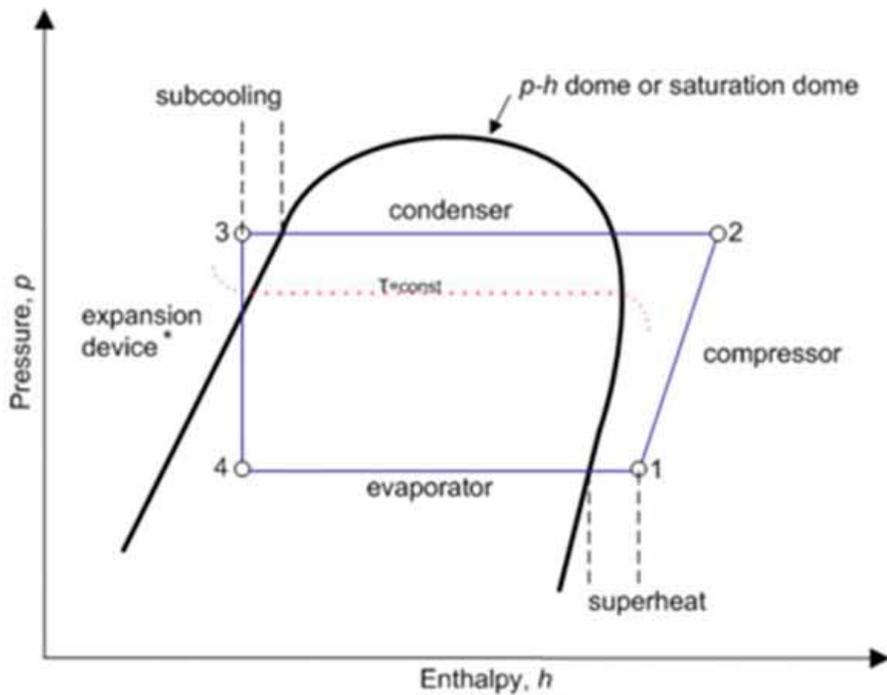


Figure 1

refrigeration capacity.

Another important fact to be remembered is refrigeration compressor is not designed to increase the discharge pressure. The discharge pressure is totally dependent on condenser cooling medium and condensing temperature. I have observed that most of the engineers, while conducting training programs, indicate that function of refrigeration compressor is to raise the pressure. This statement is incorrect. The compressor increases the temperature of refrigerant so that it is able to reject heat to cooling medium. The corresponding pressure to this condensing temperature is the property of refrigerant used in the system. There is nothing built into the compressor whereby one can increase pressure. Once the condensing temperature is decided, the refrigerant discharge pressure will be based on which refrigerant has been used. For example, at 40°C condensing temperature the same compressor, when used with Ammonia refrigerant will have discharge pressure as 14.55 bar whereas it would have, the discharge pressure for R134a refrigerant as 10.11 bar and with 404A 18.5 bar approximately and with 410A 24.5 bar approximately.

Thus, it can be seen that compressor manufacturer does not provide any feature which enables these different pressures to

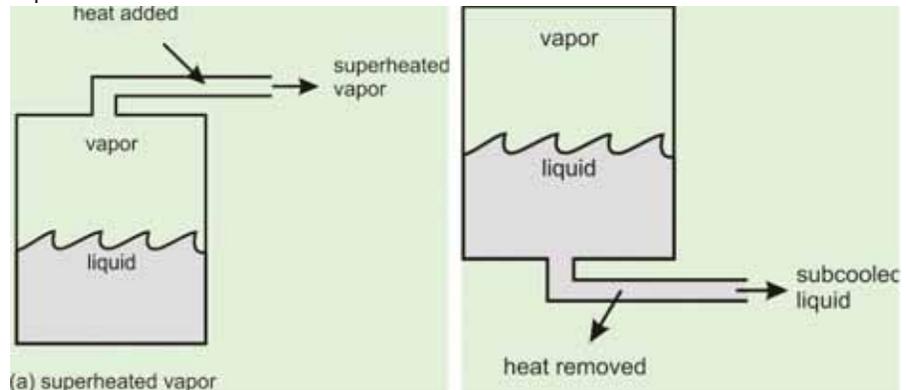
be obtained. The same compressor is used with different refrigerants. It is the property of refrigerant which decides compressor discharge pressure.

Sub cooling & superheating

Many professional do not clearly understand the meaning and use of these terminologies.

In order to understand these, knowledge of P-H diagram is essential. Refer Figure 1.

Sub cooling the refrigerant before it enters the expansion device increases the system capacity without increasing compressor power and this is possible to certain extent by providing additional sub cooler or building extra area in water cooled condenser where the liquid gets trapped and then it can be cooled by separate water circuit.



Majority of compressor manufacturers indicate in their published catalogues, compressor capacity with 100F or 150F sub cooling. This makes the power consumption per ton of refrigeration looks very attractive and many engineers come to me stating that so and so compressor consumes lower power as compared to that of other manufacturer who has published ratings at saturated conditions without sub-cooling. I ask the engineer to go to compressor manufacturer and find out how the compressor achieves sub-cooling as per published rating. The answer always is it is not the compressor which achieves sub-cooling but system designer must build the sub cooling circuit in his plant design or provide additional suction liquid line heat exchanger. One has to therefore be careful while comparing two manufacturers ratings to ensure both are on common basis of saturated conditions and not with sub cooling.

It can be seen from the P-H diagram that that only liquid can be sub cooled and only gas can be superheated. A mixture of refrigerant cannot be superheated or subcooled.

If we want to subcool the liquid, then it should be 100% liquid and no vapours. If vapours are present, the cooling provided would be first used in condensing the vapours and not sub cooling the liquid. Some manufacturers build separate liquid trap in condenser where only liquid accumulates and then it can be sub-cooled by providing independent water circuit. Similarly, if we wish to superheat the vapours it has to be 100% vapour. If some liquid is present, the heat would first be used in evaporating liquid and not superheating the vapours. The

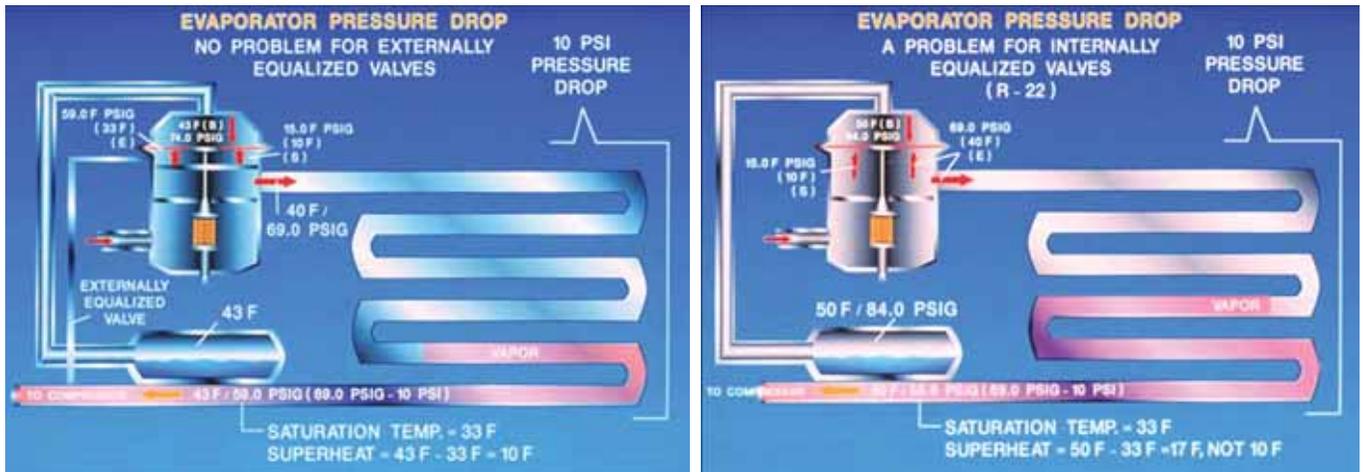


Figure 2

superheating and sub-cooling has to be at constant pressure as shown in the P-H diagram. If the pressure changes the saturation properties of refrigerant change.

Useful superheat

There is nothing like useful super heat. It may be useful from compressor point of view as providing superheat minimizes risk of liquid coming to compressor.

The superheat in the suction line from outlet of the evaporator to inlet of compressor should be kept bare minimum as it reduces compressor capacity. The myth is regarding useful superheat. If one studies in detail the thermodynamic cycle, superheat is never useful as it increases the specific volume at the entry of compressor, thereby, reducing the mass flow rate and thus the cooling capacity. It is useful in the sense that it only helps in protecting the compressor by reducing the chances of getting liquid at the suction of the compressor. Similarly, if superheat is produced in the evaporator, vapour zone area becomes larger thereby making evaporator less efficient as expensive heat transfer area is used for superheating rather than for latent heat transfer by way of evaporation, which is the main function of evaporator. The most efficient system is without any superheating of suction gas which is possible with all flooded coolers predominantly used in Ammonia systems.

Centrifugal machines or screw chillers working with R134a, 404A also use flooded evaporators as these are more efficient than direct expansion evaporators.

Figure 2 show that when superheat in the evaporator increases the more area of evaporator is wasted

Superheat Reduces Capacity

KC3 COMPRESSOR + 40°C / +5°C = AMMONIA

SUPERHEAT	CAPACITY Kcal/hr
0 K	359400
5 K	350700
10 K	342600

Latent heat makes refrigeration systems work efficiently

It is very important to keep in mind that it is only the latent heat which makes refrigeration systems work efficiently. Sensible heat has hardly ant contribution. Hence, the refrigerant which has maximum latent heat is the most efficient refrigerant.

Ammonia refrigerant is therefore more efficient than currently used any other refrigerants. Ammonia has highest latent heat as compared to other refrigerants as can be seen in Figure 3.

Ammonia refrigerant being natural refrigerant having the best thermodynamic

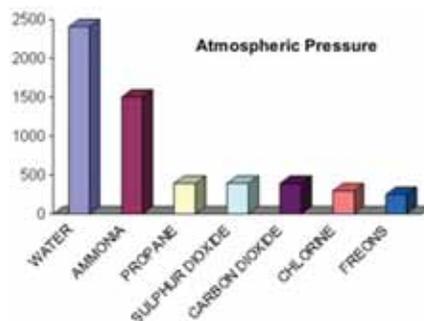


Figure 3

efficiency, and having no global warming effects is now increasingly being used in air conditioning installations where the machine room is away from the human occupied areas. Few major once are indicated below:

- Oslo Airport -Norway
- Heathrow Terminal -5
- Singapore Airport
- Dusseldorf Airport
- Zurich Airport
- New Zealand Christchurch Airport
- Stuttgart Airport Terminal 3-2300kW Grasso
- Telephone Exchange- Copenhagen
- Thermal storage systems for Malls, Cinema Halls
- KWN Greenpeace Headquarters-Vienna
- Sabb-Linkoping-Sweeden-4 ammonia chiller of 2 megawatts
- Berlin Ostbahnhof train station-Grasso system for three storey building complex
- Roche Headquarters in London -930 kW- Star Refrigeration
- Mulligan Letter sorting center-Switzerland-Johnson Controls
- Ozeaneum in Stralsund-Johnson controls-500kW A

Ramesh Paranjpey
Fellow Life Member, ASHRAE
Member IAR USA

ACREX 2017: Opportunities Galore

ACREX India will open its doors in Greater Noida, Delhi-NCR from 23 to 25 February 2017. The theme for this year at ACREX India 2017, **Rising India: Enterprising and Cool**, is directly linked to the growing economy of India.



18th Edition of ACREX India will open its doors in Greater Noida, Delhi-NCR from 23 to 25 February 2017. South Asia's leading trade fair on Refrigeration & Cold Chain, Air Conditioning, Ventilation & Intelligent Buildings is organised by Indian Society of Heating, Refrigerating and Air Conditioning Engineers (ISHRAE) and produced by NuernbergMesse India.

It has been an endeavour of ISHRAE to bring HVAC&R industry into the forefront and make ACREX India the most coveted event for the built environment. Therefore, ISHRAE has formulated a Build Fair Alliance (BFA) this year, with five independent shows catering to the various segments of the building construction industry. BFA will bring different players of the construction industry under this umbrella and thus offer all stakeholders of the industry an opportunity to acquaint themselves with the latest technology in the field. The Alliance comprises following events and will be conducted at the same venue as ACREX India:

- **ACREX India:** Covering HVAC, Refrigeration and Building Automation systems
- **ISH India powered by IPA:** International trade fair showcasing plumbing, sanitation, bathroom & kitchen, renewable energy and home automation systems in India
- **Fire & Security India Expo (FSIE):** Previewing fire safety and security solutions
- **FENSTERBAU FRONTALE India:** Focusing on Façade & Fenestration products

- **glasspro INDIA:** Encompassing solutions and innovations for the glass industry

"With every edition, ACREX India is becoming grander than before – offering more opportunities for stakeholders across the industry. Build Fair Alliance is an initiative to bring five strengths of the built industry under one roof. All individual experts under the alliance will present the best ever platform with respect to participation and networking opportunities for the construction industry. We look forward to welcoming you there!" says, **Sonia Prashar, Managing Director, NuernbergMesse India.**

ACREX 2017 is expected to attract 500 exhibitors, 30 percent of them from outside of India and more than 50,000 decision-makers, architects, developers, end consumers, advisers and project managers.

The venue, India Exposition Mart (IEM), Greater Noida, Delhi-NCR, will be hosting the event for the first time. This location provides a larger exhibition area, which meets the call from ACREX exhibitors for more space. Even the area for which firm bookings have been received so far is up 15 percent as compared to 2016 edition.

India is the fastest growing economy in the world today – an impressive position it has held since the year 2015. The theme for this year at ACREX India 2017, **Rising India: Enterprising and Cool**, is directly linked to the growing economy of India, laying emphasis on how welcoming a country can be.

"India is currently one of the favourites of the major international players. The world views our country as an engine for growth for their business," said **Ashish Rakheja, Chairman, ACREX India 2017.** He added, "There is a greater focus on

energy efficiency and end consumers, skilled workers and installers all consider there will be more and more need for energy-saving technologies. There is growth in all areas – hospitals, retail, industry, infrastructure and commercial development zones – which offer incentives for central industrial plant businesses. The refrigeration industry is also enjoying continued growth. All of this offers the ideal conditions to make ACREX India 2017 a success".

ACREX India 2017 will have country pavilions hosted by Turkey, Germany and China. Besides these, there is individual participation by 25 countries including USA, UK, UAE, Taiwan, Italy, France, Hong Kong, Russia, Mexico, Sweden, Korea, South Korea, Thailand, Czech Republic, Switzerland, Malaysia, Vietnam and many more. Russia and Hong Kong will also be participating in the event for the first time. Country delegations are expected from Malaysia, Indonesia, Turkey and China. One of the biggest highlights this year is Turkey as Guest Country at the event. Turkey will be represented by ISIB in order to improve relations between India and Turkey.

Besides participation of international global players, the event show has international support from organizations like ASHRAE, REHVA, ISKID, CAR, ANPRAC, Eurammon, KNVIK, ISIB, CIBSE, etc.

Focus on MSMEs

The objective of the event is also to give small and medium-sized enterprises better opportunities to participate in the trade show. Special packages have been developed for them, including an exhibition area of 6-9 m² with a hostess provided, along with airport transfers, hotel accommodation and tickets for important industry events as part of the trade show. Next year there will also be a focus on increased participation by companies in the automation industry. From the perspective of manufacturers and skilled workers, this sector offers strong parallels with the Heating, Ventilation, Air Conditioning and Refrigeration technology industries. ■

Testo in Making of Smart HVACR World

The air capture hood Testo 420 and the new range of Smart Probes equip users with smart and easy measurement techniques by using smart phone interface. The new electrical instruments are very distinct and unique in its features...



the working system, there is a need to implement a technology that is self-driven, convenient and equally efficient. That is how we have come up with ideas of cloud data storage, Wi-Fi, bluetooth operation and smart phone integration technique that has simplified functioning of every industry. All time consuming, manually driven operations or record keeping can now be governed with just once click, making the process more easy, accurate, fast and reliable.

Testo India provides multiple instruments to various industries with distinguished utilities and applications. However, we understand that the necessity for any application is the ease with which the instrument operates, minimum optimal time it requires to perform the test and the genial feel that is renders to the user. In short, the need is to have a smart technology with smarter instruments, and this is precisely what we deliver. Currently, Testo products are used for HVACR applications with parameter measurement like temperature, humidity, pressure, RPM, lux, electrical etc, data monitoring, flue gas analysis, combustion and emission controls and thermography. As we all know, with the growing digitization of

As mentioned earlier, the latest trends and technologies that we are witnessing are coming from the digitization of the existing systems. The traditional methods and processes are now getting replaced with smart solutions and we believe in keeping pace with the new advancements prevailing around. Thus, our new product range for instance, the air capture hood Testo 420 and the new range of Smart Probes equips users with smart and easy measurement techniques by using smart phone interface. The new electrical instruments are very distinct and unique in their features. WiFi Data Logger – Saveris 2 is an excellent advancement in data monitoring system. With a secure online



storage of all readings in Testo Cloud, the data can be managed and analyzed online by the user via smartphone, tablet or PC absolutely anywhere and anytime. Our latest solution to the industry is new range of Thermal Imagers with smart phone integration designed to deliver networked thermography. Their wireless operation, with the ease of saving and transferring data over networks, make our instruments more user-friendly and cost effective. Our continuous approach towards innovation, research and development, ensures eminent future of our products which are sure to redefine the overall working experience of test & measurement sector.

For instance, the Testo Smart Probes are eight intelligent, wireless probes which equip clients with smart measure real time and can be operated with his smart phone. This makes the Testo Smart Probes not only lighter and more compact than conventional measuring instruments, but they can also be operated with greater convenience. These pocket-friendly smart probes can travel with clients, wherever they go.

On the other hand, the App for new manifolds Testo 550 and Testo 557 is one of many new developments with which Testo is once again meeting requirements of the market, and underlining their expertise in refrigeration. A further highlight is Pirani probe developed by Testo for the new testo 557, which allows highly precise vacuum measurements.

With the smart solutions coming up and increased focus on advanced technology, the HVAC industry is showing great potential and growth opportunities. Testo India also enjoys its share in this success story and strives to cater the segment with its latest technology. Testo India is now even more posed towards growth of this industry with its dedicated and smarter measurement solutions. ■

Fluke Laser Levels Deliver Accuracy

Fluke Corporation introduces Fluke® Laser Levels, a new line of professional-grade, precision tools that are designed to survive a one meter drop and keep working. The Laser Levels feature a fast settling, self-leveling gimbal that quickly delivers accurate reference points, expediting electrical and HVAC layouts.

The Fluke Laser Level family includes:

Fluke-3PR (red laser) and Fluke-3PG (green laser) Point Laser Levels— self leveling three-point laser levels for fast, accurate layout of reference points. Accurate to 6 mm at 30 meters (1/4

inch at 100 feet), it includes a floor stand for fast, easy overhang and centerline measurements. The green laser (Fluke-3PG) is up to three times brighter for



improved visibility in outdoor and long range applications.

Fluke-180LR and Fluke-180LG Line Laser Levels— self-leveling, horizontal- and vertical-cross line laser levels for rapid, accurate (3 mm at 10 meters; 1/8 inch at 30 feet) leveling and layout.

Fluke-LDR and Fluke-LDG Laser Line

Detectors — laser line detectors for use in high ambient light settings with visual and audible indicators for ease of use. The detectors are compatible with Fluke-180LR (Fluke-LDR) or Fluke-180LG (Fluke-LDG) models and include mounting bracket for quick, steady positioning.

Fluke-180LR System and Fluke-180LG Systems — comprehensive self-leveling, horizontal- and vertical-cross line laser level systems that include laser line detector and detector bracket for use in high ambient light settings.

All laser level models include magnetic wall brackets for easy, stable mounting. ■

Easy Way of Buying HVAC Tools



A few advantages of online purchase:

- Save precious time and energy
- Save money
- Secure payment systems
- At convenient time
- Compare prices & features

Infinity HVAC Spares & Tools has been a leading supplier of high quality tools for the last two decades all over India. Infinity also has exclusive retail outlets in Dadar, Thane, Pune and Nashik.

Over the years, Infinity has developed a reputation for dealing in great products at honest prices. www.hvacmall.in is an extension of the same. Here we are enabling our customers to purchase

online from the comfort of their home globally tested products of reputed brands.

Online shopping experience at www.hvacmall.in is easy, enjoyable and secure. It has a wide range of products from thermometers, vacuum gauges, vacuum pumps, data loggers, measuring instruments, manifolds, hand tools, water pressure pumps, etc. A few of its benefits for clients:

- Best prices – Infinity offers their best prices at www.hvacmall.in.
- Free Shipping – Client gets free

shipping and that saves more money.

- Cash on delivery- COD option is available within the city limits of Mumbai, Thane, Pune and Nashik for order values of above Rs 1000/.
- Secure Payments – www.hvacmall.in is tied up with Infibeam, one of the largest online retailer and a premier technology provider in India.
- Company backing – The online portal is run by the reliable and trusted Infinity HVAC Tools, so the client has the backing and after sales support.
- Top brands – All the best brands - Supco, Refco, Mighty Mounts, Rex, Kyowa, Extech, Aspen, Microdam well-known in the industry for years.
- Way to the future – The online retail industry is the way of the future, so step in and reaps the benefits. ■



Carrier's Launches AquaEdge™ 19dv Centrifugal Chiller

Carrier officially launched its latest innovation, the new AquaEdge™ 19DV centrifugal chiller with Greenspeed™ intelligence and PUREtec™ low Global Warming Potential (GWP) refrigerant. The new product, which was previewed at the China Refrigeration Expo earlier this year, was unveiled at Shanghai Yileng Carrier Air Conditioning Equipment Company Limited, a local Carrier entity. The breakthrough technology is now commercially available for the first time and delivers on customer demands for excellent performance, leading efficiency and environmental responsibility, due in part to the use of environmentally sustainable refrigerant R1233zd(E), which has a GWP of 1.34. Carrier is a part of UTC Climate, Controls & Security, a unit of United Technologies Corp.

"The AquaEdge 19DV centrifugal chiller is illustrative of Carrier's ongoing

commitment to innovation and technology leadership through the development of energy-efficient, reliable and environmentally-responsible solutions to serve different segments," said Guarang Pandya, President, Asia Pacific, UTC Climate, Controls & Security.

The AquaEdge 19DV features advancements in refrigeration, mechanical design, aerodynamics and heat transfer to provide efficiency improvements of up to 7.0 COP full-load and 11.8 IPLV.IP as rated in accordance with and certified by AHRI 550/590-2015 at standard rating conditions. In particular, the back-to-back compressor offers excellent compression efficiency with an optimized design and simultaneously cuts down 75 percent of the mechanical transmission loss by using

a high-speed direct driven motor, as compared to that driven by gears.

Equipped with Carrier's latest achievement in PIC5+ intelligent controls, and integrated with the Carrier lifecycle data management system, the AquaEdge 19DV allows users to easily track and analyse the chiller's operational data which helps to identify potential risks or areas for upgrading.



The control system can also be linked to the user's building automation system, enabling remote access to the chiller's running data in real time.

The AquaEdge 19DV adopts multiple technologies to optimize itself for robust operation in various demanding scenarios.

Honeywell's Sensors Help Reduce Energy Costs

Honeywell announced it has expanded its line of pressure monitoring sensors designed to minimize the total cost of pressure management for HVACR.

Honeywell's PX3 series heavy duty pressure transducers convert pressure into an analog electrical signal. The sensors feature brass housing and can support multiple configurations to minimize implementation and production costs.

"Building owners and operators are facing more pressure to optimize efficiency for their HVAC and refrigeration systems and incorporate new refrigerants to meet environmental standards," said Graham Robinson, President of Honeywell's Sensing and IoT business. The new line of pressure transducers is



compatible with many next-generation, low-global-warming-potential refrigerants, including Honeywell's Solstice® N40. As the lowest-GWP, non-flammable, refrigerant alternative to R-404A and R-22 available today, Solstice N40 is widely requested by companies committed to sustainable development. It has a GWP that is 68 percent lower than the current, most commonly used supermarket refrigerant, R-404A. In supermarket trials conducted in the US and Europe, Solstice N40 demonstrated three percent lower energy consumption in low-temperature applications, and five to 16 percent lower energy consumption in medium-temperature applications.

The new line expands the sensors' pressure range to 1 bar to 50 bar (15 psi to 700 psi). In addition, the PX3 series also offers:

- Freeze-thaw resistance to frost, which is commonly found in refrigeration systems
- High electromagnetic compatibility (EMC) radiated immunity to operate
 - Shock and vibration tolerance
- Wide operating temperature range
- Durable design with high surge immunity at $\pm 1000V$ line to ground per IEC 61000-4-5.

Honeywell's Sensing and IoT business supplies custom-engineered sensors, switches, machine safeguarding and other devices globally to offer original equipment manufacturers enhanced precision, repeatability and durability. Honeywell's sensors help HVAC and refrigeration systems operate efficiently, accurately and reliably to help avoid high energy costs. This technology portfolio provides HVAC and refrigeration control, monitoring and temperature solutions while maintaining energy efficiency. ■

Samsung's Wind-Free™ Air Conditioner

Samsung Electronics announced it will unveil its first ever, award-winning Wind-Free™ wall-mounted air conditioner at CES 2017 in Las Vegas, following the huge success of its floor-standing Wind-Free™ air conditioner in South Korea. The AR9500M air conditioner has integrated Samsung's exclusive Wind-Free™ Cooling technology into its design – providing customers with a cooler indoor climate and optimal energy efficiency without the discomfort of direct cold airflow.

“Consumers will love the cool, efficient air conditioning capabilities of the AR9500M in their home,” said Byung-Sam Seo, President of home appliances at Samsung Electronics. “And they will really love that they no longer have to deal with uncomfortable, cold air – as well as reduced electric bills.”



The AR9500M provides customers with the ideal condition by maintaining the comfortable room temperature, using Wind-Free™ Cooling to gently disperse cold air through 21,000 micro air holes. A

the AR9500M's motor generates fewer torque fluctuations – reducing the overall energy required and shortening the time needed for the compressor to reach its maximum speed (Hertz).

The AR9500M is also Wi-Fi-enabled so it can be controlled from anywhere through Samsung's Smart Home app. Users can remotely regulate temperature, adjust settings, receive real time updates about performance and daily energy usage, as well as troubleshoot solutions

when a repair is needed.

The AR9500M's unique Triangle Architecture has a wider inlet which allows more air to be drawn in at once, while the optimal width and angle of the outlet, extra v-blades, and large fan – 22 percent larger than previous models – ensure air is cooled and expelled faster, farther and wider, to reach every corner of the room. ■

two-step cooling system which first lowers temperatures in “Fast Cooling Mode” and then automatically switches to “Wind-Free™ Cooling Mode” creating “still air” once the desired temperature is reached. This approach can also reduce energy consumption by up to 72 percent compared to Fast Colling mode.

Using Samsung's new Digital Inverter 8-Pole with POWERboost technology™,

Daikin Applied updates EWAD-TZ chiller

Capacity

170kW to 710kW

EWAD-TZPSPR | EWAD-TZXSXR

The EWAD-TZ chiller covers a range of capacities from 170kW to 710kW – a capacity range three times as wide as the units it replaces. On top of this, the full load efficiency (EER) average of 3.4 is 35% better than a traditional screw chiller and the seasonal efficiency (ESEER) of up to 6.0 is 26% higher than a traditional screw chiller. Plus the unit is 30% smaller in footprint.

Features

- High energy efficiency both at full and part load conditions
- One or two truly independent refrigerant circuits for outstanding reliability



- Advanced compressor technology featuring integrated inverter and variable volume ratio (VVR)
- Low operating sound levels are

achieved by the latest compressor and fan design

- Compact design for small footprint and minimized installation space ■

Forthcoming Events At A Glance

Cooling Technology Institute Annual Conference

Venue: Sheraton New Orleans, New Orleans, LA 70130
Date: 5th to 9th February, 2017
Website: www.cti.org

Aqua-Therm

Venue: IEC Crocus Expo Centre, Moscow
Date: 7th to 10th February, 2017
Website: www.aquatherm-moscow.it

Campus Energy 2017

Venue: The Hyatt Regency Miami, Miami Florida
Date: 20th to 24th February, 2017
Website: www.cvent.com

Acrex India

Venue: India Expo Centre (IEML), Greater Noida, Delhi
Date: 23rd to 25th February, 2017
Website: www.acrex.org.in

Climatización Y Refrigeración 2017

Venue: Feria de Madrid, Madrid, Spain
Date: 28th February to 3rd March, 2017
Website: www.ifema.es/climatizacion_06/

HVACR Vietnam

Venue: Saigon Exhibition and Convention Centre (SECC), Vietnam
Date: 29th to 31st, March 2017
Website: www.hvacrseries.com

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Modbus Integration solved at Galeria Manhattan Shopping Mall

Contemporary Controls announced that three of their popular BASgatewayLX – Modbus to BACnet gateway – were used to integrate 66 System Air heat pumps at the newly renovated Galeria Manhattan shopping mall in Gorzów Wielkopolski, Poland. Each heat pump then appeared as a “virtual BACnet device” to the BACnet headend. A single BASgatewayLX can easily handle up to 30 Modbus devices and 1,000 points.



Nord Instal and MOBBI needed to integrate HVAC, lighting, power monitoring, security and water monitoring at the Galeria Manhattan shopping mall. Using Delta Controls controllers, MOBBI lighting controllers and the BASgatewayLX, Nord Instal was able to provide complete system integration. The system included controls for the outside building lights; controlling and managing current power receivers; monitoring sewage pumping stations and sewage treatment; control of chillers, cooling towers, ventilation and heat pumps; and central control and monitoring of temperature. Modbus is commonly found on jobs such as heat pumps, boiler control, variable speed drives, and metering applications, but these devices lack BACnet compliance. ■

Siemens improves energy efficiency of largest museum

Siemens was awarded the contract to comprehensively upgrade the lighting, water and cooling systems of the museum organization. The Energy Performance Contracting (EPC) agreement has a value of 4.2 million euros. The investments will be paid back over seven years through the energy savings achieved.

Museum Victoria in Victoria is the largest museum consisting of three large individual museums including the Melbourne Museum, the Immigration Museum, a heritage listed exhibition space, and Royal Exhibition Building, as well as two storage facilities. The State Government of Victoria is aiming to make the operation of all its museums more environmentally



friendly. This includes reducing greenhouse gas emissions and potable water use. This will include installing the Desigo CC building management system which will see optimization of the control strategies for the mechanical plant.

The system also has the future capability to integrate with the existing lighting, fire and security system at the Museum. The energy consumption of the chiller plants will be optimized using Demand Flow at the Melbourne Museum, whereas at the Immigration Museum, the existing chillers will be replaced completely. All museums will see upgrades that reduce water use

and make lighting more energy efficient via implementation of a new lighting design. ■

Platinum Rating for Delta Electronics India Mumbai Office

Delta, a global leader in power and thermal management solutions, announced its Mumbai office has successfully achieved a Platinum Rating under the USGBC LEED (Leadership in Energy & Environmental Design) Commercial Interiors Rating System. The interior of the Mumbai office was designed using energy efficient architecture, natural sky-lighting and ventilation, rain water harvesting and water recycling, as well as eco-friendly building materials that provide a clean, healthy, and safe workplace for employees.

For harmony with nature and the local community, every detail of the factory fulfills green building criteria. For instance, the building has an above baseline energy performance of 37%, reduced water use by 40%, and natural lighting for 85% of the total area. The building also has facilities for parking and charging electric



vehicles. Dalip Sharma, Managing Director of Delta India said, “The certification recognizes our efforts in reducing the environmental impact of our business operations, daily processes, products, buildings and R&D. We are committed to energy savings and environmental protection to help diminish the serious threat of global warming. In addition, the platinum rating confirms that our efforts go beyond mere compliance with ecological guidelines.”

As one of its commitments to corporate social responsibility, Delta designs its plants and offices to be in sync with the green building spirit. When planning new buildings, Delta’s focus is on energy efficiency, minimizing impact on the environment, indoor air quality, a healthy environment and the employee feel good factor. ■

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