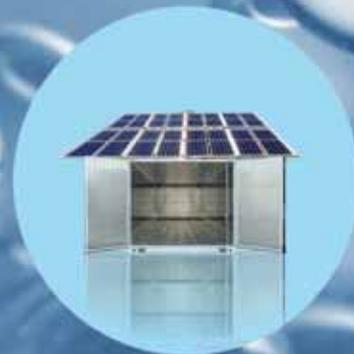
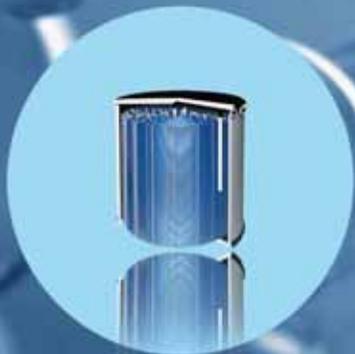


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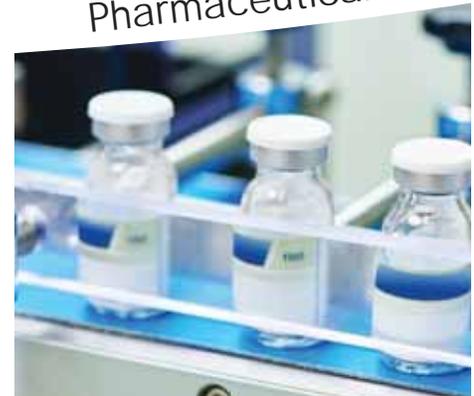
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Healthcare



Pharmaceuticals





Publisher's Letter

Hello and welcome once again to *Cooling India*.

India is a leading producer of milk and second-largest producer of fruits and vegetables in the world. However, more than 15-16 per cent of this produced fruits and vegetables goes waste due to lack of adequate and proper cold storage and cold supply chain facilities.

Today, India has around 7,500 cold storages with installed capacity of over 40 million tonnes. According to a government estimate published in 2017, nearly 75 per cent of the total cold storage capacity in India is used for the purpose of storage of horticulture crops including potato. Moreover, 95 per cent of cold storages in the country were owned by private sector, 3 per cent by cooperatives and only 2 per cent are under Public Sector Undertakings. This depicts the poor state of cold storage infrastructure in India.

However, in the recent past, laying emphasis on improving cold chain infrastructure, the government has made an investment of over \$1 billion during 2014-19 in the food processing sector, double from investment made between 2004 and 2014. According to Crisil Research, the Indian cold storage chain market is expected to log a CAGR of 13-15 per cent over the five years through fiscal 2023, from around Rs. 27,900 crore in fiscal 2018.

Besides, on 23rd October last year, Cabinet Committee of Economic Affairs (CCEA) has also approved the setting up of a dedicated Fisheries and Aquaculture Infrastructure Development Fund (FIDF) worth Rs. 7,522 crore to fill the large infrastructure gaps in fisheries sector in the country through developing infrastructure projects that include cold storages.

In August, we will bring you a special issue on food industry HVACR wherein we'll discuss on the changing face of food industry highlighting the transformation in terms of HVACR product innovations and disruptions. We invite you to be a part of this upcoming issue.

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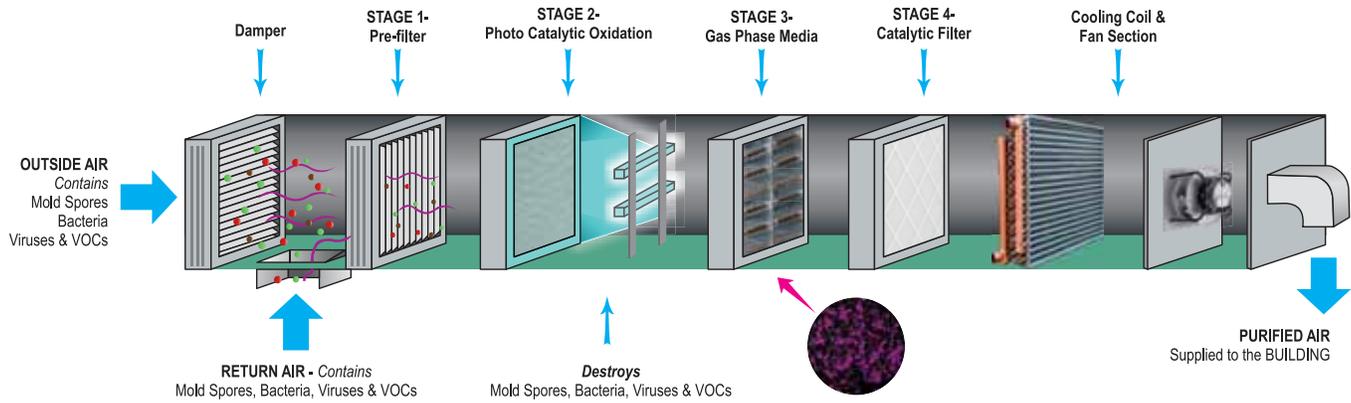
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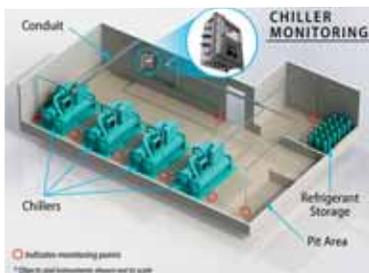


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F&B Cold Storage Gaining Traction

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Johnson Controls opens HVAC Rooftop Centre of Excellence

Johnson Controls opens Rooftop Centre of Excellence facility for HVAC rooftop unit design, manufacturing and testing. Johnson Controls officially opened the state-of-the-art Rooftop Centre of Excellence design, manufacturing and testing facility during a grand opening. The facility has been located in Norman, OK for nearly 50 years and will now serve as the flagship location for industry research, manufacturing and testing of Johnson Controls HVAC rooftop units. The 900,000-square-foot facility includes almost 400,000 square-feet of incremental laboratory and manufacturing space and renovations to over 150,000 square-feet of office and meeting space. "Investing in the future of rooftop unit innovation in design and manufacturing is an investment in our customers," said Steve Maddox, Vice President of Engineering, Commercial Ducted Systems, Johnson Controls. "The expertise of the people leading this facility increases our speed to market, provides unmatched quality assurance and supports the development of industry-leading, energy efficient technology." The plant includes a two-story, 52-foot high testing lab roughly the size of one-and-a-half football fields. The extensive laboratory offers an environment that allows Johnson Controls to conduct on-site, complex development, regulatory compliance, performance, safety, and reliability testing including the ability to test a 150-ton rooftop unit in climates ranging from -30F to 130F.

"The need for high-efficiency rooftop units has grown as customers demand simplified solutions to achieving sustainability," said Philip Smyth, Director of Product Management, Applied DX, Johnson Controls. "The combined testing and manufacturing location allow us to better serve our customers while enhancing HVAC technology through collaboration and innovation." ■

Carrier and Clayton announce exclusive HVAC supplier relationship

Carrier is launching a national program with Clayton Home Building Group, one of the nation's largest off-site and on-site home builders, to provide SmartComfort by Carrier furnaces for all off-site constructed Clayton Built homes nationwide. The SmartComfort by Carrier brand products will be exclusive to Clayton in the off-site built housing industry and run on the same technology that is featured across Carrier's portfolio of products. Carrier, a leader in high-technology heating, air-conditioning and refrigeration solutions, is a part of Carrier, a global provider of innovative heating, ventilating and air conditioning (HVAC), refrigeration, fire, security and building automation technologies.

"We're pleased to offer the SmartComfort by Carrier brand to Clayton homeowners," said Mike Ackermann, Senior Manager, National Accounts, Carrier Residential HVAC. "The off-site built housing segment is new for Carrier and this collaboration will allow us to provide innovative and reliable equipment to meet the unique needs of customers living in manufactured and modular homes."

Clayton Home Building Group started the testing phase of SmartComfort by



Carrier in May 2019. The smart, durable design of the SmartComfort units delivers dependable performance and all-year comfort. Consumers will benefit from a dense coil guard for easy maintenance, air filtration and an insulated and sealed unit for energy efficiency and noise reduction.

"This long-term business relationship will allow Carrier to develop products and solutions to meet the needs of one of the most innovative home builders in the industry," said David Meyers, vice president, sales and distribution, Carrier Residential HVAC.

"We are thrilled to work with Carrier to provide our homeowners with innovative, top-of-the-line, heating and cooling solutions for their Clayton Built home," said Keith Holdbrooks, President of Clayton Home Building. "The Clayton and Carrier brands share a common commitment to providing an excellent customer experience and creating high quality, innovative products that make our customers' lives easier." ■

Whirlpool and Nidec complete Embraco deal

Whirlpool has confirmed the completion of the sale of its Embraco refrigeration compressor business unit to Japanese company Nidec. Nidec's bid for the Embraco business last year prompted an investigation by the European Commission after concerns that the takeover might reduce market competition. The deal was cleared in April of this year after Nidec committed to sell its Secop refrigeration compressor business, which included plants in Austria, Slovakia and China. These were subsequently sold to private equity funds ESSVP IV LP, ESSVP IV (Structured) LP and Silenos GmbH & Co KG.

Despite the sale of the Secop group, Nidec says it believes the deal to buy

Embraco will enable it to expand further into the global refrigeration compressor market through an expansion of its product portfolio and sales area. Embraco will also remain a significant supplier of hermetic compressors to Whirlpool Corporation.

In addition, it sees ever stricter environmental regulations stimulating customer demand for Embraco's eco-conscious and space-saving refrigeration compressors. Nidec also believes its brushless DC motor technology will complement Embraco's compressors. Furthermore, as motors and compressors have similarities in terms of the nature of components used, Embraco expects to reduce procurement costs by taking advantage of synergies of the Nidec group's purchase capabilities. ■



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Montreal Protocol to step up its fight against ozone damage

As the 41st Open-Ended Working Group of the Montreal Protocol opened on 2nd July in Bangkok, EIA released the new briefing High Stakes with recommendations for tougher and more effective commitments under the Montreal Protocol.

After more than three decades as the world's most successful international environmental agreement, the Montreal Protocol is now being put to the test by illegal manufacture and trade in banned or controlled chemicals which damage the ozone layer and drive global warming.

Alarming high, unexplained CFC-11 emissions were initially exposed by scientists in a letter to Nature. The subsequent undercover investigations identified illegal production and use of CFC-11 in China for the polyurethane (PU) foam insulation sector as the likely root cause.

A new study confirmed the findings, primarily in the north-eastern provinces of Hebei and Shandong; 40-60 per cent or more of the global emissions increase since 2012 can be attributed to this region. EIA Climate Campaign Lead Avipsa Mahapatra said, "The huge and alarming CFC-11 spike must inevitably raise questions as to the fitness of the Montreal Protocol's institutions and controls.

"This considerable illegal trade, including illicit production as well as use, happened on the Protocol's watch and we're calling for a comprehensive fitness check of the Montreal Protocol to ensure it keeps ahead of the game.

"These will ensure not only that ozone-depleting substances (ODS) continue to be phased out but also that the Protocol can properly address new challenges unique to the phase-down of hydrofluorocarbons (HFCs) under the Kigali Amendment." ■

Chemours inaugurates New Opteon refrigerants facility

The Chemours Company (Chemours), a chemistry company with leading market positions in fluoroproducts, titanium technologies, and chemical solutions, formally inaugurated its new Opteon production facility near Corpus Christi in Ingleside, Texas.

The USD 300 million production facility will triple Chemours' capacity of Opteon YF, a hydrofluoro olefin (HFO)-based refrigerant, now used in millions of vehicles and thousands of retail stores around the world. When used in automotive air conditioning, Opteon YF has a Global Warming Potential (GWP) that is 99.9 per cent lower than the legacy refrigerant it replaces, helping to reduce greenhouse gases and taking a significant step toward meeting environmental global-warming regulations around the world.

Chemours and its predecessor companies have been manufacturing



refrigerants in the Coastal Bend since 1972. Including the new Opteon YF production facility, where production started up in February of this year, the site now employs approximately 250 employees and 100 contractors.

"This is a historic moment for our young company, and we're thrilled to increase our production capacity of Opteon to help meet our customers' needs today and, in the future," said Mark Vergnano, Chemours President and CEO. "We are committed to bringing game-changing, sustainable solutions to the marketplace, including Opteon, and we're proud to manufacture this industry-leading refrigerant right here in the United States, allowing us to create new jobs in our local community." ■

Daikin pledging free access to more patents

Daikin announced its Pledge describing the grant of free access to its pledged patents in relation to applicable HVACR equipment using non-blended, single-component refrigerant HFC-32 (R-32). Providing this free access to these pledged patents without requiring a written contract with Daikin will further international adoption of HFC-32, which has a lower global warming impact than many refrigerants commonly used.

The Kigali Amendment to the Montreal Protocol was approved in October 2016 to systematically reduce the global warming impact of HFCs and became effective in 2019. The countries that ratified the amendment are now working to replace refrigerants commonly used today with those that have a lower environmental impact.

HFC-32 has many advantages that can help reduce the environmental impact of air-conditioning and heat pump equipment. HFC-32 is a non-ozone depleting

refrigerant with a global warming potential (GWP) one-third of that of current R-410A refrigerant. It also provides excellent system performance and is readily available. As a single-component refrigerant, it is easy to recover, recycle, and reclaim, which helps reduce the need for additional production of refrigerant. Therefore, Daikin believes HFC-32 is suitable refrigerant to reduce environmental impact in many regions.

Daikin launched the global first HFC-32 residential equipment in Japan in 2012. Since then, HFC-32 residential and commercial equipment have been offered in more than 60 countries. To facilitate the use of HFC-32 by other manufacturers, Daikin offered free access to 93 patents for emerging countries in 2011, and then expanded free access to those patents worldwide in 2015 to encourage the use of HFC-32 globally. Many other manufacturers are already offering HFC-32 equipment, and its demand and interest are increasing. ■



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Airedale opens doors to data centre customers

Air conditioning manufacturer Airedale International, held an open day recently for its data centre customers at its manufacturing plant in Rawdon, Leeds. The event, which fell in the same week as World Refrigeration Day, attracted nearly 40 guests from Europe and the UK.

Airedale's Marketing Manager Darren Farrar said, "The event provided a rare opportunity for guests to see our world-class facility first hand, see data centre equipment up close, and hear directly from our experts on the latest industry innovations."

The day began with a welcome breakfast and overview of the company from its humble beginnings in 1974 to the worldwide operation it is today, delivered by Sales Director Paul Oliver.

Guests were then given a tour of the factory and had the opportunity to attend two seminars, one on the evolution of DC cooling and the other on F-Gas refrigerants, delivered by Business Development Director Stuart Kay and research & laboratory manager David Wilks respectively.

Farrar explained, "In the afternoon, guests were invited on a guided tour of our state-of-the-art research and development facility and test chambers. These labs are not usually open for visitors due to them being where we keep products not yet ready for market, but we wanted our visitors to see our commitment and investment in future technology."

"Within the research and development facility, there were several prototypes on display that Airedale has not yet released to market and the clients were able to speak to the engineers directly involved in developing them.

"Feedback from visitors to the open day was positive and it was a fabulous opportunity for us to show off our facilities, based in this beautiful part of Leeds, to customers from across Europe, some of whom had flown in especially." ■

Atlas Copco launches five new air compressors

The home of industrial ideas launched five new specially designed products in the air compressor segment for the Indian market, providing an edge to small and medium scale business units. This new range includes piston air compressors, screw air compressors, and on site nitrogen generator series to cater to the changing demands of customers from different sectors across India. The key industry segments which will benefit from these compressed air solutions are food and beverages, cement, textile, foundry and forging, general engineering, metal, auto and ancillaries, paper and many more.

This range of new innovative products will enhance customers' productivity and help reduce energy consumption. Amongst the five products, GA 75-110 VSD+ is a variable speed drive oil-injected screw air compressor which is an ideal choice for fluctuating demands of customer applications and can save upto 50 per cent of energy costs. GA 75-110 VSD+ has

integrated Elektronikon - most intelligent microprocessor for advanced monitoring, control and connectivity, thus providing customers peace of mind by remaining connected with the machine at all times. It has a magnetically fixed pre-filter that enables the application for handling high dust. G 15-22 and GA 15-22, are fixed speed oil-injected screw air compressors with the revolutionary new screw element. These products are intended to reduce energy consumption and offer higher uptime and reliability. The cast iron piston series, ATC, ranging from 3 hp to 10 hp is coupled with IP55 motor that is known for reliability and can function in operating temperatures up to 46C.

In Nitrogen generator segment, Atlas Copco's new NGMs 1-3 membrane technology units offer efficient, compact and simple low-cost on-site solution for low-flow N2 requirements with benefits of minimal maintenance and operational costs. These generators come with a wall mounting option as well. ■

Midea opts for Honeywell's A1 aircon refrigerant R466A

Chinese manufacturer Midea is looking to use Solstice N41 (R466A), Honeywell's new non-flammable, lower GWP refrigerant in all its VRF and chiller systems. Honeywell's partnership with Midea Group, follows promising test results with the new refrigerant announced by fellow air conditioning manufacturer Toshiba Carrier in January.

"As the first non-flammable refrigerant replacement for R410A, Solstice N41 is a promising option to ensure our products are compliant with environmental regulations in target markets," said Mingli Tian, Midea's central air-conditioning division general manager. "This cooperation will help us enter the new future with a sustainable and safe offering for end users," he added.

Solstice N41 is expected to be

commercially available in late 2019. It will be the first A1, non-flammable, reduced GWP R410A replacement offered for stationary air conditioning systems and created considerable interest when it was first announced last year. "We've partnered with the best-of-the-best in our industry to validate the performance of Solstice N41," said Chris LaPietra, Vice President and General Manager, Honeywell Stationary Refrigerants. "Key partnerships like the one we have with Midea help ensure it is ready for broad industry adoption later this year," he added. R32 has

become the lower GWP refrigerant of choice for smaller air conditioning systems. Its A2L flammability, however, makes it unsuitable, currently, for use in larger systems and there are doubts whether it will ever be acceptable for use in VRF systems. ■

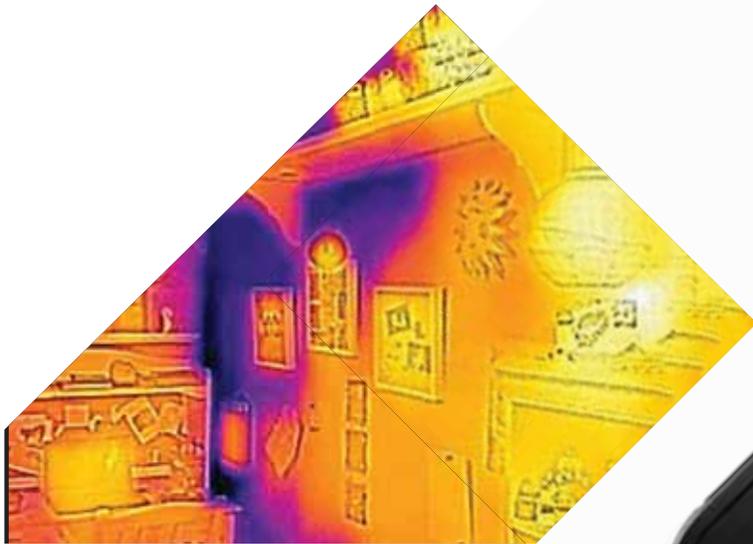


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Electrolux to invest EUR 130 million in Italian refrigeration facility

The Electrolux announced it will invest approximately MEUR 130 million in automation, digitalisation and innovation at its manufacturing facility in Susegana, Italy. The investment is part of Electrolux previously communicated manufacturing investment program (announced at the Capital Markets Day in 2017), totaling SEK 8 billion over 4-5 years as from 2018. Focused on automation, digitalisation and improved innovation capabilities through new modularised product platforms, the program is expected to generate annual cost savings of approximately SEK 3 billion with full effect from 2024.

The decision to invest in Susegana follows an agreement with local unions regarding the continued industrial development of Electrolux operations in Italy. Scheduled to be completed in 2022, the investment includes two new assembly lines and resources for product and process development. This will support the competitiveness of Electrolux built-in refrigeration products and enable the company to achieve top performance levels in coming European energy label regulations. The upgrade will also entail improved ergonomics at workstations throughout the facility. ■

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

ABB pilots automation solution for next gen of data centres

Optimisation of data centre performance, increased tenant retention, agile communications between operations and upper management, and reduced costs are just some of the benefits available to a leading colocation data centre provider as they pilot a world exclusive cloud solution from ABB.

With its unique holistic data center approach the solution provides a detailed insight into how multiple data centres and devices are performing. By bringing all the information into one place, it offers a composite and consolidated view of overall data centre performance both locally and globally which enables in-depth analysis and better strategic decisions.

A strong differentiating factor of the new solution is the increased accessibility provided by the unique state-of-the-art dashboards that display the data in a clear and comprehensive way. The insights result in better operational management



providing optimisation of operations and business. "This is an exciting new ABB Ability™ Data Centre Automation solution and it is a world first. A leading colocation data center provider in Singapore was the obvious choice with whom to work not just on the project pilot but also as a partner in development," said Madhav Kalia, Global Business Manager, Data Center Automation of ABB Control Technologies. "Their world vision and leading market position meant that they were able to offer a very valuable, constructive contribution, including helping us to define the minimum viable product (MVP) requirements." ■

Boyce installed as new ASHRAE President

Building for people and performance, achieving operational excellence, is the theme for the year of new ASHRAE President Darryl K Boyce. Installed during ASHRAE's annual conference in Kansas City, Boyce succeeds current President Sheila J Hayter for 2019/20.



for the finance committee and chair of the members council, appointments roadmap committee and president-elect advisory committee.

During his inaugural address on June 24 he focused on overcoming the challenges associated with

the efficient operation and performance of buildings. He shared insights into leveraging the latest strategies and innovative technologies to ensure operational success for the people living and working within buildings.

Previously served on the board of directors as treasurer, vice president and director-at-large, Darryl K. Boyce is the recipient of ASHRAE's Distinguished Service Award, Exceptional Service Award and Regional Award of Merit. He is currently special advisor to the vice-president (finance and administration) at Carleton University in Ottawa, Ontario, Canada.

"People must succeed within the buildings we create," said Boyce. "ASHRAE is committed to preparing building professionals through learning opportunities, engagement and adopting better practices. These are the steps needed to achieve effective operational performance and operator experience." ■

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Danfoss wins SDG Tech Awards

Danfoss has received an international recognition for its sustainable and innovative tech solutions and was announced to be the 'Best Company' with overall exceptional performance among the other established companies, by Sustainary, the team behind SDG Tech Awards Denmark. In the final Danfoss competed against Rockwool, Carlsberg, Chr. Hansen and Siemens Gamesa.

It is the first time SDG Tech Awards Denmark was organised and the prize statue will be passed over to the next winner at the ceremony next year. The SDG Tech Awards Denmark accounted for a hundred nominees appointed for several categories, where the prize for the 'Best Company' is the biggest award of the ceremony.

"It is very positive that Denmark have so many companies that work purposefully and professionally with the Sustainable Development Goals, because that is absolutely necessary if we want to solve the challenges we see all over the world. At Danfoss, we develop and produce technologies and solutions



that help reduce our energy consumption and ensure fresh food. And we take our own medicine, so it is natural for us to work very concretely and purposefully with the SDGs and sustainability in general," says Danfoss Sustainability director, Flemming Lynge Nielsen.

It is Danfoss goal to ensure, that we can provide the latest technologies available to meet our climate targets

and help our customers to increase their energy efficiency. As a business founded on energy efficiency, Danfoss solutions help our customers to reduce energy consumption and contribute to achieving sustainable development goals - the global joint framework to mitigate climate change.

The example of such solution is Turbocor oil-free compressor for chillers, which was endorsed by energy efficient label Solar Impulse earlier this year and recognised for its contribution to SDG 7 "Affordable and Clean Energy for All". The Turbocor oil-free compressor was initially nominated for the SDG Tech Awards Denmark in the category "Resource Management" and was among the finalists in the category. ■

CAREL awarded as member of excellence of CAR

The Chinese association for refrigeration and air conditioning (CAR) has recognised CAREL as a member of excellence. The award was presented to Daniel Chen, APAC Marketing Manager (HVAC), during the award ceremony held in Nanjing recently. CAREL won this award for its considerable support to the association and for its commitment to the promotion and development of the entire sector.

"It is a great honour for us to receive this award," commented Daniel Chen. "Through its collaboration with international associations, CAREL strives for fair recognition of the refrigeration and air conditioning markets and promotes long-term sustainability." ■



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Gitlin appointed as Carrier President and CEO

United Technologies (UTC) has appointed David L Gitlin as President and CEO of its Carrier air conditioning and refrigeration business in advance of its planned spin-off next year.

Described as a UTC veteran, Gitlin moves from the group's aerospace business where he was most recently President and COO of Collins Aerospace. He was previously President of UTC Aerospace Systems after leading the integration of Goodrich Corporation with UTC. UTC announced late last year its intention to separate into three independent companies by spinning off its Carrier and Otis elevator businesses. A new president and CEO, Judith F Marks, has also been appointed for its Otis elevator business.



David L Gitlin

"I'm pleased to announce these most important assignments as we make strong progress toward our goal of establishing both Carrier and Otis as stand-alone public companies and clear leaders in their respective industries," commented UTC Chairman and CEO Greg Hayes.

"As we prepare to become an independent public company, we will be working tirelessly to ensure that we provide best-in-class performance for our customers, employees and shareholders," added Dave Gitlin. The spin-off of the Otis and Carrier businesses is not affected by today's announcement that UTC is to merge with aerospace company Raytheon. The timing of the separation of Otis and Carrier is said to be on track for completion in the first half of 2020. ■

Steinborn becomes MD of Bitzer South Africa

Torsten Steinborn has been appointed MD of Bitzer Kühlmaschinenbau (SA) Pty and Bitzer Nigeria Ltd. Steinborn will be responsible for the leadership of both subsidiaries including the sales to the large number of other countries in Africa falling under the remit of Bitzer South Africa. He takes over from Bernhard Blaeser who has moved to the Bitzer headquarters in Germany as global industrial refrigeration manager.

After a career in Germany, Steinborn moved to South Africa to take up the position of technical sales engineer at Bitzer Kühlmaschinenbau in 2013. He later became operations manager of the Cape Town branch as well as being the business development manager for South



Torsten Steinborn

Africa. Besides his responsibility for the South Africa operations, Torsten Steinborn will also oversee Bitzer Nigeria Ltd, which was established in 2017. "We have made significant progress over the past two years, having established partnerships with a number of local agents, one of whom will shortly open a Bitzer Authorized Service Centre in Lagos, further enhancing our ability to service this market," Steinborn revealed.

He is also optimistic about Bitzer's prospects on the continent: "The potential for Africa is huge, and with economic growth rates projected at close to 5 per cent per annum over the next few years, it's a market that's a great fit for the Bitzer brand." ■

John Norfolk is President of BESA

John Norfolk, senior project manager at Imtech Engineering Services, has been elected to serve as president of the Building Engineering Services Association (BESA) for 2019-20.

He was confirmed in his role at last week's AGM and takes over from Tim Hopkinson of E Poppleton and Son, who served for two years. Norfolk is senior project manager at Imtech Engineering Services. He was chair of BESA Yorkshire region from 2010 to 2012 and is a long serving member of the Association's membership and legal and commercial committees.

He described BESA members as the Association's greatest asset and pledged to build on the technical legacy of the



Martin Schulz

115-year-old body to help tackle the modern challenges created by climate change and the need for better buildings to help address social problems.

"Never has our sector's specialist knowledge been more in demand and more valuable," said Norfolk in his inaugural speech. "We are in the midst of major technical and philosophical change in this country. Part of the political upheaval, which dominates headlines and conversations, are the critical challenges we face around climate change.

This will transform the way we work and thrust our industry into the limelight," he said. "However, this also creates an opportunity to address even more fundamental social issues affected by building performance." ■



Cold Chain Monitoring Market worth USD 6.46 bn by 2023

According to the new market research report 'Cold Chain Monitoring Market', the cold chain monitoring market is expected to grow from USD 3.80 billion in 2018 to USD 6.46 billion by 2023 at a CAGR of 11.17 per cent between 2018 and 2023. The growth of the cold chain monitoring market can be attributed to the increasing demand for temperature-sensitive drugs, rising demand for better food quality and need to reduce food wastage, growing demand for generic drugs owing to higher accessibility and growing governmental focus on issuing policies impacting the supply chain efficiency of fast-growing pharmaceuticals sector in Europe and North America.

Cold chain monitoring market for software to grow at a higher CAGR between 2018 and 2023

The cold chain monitoring market is segmented based on components into hardware and software. Software solutions utilised in cold chain monitoring applications add huge value to the overall monitoring system. These solutions provide data management and analytical support for monitoring the cold chain. This helps in real-time actionable data being available to relevant parties involved in the cold chain, thereby increasing efficiency and reducing wastage.

Cold chain monitoring market for pharmaceutical & healthcare application to hold the largest share in 2019

Monitoring the temperature is a critical factor in the pharmaceuticals and healthcare cold chain. The specific temperature requirement varies according to the specific pharmaceutical product. The potency of drugs or vaccines tends to degrade in the case of temperature variations encountered in the supply chain. Moreover, the value chain of the pharmaceuticals and healthcare industry has a significant impact of government

regulations, which facilitates the adoption of cold chain monitoring solutions across the value chain.

Cold chain monitoring market for transportation to grow at higher CAGR between 2018 and 2023

The high growth of the transportation segment is driven by the growing distribution network of the cold chain. Now a days, cold chains have become vital for modern supply chain solutions, transporting larger volumes of more sensitive or vital cargo over greater distances through diverse climatic conditions. Being prone to environmental variations, cargo needs to be maintained at a specific temperature or within an acceptable temperature range, which is also driving the growth of the market for the transportation segment.

Americas to hold largest share of cold chain monitoring market in 2018

The Americas is the largest market for cold chain monitoring. The Americas to hold the largest share of the global cold chain monitoring market. Pharmaceuticals and healthcare are expected to continue to account for the largest size of the cold chain monitoring market in the Americas in the next few years. Various pharmaceutical companies supplying numerous drugs that require cold chain monitoring solutions are based in the country. Increasing demand for chilled and frozen foods in North American countries triggered the cold chain market growth in North America, thereby, driving the growth of the cold chain infrastructure market, which includes refrigerated storage and refrigerated transport. The main factors for supporting the growth of cold chain monitoring market in the Americas are the regulatory environment for the pharmaceuticals industry and the rise in the demand for generic drugs. ■

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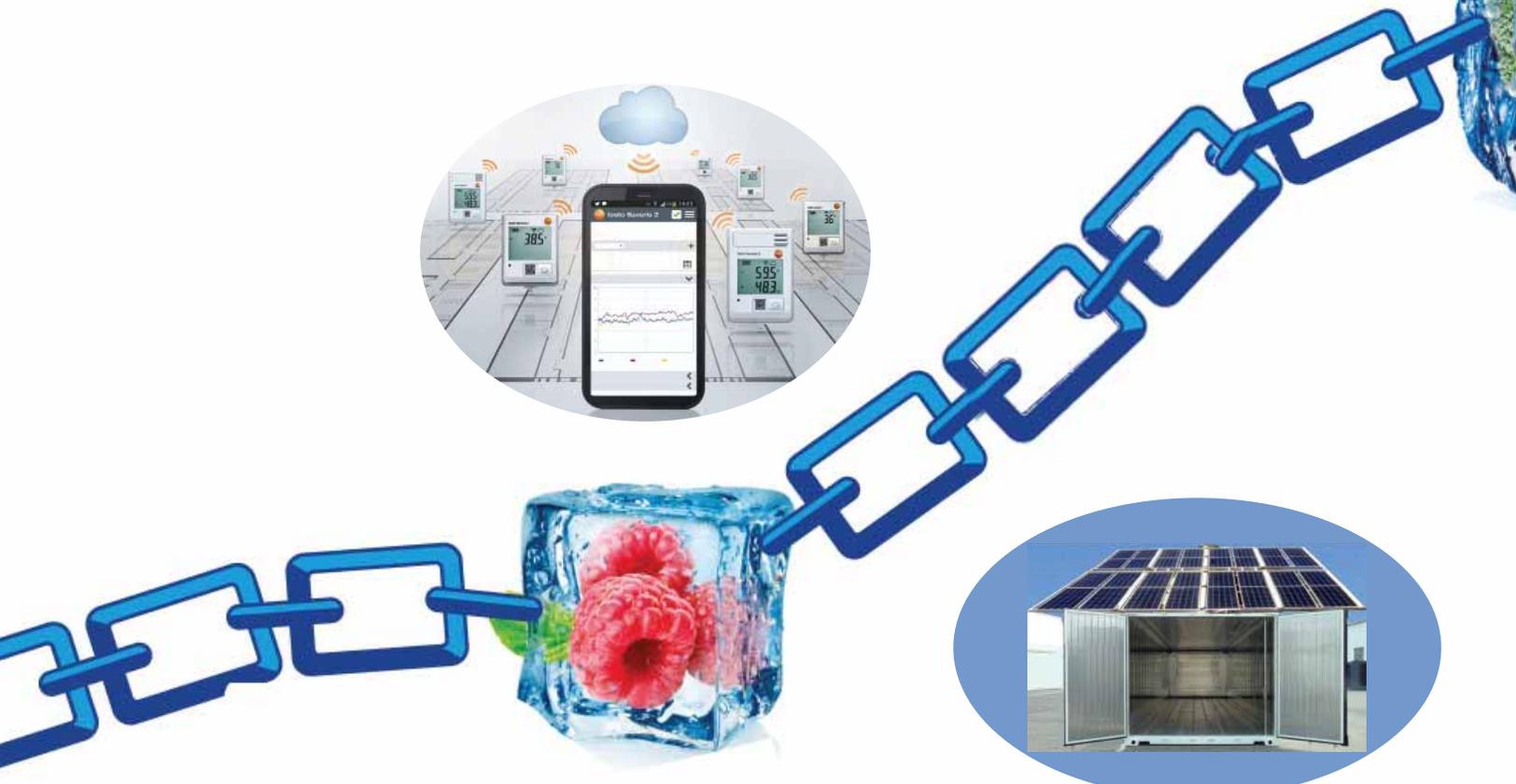
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F&B COLD STORAGE GAINING TRACTION



Here's how advanced cold storage technologies can help F&B industry to move forward while creating new value for businesses.

– **Supriya A Oundhakar**
Associate Editor

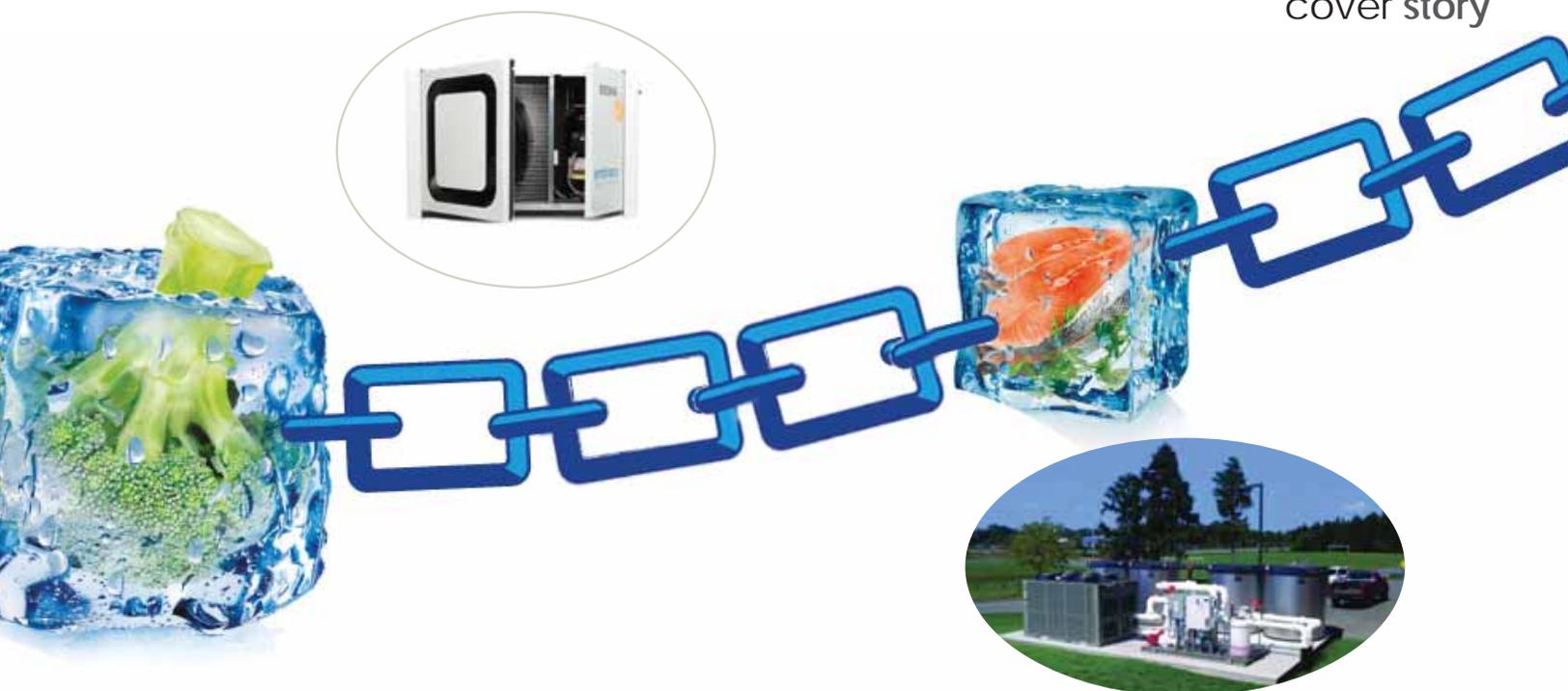
Being one of the largest producers and biggest consumers of food, food services (F&B) markets in India is gaining traction owing to the young working population, rising disposable incomes, growth of the consumers in various socio-economic strata, exposure to new cultures and cuisines, and change in eating habits of families. The role of food processing industry is important for food preservation and reduction of food waste. The industry has recorded an impressive growth at a compound annual growth rate of 14.6 per cent from 2016 to 2020, according to the government data.

Crisil Research has projected an

investment of Rs 16,000-21,000 crore in the cold storage sector between 2019 and 2023 for optimising the domestic post-harvest value chain and to feed the downstream food processing industry.

According to various research reports, the market for restaurants including cafes and Quick Serve Restaurant (QSR) is expected to grow between 15 to 20 per cent CAGR, thus, driving the QSR consumption. This will promote the processed food and beverages industry, resulting in backward integration to farms.

"India is among the world's largest producers of fruits, vegetables, milk, meat, and seafood, but the nation has access to



only 60 per cent of this production. Embraco believes that the country has a huge potential to improve it, developing the whole system, while reducing the gap between production and cold storage and avoiding food waste," says Esequias Pereira Junior, Sales Senior Manager for Asia Pacific Region, Embraco.

According to Invest India, a national investment promotion and facilitation agency, the annual value of harvest and post-harvest losses of major agricultural produce at the national level is estimated to be USD 14 billion. Alongside that, India is ranked second in food production globally. Hence, the cold chain solutions are important for the F&B industry to support every step of the way linking Indian farmers to consumers.

Trends

Generally, type and level of cold storages to be set up depends on the size and scale of operations in F&B industry, be it a hotel or a QSR or a dine-in restaurant or an F&V

(food and vegetable) storage. Maintaining quality, retaining freshness of perishables, reducing food wastage, and optimising supply-demand are the main drivers.

M Srinivas Reddy, Senior General Manager – Commercial Refrigeration and Corporate Planning, Blue Star Limited informs, "Technology wise, the refrigeration systems deployed walk-in cold and freezer rooms would use either air-cooled or water-cooled heat exchanger with choice of hermetic or semi-hermetic compressors. Water-cooled refrigeration systems for cold rooms are preferred in those places where water is available from captive cooling towers such as at hotels, and they consume 15-20 per cent less energy as compared to air-cooled ones."

Nowadays, consumers prefer fresh and quality products. So, it is pertinent to make sure that the food product always remains fresh and is stored under desired conditions not only at the outlet but also during transportation.

Real time data monitoring with the growing dependency on IT infrastructure plus the cloud technology is now becoming the need of the hour as it enables the supplier to prove the quality and credibility of the goods anytime anywhere. Transportation trucks, warehouses, cold rooms etc. can now be remotely monitored via Testo data loggers and data monitoring systems. To any facility in-charge these solutions provide uninterrupted and reliable measurement. Testo data loggers measure and document temperature and humidity automatically and without interruption at every step, informs Kalidas Bhangare, Managing Director, Testo India.

Cold storages need steady power supply to maintain temperature. Power cost contributes to more than 50 per cent of total cost of operating cold storages.

In cold storages one of the prime trends is to find ways to keep the asset operating cost low by optimising the running during low utilisation periods. A cold storage has to operate 24/7 to meet



Real time data monitoring with the growing dependency on IT infrastructure plus the cloud technology is now becoming the need of the hour as it enables the supplier to prove the quality and credibility of the goods anytime anywhere.

KALIDAS BHANGARE, MANAGING DIRECTOR, TESTO INDIA.



Retrofitting the current cold storage to utilise renewable energy is an effective trend in reducing the operating cost and also the impact on environment.

VISHNU SASIDHARAN,

VICE PRESIDENT-NEW PRODUCT INITIATIVES, PLUS ADVANCED TECHNOLOGIES

compliance even if it is occupied with only 5 per cent payload. Hence, many times cold storage owners turn the equipment off for 8 to 10 hours to save on the cost, Vishnu Sasidharan, Vice President-New product Initiatives, Pluss Advanced Technologies.

Innovative Cold Storage

Development of highly efficient cold chain is essential in order to ensure safe and nutritious food and improve food security. As a result, innovations are taking place in every sphere of cold chain like, related machinery for energy efficient cooling as also use of environment friendly natural refrigerants, fast handling and management to keep food and beverages, and other technologies specific to the type of food to maintain its integrity.

In order to reduce the carbon footprint, cold chain sector in F&B is exploring the use of renewable energy such as solar, biomass, and wind energy.

“Even technologies emerging for food processing are such that function in hybridisation manner with cold chain involving minimal processing of its constituents. Cryogenic technology has another dimension for F&B sector to prolong their life. Trends are changing even in case of regulatory standards and guidelines to facilitate cold chain growth

vis-à-vis F&B,” informs Atul Khanna, Atul Khanna - India Representative, Global Cold Chain Alliance (GCCA).

M Srinivas Reddy apprises, “The compelling need for reducing energy consumption and care for environment are driving innovations in compressor technology, heat exchanger design, eco-friendly refrigerants, precision temperature monitoring and controlling, use of Cyclopentane in PUF manufacturing etc. Though renewable energy adoption is still in experimentation levels, we can expect the use of renewable energy in cold storage systems in near future.”

Vishnu Sasidharan believes that these new technologies come at a cost, however, innovative business models allow for leasing out these technologies on pay per use basis. He further lists out the benefits of thermal energy storage such as offering 10 -16 hours of backup during power outages, reducing the compressor run time by at least 25 per cent and shifting electric load from peak to off-peak period.

“Retrofitting the current cold storage to utilise renewable energy is an effective trend in reducing the operating cost and also the impact on environment. In many areas such as in the last mile wherein energy access is limited solar based micro-cold rooms integrated with thermal energy storage systems offer cooling

without dependency on the grid,” further adds Sasidharan.

Nowadays, integration of IoT has brought about a tectonic shift in the working of cold storages for F&B, thus offering visibility of real time temperature and utilisation data that predicts or simulates a scenario. And accordingly, corrective actions can be taken before the product is stored such as predictive maintenance and capacity augmentation.

The testo Saveris 2 Wi-Fi data logger system is the apt solution to humidity and temperature monitoring in storerooms, cold storage area and work rooms, as well as during workflow processes. This innovative monitoring system eliminates staff work of reading out and documenting the individual measurement data, simplifying the assurance of high product quality. “With a secure online storage of all readings in Testo Cloud the data can be managed and analysed online by the user via smartphone, tablet or PC anywhere and anytime. In case of deviations, it is provided with an alarm by e-mail, or optionally by SMS. Testo Saveris 2 equips the responsible person to analyse and document the real time readings of multiple locations and cold rooms from one place,” informs Kalidas Bhangare from Testo.

Embraco offers a wide range of cooling solutions for food retail, food service, and



Trends are changing even in case of regulatory standards and guidelines to facilitate cold chain growth vis-à-vis F&B.”

ATUL KHANNA,

ATUL KHANNA - INDIA REPRESENTATIVE,
GLOBAL COLD CHAIN ALLIANCE (GCCA).



The compelling need for reducing energy consumption and care for environment are driving innovations in compressor technology, heat exchanger design, eco-friendly refrigerants.

M SRINIVAS REDDY,

SENIOR GENERAL MANAGER - COMMERCIAL REFRIGERATION AND CORPORATE PLANNING, BLUE STAR

merchandisers segments. Embraco developed Bioma, a tailor-made solution for urban areas that meets food retail and food service needs, such as easy maintenance, fast installation, and space restrictions. The compact equipment is designed for cold rooms and outdoor applications with low noise level requirements, such as petrol stations, restaurants, and convenience stores.

Bioma employs innovative airflow management and looks with a hidden fan to prevent phantom sound. The unit achieves more than 50 per cent noise reduction level if it is compared to the similar models in the market, a result made possible by the unique and squared front design and the use of only one fan in all three sizes, informs Esequias Pereira Junior.

Advanced Cold Storage Technologies Helping F&B Industry

The advent of advanced cold chain technologies has helped to meet the requirements of different business models for frozen and processed food items such as meat, fish, frozen food products, and ready-to-eat meals and snacks and has helped to bring market-oriented results.

Further, technology supports the F&B industry to stick to necessary regulations like for refrigeration-mandatory foods, legal stipulations regulate the temperature zones which must be adhered to during the cold chain. It is necessary to maintain temperature for certain food items for maintenance of its quality and freshness. Bhngare informs about temperature requirement for fruits and vegetables, meat, dairy and fish as follows:

- Deep-frozen meat and fish need to be

continuously chilled through (-)18C

- Max temperature required for fresh meat is (+)4C
- Other perishable foods including e.g. baked goods with incompletely baked filling or covering, freshly cut salads and delicatessen salads: (+)7C
- Pasteurised milk: (+)8C
- Butter, cream cheese, soft cheese: (+)10C
- For fruits and vegetables, a temperature range of (+)1 to (+)12C is applicable.

“Food should be made safer for the consumer and these technological aids confirm the freshness and nutritional value of the food items. Consistent data monitoring from farm to fork is crucial to retain the food quality. This helps in reducing any sort of wastage or rejection at any step of the food distribution chain and saves a lot of money. Business grow in terms of quality, brand name and consumer confidence just by adhering to the very basic measurement techniques. Not only that, technological advancement by maintaining the quality of food, ultimately promotes customer health as top priority,” he adds.

While illustrating the advanced technologies playing significant role in F&B industry, Khanna gives the example of China. In the dairy industry, for instance; milk and cheese are relatively new to the Chinese diet, but consumers’ taste for them is growing. US exports of dairy products to China are skyrocketing as 1.4 billion people migrate to cities, draw middle-class wages, and discover foods like ice cream, cheese pizza, and chocolate-flavoured milk. Another reason for this fast growth is that China’s domestic F&B industry has a dismal track record when it comes to meeting quality

standards, and Chinese consumers have grown leery of domestically produced products after a history of contamination scares. Advance technologies will play a significant role in ameliorating such problems.

M Srinivas Reddy predicts that the reliability of design, quality standards in installations, post-sales service assurance and post-warranty costs coupled with the company’s ability to deliver on-time service during product lifecycle are going to weigh critically in customer’s mind. This will contribute to significant value creation in the supply chain by way of wastage reduction and offering consumers quality products.

Vishnu Sasidharan believes that it is important for business heads and supply chain managers to look at the intangible benefits that come from the end customer experience in terms of efficiency of the service which would be the long-term result of implementation.

Conclusion

India has an immense potential to become a food supplier to the world, given its scale in food production and consumption. Therefore, it is extremely important to have a robust supply chain involving cold chains from farm to fork to reduce wastages across the value chain. containing food wastage by any measure will significantly save our precious natural resources.

F&B cold chain will continue to be at the forefront of trends within the distribution warehousing industry for many years to come. These will include the growth in specialised services and regulations for the basic, life-sustaining nature of the food and beverage sector, concludes Khanna. ■



Transport Hub

Changing the landscape of cold chain logistics with IoT

Transport Hub provides technology platform based on the Internet of Things for cold chain logistics sector. The company has developed a device — ICE (improvement in cold chain efficiency) to address the inefficiency in the transportation of perishable goods and cold storage systems. In an interaction with *Cooling India*, **Rohit Chaturvedi, CEO, Transport Hub**, talks about the solutions offered by the company and the way Transport Hub is driving the key innovations in the cold chain logistics sector with IoT.

What are the trends in cold chain logistics?

Cold chains traditionally relied on drivers, warehouse managers and transporters to confirm that temperature of goods transported by them is maintained at optimal temperature during the course of entire chain. As an improvement, post-delivery, a data logger was then used to download data and verify the temperature reading in warehouses and during journey. However, in recent times, with the advent of IoT and strict requirements of the shippers, all participants are more focused on getting real-time visibility of temperature data. But the use of IoT is not adopted in an integrated manner and it is used for corrective measures rather than preventive measures. In other words, use of analytics to improve operations and business decisions is largely absent.

Moreover, the real use of IoT shall be in reducing human errors by automation. This will not only reduce human mistakes but also make the entire operations more efficient.

What evolutions have you witnessed in cold chain logistics with IoT?

IoT has gradually redefined the way we see and interpret

data. IoT technology makes it easy to collect accurate data automatically which when combined with useful analytics, help derive substantial business benefits. Temperature data that was available post facto are now available real-time. Real-time alerts can be configured to alert concerned personnel in case of temperature violations during journey to effect preventive steps. This enables logistics personnel to take timely appropriate action instead of post facto. The next stage of IoT evolution is towards integration of IoT with analytics tools such as Machine Learning. The analytics can be used not only by the operations team but also by the management to improve business metrics on real-time basis.

How Transport Hub is driving key innovations in cold chain logistics with digitization (IoT)?

Transport Hub decided to push the boundaries of innovation still further with its next -gen solution ICE (Improvement in Cold Chain Efficiency). Why should logistics team be alerted in case of temperature violations during transit? TH team decided to automate temperature control inside a reefer or warehouse through ICE. You no longer need to

depend on the driver for switching on and off of your reefer air conditioner. Neither do you have to depend on alerts generated by some IoT device to take action. TH ICE automates temperature for you. The device will ensure that the air conditioner is switched on and off respectively when temperature thresholds are violated.

What are the solutions offered by Transport Hub for cold chain logistics?

Cold chain logistics can broadly be categorised into two – Cold Storages and Cold Chain Reefer Container Vehicles. Transport Hub offers TH ICE solution for both Cold Storages and Cold Chain Reefer Container Vehicles. TH ICE automates temperature thereby, eliminating the requirement of a dedicated person to monitor and ensure that the temperature is maintained.

How does ICE work? How does it benefit the cold chain sector?

TH ICE eliminated the need for personnel to monitor and ensure optimum temperature in a moving reefer container of a cold storage. With TH ICE the cold storage or reefer owner can automate temperature inside the enclosure. The cold chain sector can finally ensure optimum temperature without deployment of resources to monitor and change refrigeration status manually.

What challenges do you face while offering your solutions to the cold chain logistics sector? What are the solutions for overcoming these challenges?

Humans are generally reluctant to change. Any technology needs time to reach the masses. Moreover, data received from legacy data loggers has wide acceptance in the industry. Despite initial reluctance towards change, Transport Hub has managed to get a number of marquee clients on board for TH ICE solution. The only way to increase acceptability is by increasing product awareness and we believe given the great economics and significant benefits provided by ICE will enable the users to adopt in large scale.

What are your clients in the cold chain logistics sector?

Transport Hub has a diversified group of customers in the cold chain logistics sector. Pharmaceutical companies like Kanchan Pharma, Seed Companies like Sakata Seeds and Food companies like Allana Foods and Vadilal are a few of Transport Hub's marquee clients.

What kind of growth do you envisage for Transport Hub for next 2 to 3 years?

India is currently the world's largest producer of milk, second largest producer of fruits and vegetables and has a substantial production of marine, meat and poultry products. According to a leading market research company, the Indian cold chain market was worth Rs 1,121 billion in 2018. The market is further projected to reach Rs 2,618 billion by 2024, growing at a CAGR of 14.8 per cent during 2019-2024. With this kind of growth, Transport Hub projects an exponential growth in acceptability of its proprietary, patented TH ICE solution.

What is your outlook for cold chain logistics?

Given the lack of economical cold chain infrastructure and operational issues in a warm and large country like India, lots of perishable goods cannot move far. This creates demand supply mismatches which are detrimental to both the consumers and growers. In fact, UN's Food and Agriculture Organization estimates that 40 per cent of fresh fruits and vegetables are wasted every year due to lack of cold-chain infrastructure. Centre for Public Policy research has in its report in 2016 mentioned that only 2 per cent of produce in India are kept or transported using cold-chain as compared to 85 per cent in the US.

However, with better electricity and road infrastructure along with the push by the government, the cold chain industry is set to grow very fast in near future. Also, increasing prosperity will lead to demand for pharmaceutical products, dairy products, material for food and restaurant industry and discretionary goods like chocolates etc. The trends bode extremely well for the industry and the support industries like technology companies will also see great growth opportunities in near future. ■

According to a leading market research company, the Indian cold chain market was worth Rs 1,121 billion in 2018. The market is further projected to reach Rs 2,618 billion by 2024, growing at a CAGR of 14.8 per cent during 2019-2024.

Temperature Management for Horticultural Produce

The quality and safety of horticultural produce reaching the consumer hinges upon pre-harvest factors as well as proper post-harvest management practices throughout the chain, from field to consumer.



Horticultural produce plays a significant role in human nutrition by supplying vitamins, minerals, fiber and antioxidants to the diet. Fruits and vegetables contribute approximately 91 per cent of vitamin C, 48 per cent of vitamin A, 27 per cent of vitamin B6, 17 per cent of niacin, 16 per cent of magnesium, 19 per cent of iron and 9 per cent of calories to the human diet. Other important nutrients supplied by fruits and vegetables, include riboflavin, zinc, calcium, potassium, phosphorus etc. The consumption of fruit and vegetable has increased in response to growing health consciousness. Their consumption has been strongly linked to reduced risk of some forms of cancer, heart disease, stroke and other chronic diseases. Fruits and vegetables are sources of antioxidants which modify the metabolic activation and detoxification or disposal of carcinogens, or even influence processes that alter the course of tumor cell growth.

Both quantitative and qualitative losses occur in horticultural commodities between harvest and consumption. The quality and safety of horticultural produce reaching the consumer hinges upon pre-harvest factors as well as proper post-harvest

management practices throughout the chain, from field to consumer. Each stakeholder along the post-harvest chain i.e. those involved in harvesting, handling and marketing of fresh produce has a role to play in assuring safety and quality of fresh produce. In order to get good economic returns, fresh horticultural produce is required to be marketed at far off places from the point of production. To achieve this, we need to stretch the post-harvest life of these perishables commodities to its limit. Disease and disorder can occur in these living commodities due to various reasons till it reaches the consumer, thereby, greatly hampering shelf life thus, the profitability of enterprise. In addition, a number of factors threaten the safety of fruits and vegetables. These include naturally-occurring toxicants, such as glycoalkaloids in potatoes; natural contaminants, such as fungal toxins (mycotoxins) and bacterial toxins, and heavy metals (cadmium, lead, mercury); environmental pollutants; pesticide residues; and microbial contamination. The health authorities and scientists regard microbial contamination as the number one safety concern. The post harvest handling along with physical and physiological condition determines the loss due to rot. Generally debilitating



Figure 1: Current practices of post harvest handling

environments are to be avoided and physical injuries to be prevented. In large part, post-harvest environments are designed to reduce the rate of respiration to the minimum required to maintain vital processes. The stored reserves are thereby, conserved and post-harvest life of the fruit is extended to a maximum. The rise in respiration roughly coincides with a striking reduction in fruit's resistance to certain pathogens.

Low temperature is the most effective means to accomplish this task of extending the shelf life while keeping many of rotting fungi at bay. In fact, temperature management is so critical to post-harvest disease control that all other control measures act as supplement to it (table 1).

Low-tech Cooling Technologies

Shade: Covering fresh produce and protecting it from direct sunlight is a low-cost way to reduce heat gain. Using roofing or cloth tenting for providing deep shade over all assembly points and working areas is recommended. A deep overhanging roof extension (at least one meter) can provide shade for windows or doorways and a light colored or reflective roof can reduce surface temperatures and temperatures under the shelter by upto 20C.

Painting storage buildings white or silver: This will reflect sunlight, reducing surface temperature and thus, reducing the heat transmitted to the cold room through exterior walls.

Outsulation combined with thick high

thermal capacity walls: Highly reflective insulating materials on the outside of the building will permit the inside walls to remain cool, especially, if they are fairly massive with a high thermal capacity. Cooling inside of a building and inside walls at night significantly reduces the amount of energy required for refrigeration, and the thick walls (e.g., concrete block) act as a thermal flywheel, with the external highly reflective insulation significantly limiting solar heating of the walls.

High altitude storage: Typically, air temperatures decrease by 10C (18F) for every one-kilometer increase in altitude. If handlers have an option to pack and store commodities at higher altitude, costs could be reduced. Cooling and storage facilities operated at high altitudes require less energy than those at sea level to achieve the same results. As a rule, night ventilation effectively maintains product temperature when the outside air temperature is below the desired product temperature for 5 to 7 hours per night.

Cold water (from deep wells or mountain streams): Well water is often much cooler

than air temperature in most regions of the world. Water from deep wells and mountain streams typically will be measured to be at a temperature that is the average annual air temperature for the area. Well water can be used for hydro-cooling and as a spray or mist to maintain high relative humidity in the storage environment. Water from streams, however, is often contaminated and is not suitable for contact with food items.

Passive evaporative cooling: Wetting the walls of a packing house or using porous materials on one end (such as found in large greenhouses) can provide passive cooling via water evaporation from the wall when air is pulled through the wet pad by ventilation fans.

Night air ventilation: If the outside air is cooler than the product being stored, natural convection, using manually operated vents, will work well and require no power. If it is feasible, the storage room should be opened only at night when air temperatures are lowest. Simple cool storage facilities can be operated manually by opening the vents at night and closing

Table 1: Effect of Temperature on the Rate of Deterioration of Fresh Produce

Temperature (°C)	Relative form of deterioration	Relative shelf life	Example of potential shelf life in days
0	1.0	100	45
10	3.0	33	15
20	7.5	13	5
30	15.0	7	2.5
40	22.5	4	1.3

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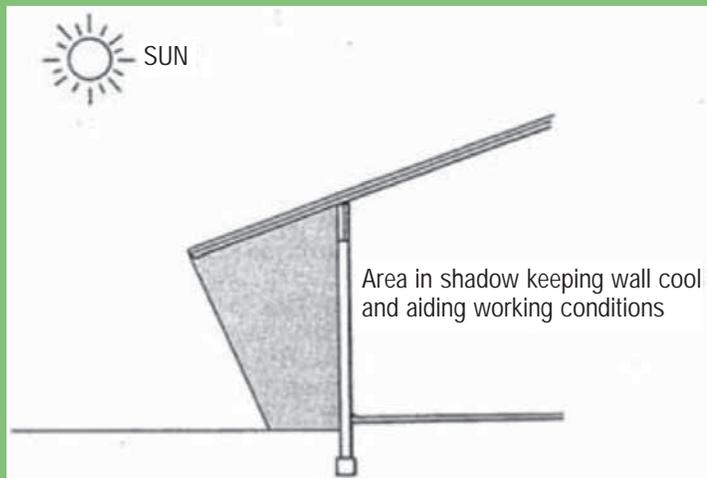


Figure 2a: Shade to reduce wall heating

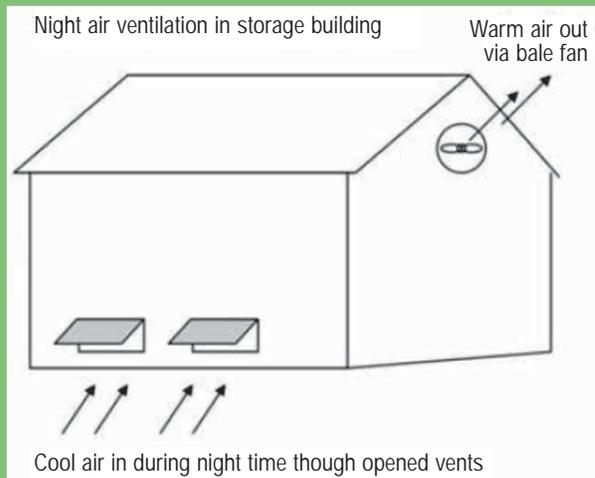


Figure 2b: Night air ventilation

them just before sunrise. A series of vents should be spaced around the perimeter of a building near ground level with a similar area of vents near the highest part of the storage building. This vent placement allows the warmer air in the top of the storage to exit the building via natural convection and draw in cool air from near ground level. If natural convection is not sufficient, a small fan (60 to 100 watts) can be used to help move warm air out of the building via a roof vent. A fan placed near the peak or gable of a storage building should be operated only during the cooler hours of the night-time, allowing cool air to be pulled into the building to replace the warmer daytime air.

Zero-energy cool chamber: A specially designed, low-cost brick and sand unit

can maintain inside air temperature of 15C to 18C and a relative humidity of 95 per cent when outside air temperatures are over 30C. These chambers work best under dry conditions, such as during the dry season or in arid or semi-arid environments, and the small sized units (holding 100 to 200 kg of produce) require no electricity or fuel. Larger- sized cool chambers are constructed as a round walk-in room with a slatted floor and a small ventilation fan (60 to 100 W) added to the roof.

Electric Powered Technologies

Evaporatively cooled storage rooms:

Evaporative coolers, sometimes called 'swamp coolers' or 'desert coolers,' use the evaporation of water to cool a storage

room. Evaporative coolers have a low initial cost, and use much less electricity than conventional air conditioners. In a direct evaporative cooler, a blower forces air through a permeable, water-soaked pad. The pads can be made of straw, wood shavings or other materials that absorb and hold moisture while resisting mildew. Aspen wood pads, also called excelsior, need to be replaced every season or two. As the air passes through the pad, it is filtered, cooled, and humidified. Evaporative coolers should be sized based on cubic feet per minute of airflow. Improper sized evaporative coolers will waste water and energy and may cause excess humidity. Two-speed coolers are available that can handle varying cooling loads. Evaporatively cooled

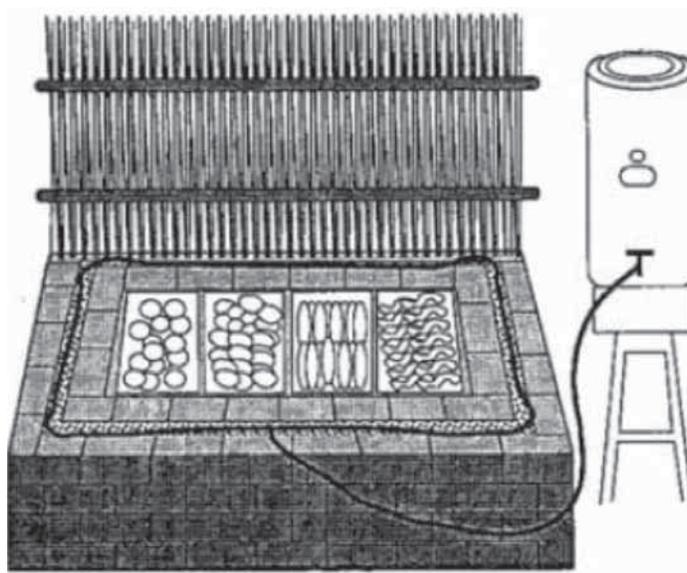


Figure 3: Zero energy cool chamber for horticultural produce



Figure 4: Evaporatively cooled storage room

storage rooms require fans with a capacity of 0.3 m³/second per MT of fresh produce (64CFM/MT). Assuming the fan operates against a static pressure of 0.6 cm of water column and has 50 per cent efficiency, the system will require 0.09 kWh per MT of product storage capacity for one day of operation. The fan will operate continuously when the outside air temperature is greater than the desired storage temperature. The fan should have the capacity to exchange the air in the room completely once every two minutes.

Room cooling: Room cooling is a simple but slow method of reducing the temperature of produce prior to cold storage, where packages of produce are placed inside a cold room and allowed to slowly cool down. Room cooling

commonly requires 24 to 48 hours or more, and is not recommended for highly perishable crops. Fans should be capable of providing 90 CFM/MT during initial cooling. The fan speed can be reduced to provide air flow at 18 to 25 CFM/MT once target temperatures have been achieved.

Ice: A central ice-making plant and ice distribution system allow produce cooling in locations where electricity and mechanical refrigeration are not available. This was the original basis for the development of the long-distance perishables business in the United States. However, cooling using ice is relatively inefficient because only about half the cooling effect is actually used to cool the produce. The rest is lost to heat exchange with the warm environment (Thompson

and Chen 1989). In addition, there can be significant loss of ice as it melts in transit from the central refrigeration plant to the cooling facility. Unless the packages and ice can be used within a well insulated environment (such as in an ice chest-style container), at least 50 per cent of the original ice will be lost before it can be used. As an ice machine has several electricity-driven components, making ice is an energy-intensive process and can be expensive. Most ice machines produce between 5 and 12.5 kg of pure ice per kWh. One of the most energy efficient ice makers available, produces 18.5 kg of pure ice per kWh and has a capacity of 146 kg of pure ice per hour. Since 330 kg of ice would be required to cool one MT of fresh produce by 28C, requiring upto 66



Figure 5: Forced air cooling

Table 2: Characteristics of Cooling Technologies

Cooling Technology	Typical Use, Size, or Capacity	Energy Use (kWh, liters of BTU per MT)
Evaporative forced air cooling to 13°C (0.1 hp fan)	0.5 MT	0.7 kWh
Evaporative forced air cooling to 13°C (0.5 hp fan)	1 to 2 MT	0.7 kWh
Ice put into packages (330 kg required to cool 1 MT by 28°C)	5 to 12.5 kg ice per kWh	27 to 67 kWh (actual = 54 to 134 kWh since ½ of the ice is lost before cooling)
Hydro-cooling – shower type to 0° to 2°C	3MT cooled in less than 1 hour	80 to 110 kWh
Hydro cooling – immersion type to 0° to 2°C	3 MT cooled in 1 hour	110 to 150 kWh
Hydro-cooling – shower type to 7°C	3 MT cooled in ½ hour	35 to 100 kWh
Portable forced air cooling (1hp) fan in existing cold room at 2°C	3 MT cooled in 4 to 6 hours	55 kWh
Portable forced air cooling (1hp) fan in existing cold room at 13°C	3 MT cooled in 4 to 6 hours	35 kWh
Room cooling to 0° to 2°C	Varies	55 kWh
Room cooling to 13°C	Varies	35 kWh

Source: Information compiled by Lisa Kitinoja and James F. Thompson

Table 3: Comparison of Typical Product Effects and Costs

Effects and costs	Forced air	Hydro	Room	Ice
Typical cooling time (hours)	1-10	0.1-1	20-100	0.1-0.3
Product moisture loss (%)	0.1-2	0-0.5	0.1-2	No data
Water contact with product	No	Yes	No	Yes, unless bagged
Potential for decay contamination	Low	High	Low	Low
Capital cost	Low	Low	Low	High
Energy efficiency	Low	High	Low	Low
Water-resistant packaging needed	No	Yes	No	Yes
Portable	Sometimes	Rarely	No	Common
Feasibility of in-line cooling	Rarely	Yes	No	Rarely done

Source : Thompson et al. 1998

kWh, the cost of making ice for this purpose can often be prohibitive. Melting one kg of ice has a cooling effect of approximately 316 BTU. One kg of ice will lower the temperature of fresh produce or water weighing 3 kg by about 28C.

Evaporative forced air cooling: Using an electric fan and a wet pad to move cool air through containers of fresh produce will speed the cooling process. Produce temperatures can be reduced using evaporative cooling to a few degrees above the ambient dew point temperature (the temperature at which moisture begins to form on a slick surface, indicating 100 per cent saturation of the air with moisture).

The fan must be able to provide airflow of 1 L/ sec/kg against a wide range of static pressures. Doubling the airflow will speed cooling somewhat but the cost will rise considerably because the fan would need to have approximately four times greater horsepower to accomplish the same work.

Forced air pre-cooling inside a cold room: Forced air (FA) cooling can speed the cooling of a batch of packaged produce stacked inside a cold room from two or more days to less than 8 hours. If a cold room with adequate refrigeration capacity is available, adding a portable forced air-cooling tunnel that can cool four pallets at a time will increase the fan’s power use by

only 800 to 1,500 watts per hour. A cold room with 5 tons of refrigeration can cool 3 MT of horticultural produce from an initial temperature of 27C to a target temperature of 2C in 6 to 8 hours. The area of the vents on the sides of produce containers should be at least 5 per cent of the container surface area in order to accommodate airflow without excessive pressure drop across the box. Fans for FA coolers usually operate within a typical range of 0.5 to 2.0 L/kg/sec (1 L/kg/sec equals about 1 CFM per lb). Doubling the airflow rate will speed cooling somewhat (perhaps by 40 per cent) but the energy cost will rise considerably because the fan

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would need to use 5 or 6 times as much power. For example, airflow for 3MT at 1 L/kg/sec and 1.3 cm w.c. (water column pressure) requires 1.12 HP (0.85 kW). If airflow is doubled, the fan size will need to increase to about 7 HP. Centrifugal fans with forward blades are suited for most small-scale cooling applications. Commonly available industrial propeller fans are more suited for applications with low air pressures. In the US prices typically range from USD 1,000 for a ½ HP fan to USD 1,600 for a 1 HP fan.

Hydro-cooler: Water used for cooling must be kept very cold using ice or mechanical refrigeration. Water is a far better heat-transfer medium than air, so hydro-coolers cool produce much more quickly than forced-air coolers. In well designed shower type hydro-coolers, small diameter produces such as cherries will cool in less than 10 minutes. Large diameter products such as melons will cool in 45 to 60 minutes.

Batch-style hydro-coolers will hold one or more pallets of produce and shower

cold water over the tops of the stacked containers, allowing the water to filter down through the containers and contact the produce, removing heat as it passes down through the load.

Immersion hydro-coolers are large, shallow, rectangular tanks that hold moving chilled water. Crates or boxes of warm produce are loaded into one end. Crushed ice or a mechanical refrigeration system keeps the water cold, and a pump keeps the water in motion. The duration of time the produce remains in the water varies with the initial conditions and desired ending temperature. Immersion-type hydro-coolers have longer cooling times than shower coolers because the water moves past the produce at a slower speed, but cooling speed can be improved

if the water is properly agitated.

Mechanically refrigerated cold rooms: Cold rooms are a very common feature of horticultural operations, and come in many sizes and types. Capital costs and energy use estimates for small-scale cold rooms vary considerably. The new prefabricated cold rooms and used refrigerated highway vans are the most expensive on an area basis. The least expensive options are used prefabricated cold rooms, if they are available locally, and owner-built facilities. Purchase costs for pre-fabricated cold rooms increase considerably for floor areas under the 40 m² used as a baseline floor area in large facilities with hundreds of square meters of floor area cost about the same as the new prefabricated rooms. ■

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Honeywell at the forefront of developing low-GWP refrigerants



Honeywell has developed a leading line of environmentally preferable refrigerant solutions based on next-generation HFO technology. **Rajarshi Datta, Country Head and General Manager - South Asia, Honeywell Advanced Materials** gives a glimpse of refrigerant solutions offered by Honeywell, its applications, transitions in global refrigerants markets, acceptance of environment-friendly refrigerants in India and many more in an interaction with **Cooling India**.

Honeywell is one of the leading global companies involved in the development, manufacturing and supply of refrigerants. What refrigerant solutions does Honeywell offer? What are its applications?

Honeywell offers next-generation, environmentally preferable hydrofluoro-olefin (HFO) alternatives that are available under our Solstice product line as an option to support the Indian customers to accelerate the transition from hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs) and other high global-warming-potential (GWP) materials into lower global warming alternatives.

Our refrigerant offerings also include Solstice yf, an award-winning HFO refrigerant designed for automotive air conditioning systems. It has a GWP of less than 1, which is 99.9 percent lower than the previous refrigerant HFC-134a, and is even lower than carbon dioxide (CO₂), an alternative refrigerant with a GWP of 1. Solstice zd is a nonflammable HFO refrigerant with a GWP equal to 1, for use in low-pressure centrifugal chillers, which are most often used to cool large buildings. Honeywell's Solstice N40 has become the world's most widely requested, nonflammable, lowest-GWP replacement refrigerant for R-404A in the supermarket industry, with more than 23,000 installations across North

America, Europe and Asia Pacific. N40 has 65 per cent lower GWP vs 404A while simultaneously improving system efficiency.

And Solstice ze is an HFO refrigerant which is a sustainable alternative to traditional refrigerants for energy-efficient chillers and commercial air conditioning in supermarkets and commercial buildings, as well as in other medium-temperature applications like heat pumps, refrigerators, vending machines, beverage dispensers, air dryers etc.

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

One of the most important trends in Indian refrigerants market is to use solutions which are environmentally preferable. Amid growing concerns of global warming and rising economic activities pushing the demand for cooling systems - especially in the high-growth countries, the focus has been to move towards cooling solutions that are environmentally safe. Alongside, India has embraced several measures to drive energy efficiency programs in various industries.

The Ministry of Power, through the Bureau of Energy

Efficiency (BEE), has initiated a number of energy efficiency steps in the areas of household lighting, commercial buildings, standards and labeling of appliances, demand side management in agriculture or municipalities, SMEs, and large industries. Increasing demand for the domestic air-cooling system due to rising disposable income in the developing countries is fueling the market growth. Whereas, air conditioning has also widened its application areas in automotive on account of inclination of customers toward high comfort in luxury vehicles and rising global demand for mobile air conditioning solutions.

In tandem, Honeywell has been at forefront of the industry's drive to develop safer, lower-GWP alternatives to older-generation chlorofluorocarbon (CFC) and HCFC refrigerants. We have developed a leading line of environmentally preferable refrigerant solutions based on next-generation HFO technology. Global adoption of Honeywell's Solstice products has resulted in the reduction of more than 60 million metric tons of greenhouse gases to date, equal to eliminating emissions from more than 12 million cars. We estimate that increasing global adoption of Solstice products can reduce emissions by the equivalent of 475 million metric tons of carbon dioxide by 2025—or the impact of removing 100 million cars from the road for one year. We are working with many customers to adopt low GWP solutions across a wide variety of applications.

How do you see the acceptance of environment-friendly refrigerants in India?

India is committed to following a green path for the ambitious and effective achievement of the Paris Agreement by 2030. Given the estimations of India's rapid economic growth, the government has recognised the importance of lowering the country's greenhouse gas (GHG) emissions as part of an international effort to limit global warming. Along with NITI Aayog, the government is working towards an India Cooling Action Plan.

Indian refrigerant market is getting mature - the refrigeration industry is developing new cooling technologies and making transition towards the use of more environmentally preferable refrigerants. We are also seeing adoption of HFOs in certain segments independent of regulations as they provide better energy efficiency apart from meeting sustainability goals.

How is the acceptance of your products in the market?

Honeywell has worked with many customers to adopt its

Solstice solutions across a wide variety of applications. We have exclusive partnerships with Indian manufacturers in HVAC and cooling solutions industries. Our largest technology development and incubation center—Honeywell India Technology Center (HITC)—opened a new refrigerant lab and technology center in Gurgaon in 2017. HITC is supporting local and regional original equipment manufacturers (OEMs) in designing, incubating and testing new refrigerants, while helping them transition to lower-GWP alternatives. We are also providing cutting-edge opportunities for our customers to save on energy costs through our new Smart Refrigeration Solution offering for supermarkets, which we are currently bringing to market.

Are you planning to launch any new product in near future?

We are continuously working with our customers in India to introduce environmentally preferable products which support the phase-down of HFCs. Honeywell and its suppliers have completed a \$900 million investment program in R&D and new capacity based on Honeywell HFO technology. In continuation to our strong R&D efforts, last year we developed Solstice N41, part of the family of Solstice products to accelerate the transition away from hydrofluorocarbons (HFC 410A) in the past year. In addition to this, we also unveiled Solstice L41y, a reduced GWP refrigerant designed to replace R-410A for reversible heating and cooling applications. We are actively working with commercial partners in India to enable them to save on energy costs and aim to continue with our efforts to introduce such offerings and solutions in the future as well. ■

“Global adoption of Honeywell's Solstice products has resulted in the reduction of more than 60 million metric tons of greenhouse gases to date, equal to eliminating emissions from more than 12 million cars.”



Evaporative Cooling in Greenhouses

For Indian greenhouse cultivators, high ambient temperature and excessive solar radiation during summer are of great concern. Choosing an effective, yet affordable, cooling method is an important and determining factor for success in greenhouse-based farming and return on investment.

Most parts of Indian peninsular region witness hot summer, characterised by high ambient temperature and high solar radiation. Radiation intensity puts substantial load on a greenhouse for good part of a climatic cycle. Mere shading does not serve the purpose and the shade-houses fail miserably in summer. A proper greenhouse, fully or partially covered, is therefore a need, particularly when commercial scale cultivation is attempted for plants that are sensitive to environmental parameters like radiation, temperature and relative humidity (RH). India has a very high growth potential in floriculture. But traditional open-field

cultivation cannot support this potential business in floriculture, particularly in export market where stringent quality requirements are to be met. Growth and quality of most crops and flowers get affected when temperature exceeds 30°C and RH drops below 50 per cent. It becomes necessary to remove excess heat load from the greenhouse and enhance RH during hot summer and thus evaporative cooling gets due consideration. When temperature is not at detrimental level, natural ventilation with appropriate shading could be employed. But natural ventilation fails to extract excess thermal load in high radiation periods and in order

to maintain conducive microclimate inside the greenhouse, fan ventilation is resorted to. It is to be noted that, while shade nets are quite effective in restricting solar gain of a greenhouse, it also decreases the light transmittance, decreasing plant growth rate.

In evaporative cooling of air, heat as well as mass exchange occurs between air and water. The sensible heat of air is taken up by water, which in turn evaporates and thus, increases the moisture content of the air. As a result, air temperature decreases, the extent of cooling depends on the incoming air RH and the saturation efficiency of the cooling process. Dry air naturally has greater cooling potential than moist air. Thus, evaporative cooling is more suitable for greenhouses in hot and dry climatic regions.

Evaporative Cooling

Evaporative cooling methods which are normally used for greenhouse cultivation are fogging, misting and fan-pad cooling. All these are direct evaporative cooling methods as water is directly applied into the air by means of spray or wetted surface. During evaporation, water takes heat from the warm air, thus, reducing the dry bulb temperature.

Fan-Pad Systems

Fan-pad evaporative cooling (Figure 1) has been in use for over half a decade and is the most common system in closed greenhouses. An exhaust fan is fitted on one end of the greenhouse while a wetted pad is placed on the opposite end. A pump is used to circulate water over and through the wetted surfaces of the pad. Warm outside air is drawn through the pores and channels of the wetted pad when the fan is in operation and, as a result, the warm air loses its heat due to the evaporation of water.

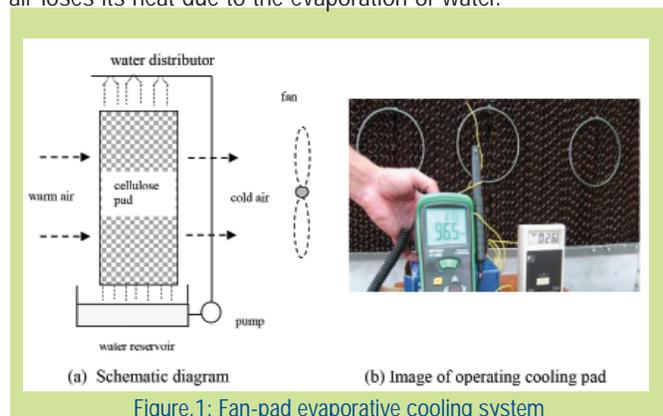


Figure 1: Fan-pad evaporative cooling system

Cooling pads of varied size and geometry are available. Most commercial pads are made of cellulose sheets, structured to give a bee-hive look and air flow channels across the width of the pad. They have good saturation efficiency, about 85-90 per cent, thus, yielding exit air temperature close to the wet bulb temperature (WBT). The air flow velocity through the pad normally remains in the range of 0.5-3.0 m/s. For hot and dry ambient air, a temperature drop of 8-10C is achievable using such cooling pads. Fans are designed to give certain number of air changes per hour or per minute (ACH or ACM) for the greenhouse. An air change of 20-30 ACH could be sufficient for moderate situations but high

heat gain situations would call for higher air changes equivalent to 1-1.5 ACM. Usually each span of greenhouse structure is provided with two induced flow fans with a combined capacity matching the desired air changes.

While fan-pad technology is quite matured and widely-used technique in greenhouse cooling, it has got certain disadvantages. There exists a longitudinal air temperature gradient inside the greenhouse and the pad end experiences a higher temperature as the air flows from pad end to the fan end. This restricts the length of greenhouse. The other disadvantage lies in the maintenance of the flow channels in the pads. Clogging of flow channels is a common problem with cooling pads and this occurs as a result of solid deposition on pad surfaces. Pad clogging reduces the saturation efficiency and thus, the pad effectiveness significantly. Unattended pad clogging often leads to insufficient heat removal from the greenhouse resulting in increased air temperature and reduced humidity inside the greenhouse.

To manage the temperature gradient along the length of a conventional fan-pad greenhouse, Misra and Ghosh proposed a longitudinally-distributed system (Figure 2), where cooling pads are placed on the side walls and fans are fitted at central part of the canopy ridge, thus, making a ridge ventilated fan-pad system. Their thermal model predicted that the average temperature in the plantation region inside the greenhouse could be uniformly maintained at a level 5-7C below the ambient temperature (for summer in Kolkata). This design envisaged canopy wall-aligned shade nets, as shown in Figure 2. Pad maintenance and replacement also become easier as each pad frame could be separately handled and could therefore be removed and replaced without affecting the operation of the system. The distributed system, however, leads to a wider water circulation system to cater to a distributed network of cooling pads.

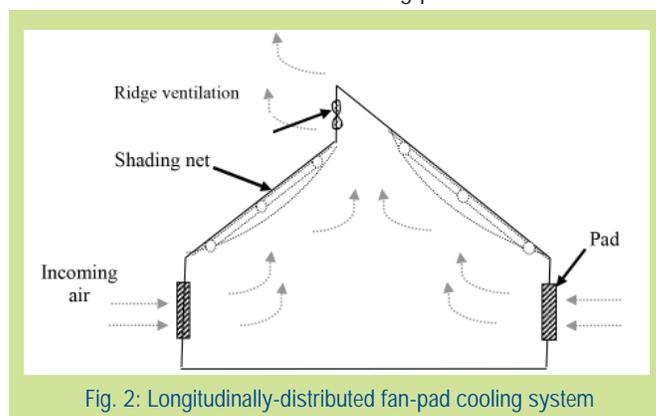


Figure 2: Longitudinally-distributed fan-pad cooling system

Fogging & Misting Systems

Fogging and misting systems rely on spraying of water into the greenhouse air. Sprayed droplets come in direct contact with air and heat and mass exchanges take place. Foggers are designed to spray finer droplets from high-pressure nozzles. These finer droplets readily disperse into the air and a good part of them evaporate early before they fall on plant foliage. The key feature of the fogging system is high water evaporation rate. Another worthwhile feature is that ventilation fans are no more a necessity

and therefore fogging and misting systems find popularity among the growers who rely solely on natural ventilation for their greenhouses to operate. Such naturally-ventilated greenhouses are normally equipped with continuous side vents or roll-up curtains as well as roof vents or continuous roof opening to aid in ventilation and air flow through the greenhouse. Fogging system performance varies widely, depending on factors such as fogging pressure, nozzle orientation and distribution, ambient humidity and air flow. Cooling efficiency usually in the range of 50-80% is observed.

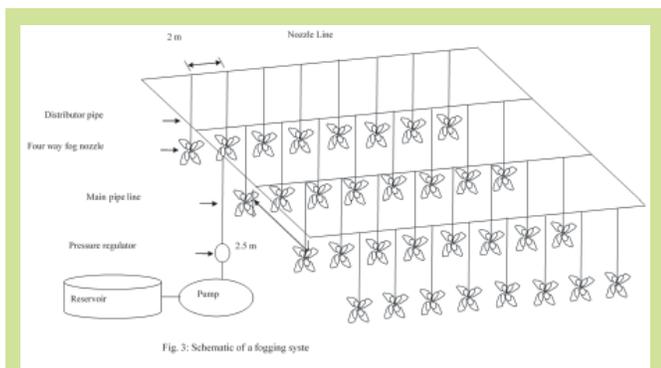


Fig. 3: Schematic of a fogging system

By using fog-cooling, average inside air temperature in a greenhouse could be maintained 2-4°C below the ambient, although higher temperature reduction in the range of 4-8°C has also been found in many studies. When the foggers are put on, air temperature rapidly reduces and with efficient fogging nozzles a near-WBT temperature could be reached. But soon after foggers are put off, air temperature rapidly rises. It is observed (Figure 4) that within 3/4 minutes of fogging, air temperature almost stabilises. Spraying beyond 4 minutes hardly reduces air temperature any further, as by that time RH rises to 90 per cent. Prolonged fogging leads to moisture separation and deposition on plants and floor of greenhouse.

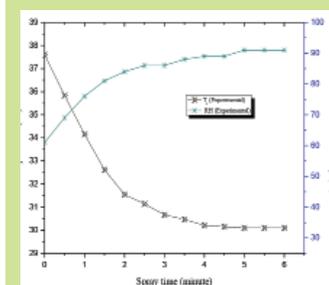


Fig.4: Effect of continuous fogging

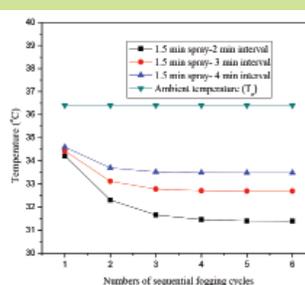


Fig.5: Sequential fogging with short spray

Thus, fogging cycle plays an important role in maintaining the average inside temperature within desired limits. Studies indicate that repeated operation in shorter fogging cycle improves the cooling effect and reduces water loss. Figure 5 shows the findings in an experiment with sequential fogging, maintaining a short spray time of 1.5 min only and varying the interval between consecutive sprays.

Other Evaporative Cooling

Roof evaporative cooling is another system where cooling is achieved by spraying water on the roof of the greenhouse. The water evaporates taking heat from roof and cools the roof surface. Here, roof cooling is independent of the internal humidity level of the greenhouse and the inside air is sensibly cooled because of a colder roof. Presence of a water film over the roof surface also reduces the transmissivity of the surface for solar radiation. Roof cooling can be combined with internal fogging to yield better result. External wetted shade cloths (Figure 6) can be used with roof cooling as proposed by Ghosal.

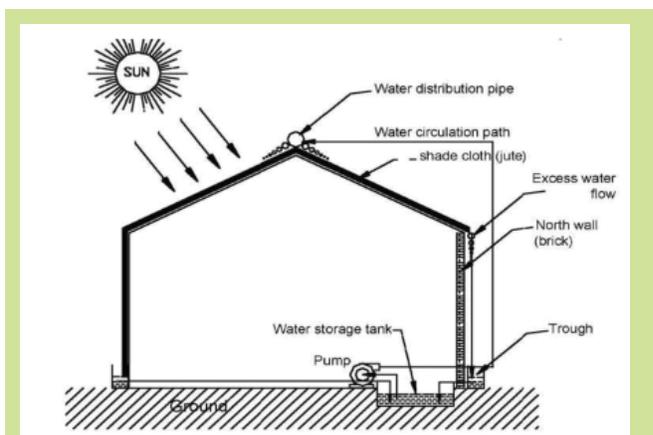


Fig.6: Schematic of roof cooling with wetted shade cloth

External evaporative cooling of incoming air by forcing it to flow over external wetted surfaces or a surrounding water body could effectively manage suitable microclimate inside the greenhouse. Main advantage of this system is that it could save the energy consumption of a conventional fan-pad system and it does not need a closed and covered greenhouse. This system can operate under natural ventilation mode and fans could also be employed to augment the ventilation rate. Such an evaporative cooling system has been proposed by Misra and Ghosh with dual ventilation mode of operation. They considered an external evaporative cooling of greenhouse air by providing surrounding shallow water ponds and floating wetted surfaces and developed thermal model to predict its performance. It was reported that greenhouse temperature could be reduced by 3-6°C as compared to the ambient temperature and with assisted fan ventilation, such system could achieve performance close to that of fan-pad system.

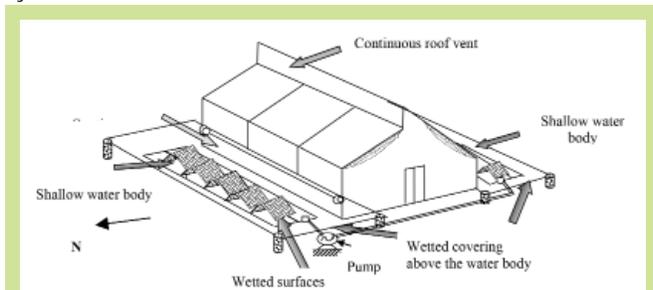


Fig.7: Surrounding water body and floating wetted surfaces

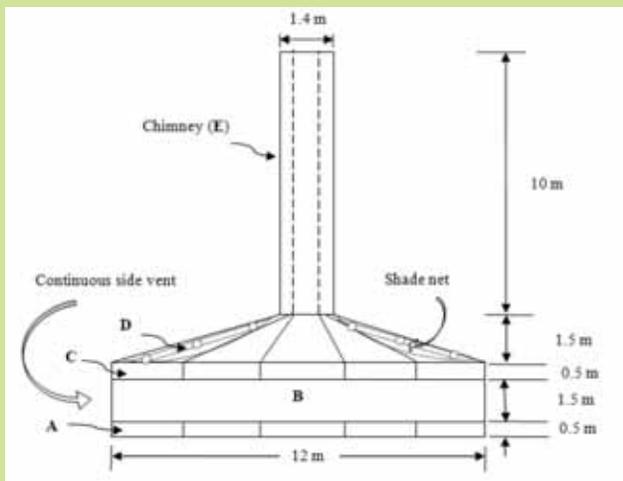


Fig. 8: Circular greenhouse with central solar chimney

Open or partially covered greenhouses that rely on natural ventilation, cannot achieve high rate of ventilation or air changes that is desired for steady growth of plants throughout the climatic cycle. The ventilation rate depends more on the free wind velocity and direction of wind at the location of facility. To enhance the ventilation rate, Misra and Ghosh proposed a new design of circular greenhouse with attached double-wall solar chimney. Studies suggest that incorporation solar chimney can yield ventilation rate 3 to 4 times that of ordinary naturally-ventilated greenhouses. Besides, a circular geometry makes such installation independent of wind direction. Figure 8 shows the arrangement of circular greenhouse fitted with solar chimney at the centre. When

the greenhouse is equipped with fogging system it could reduce the greenhouse temperature substantially lower than the ambient air temperature. They reported that greenhouse temperatures could be reduced by 4-6°C from the ambient temperature if a fogging cycle of 1.5 min spray time with 2 min interval period is used.

Two-stage evaporative cooling system comprising of a direct evaporative cooling (with cooling pad) and indirect evaporative cooling consisting (heat exchanger) has also been proposed and studied for greenhouse application. Seawater greenhouses also rely on evaporative cooling, using sea water as the working fluid. Such systems could be effectively combined with water desalination for the generation of fresh water in coastal regions.

Conclusion

This article presented an overview of evaporative cooling techniques that are applied in greenhouse systems. Selection of appropriate cooling system depends mainly on local environmental condition as well as greenhouse design and construction. Relative advantages and shortcomings of the different techniques have also been discussed. Some improvement options that can be applied in specific situations have also been discussed. ■



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Two-Stage Air Cooler for Bungalows



Fig 7. The cooled office

In this article, the author describes a novel cooler that is suitable for small ground +1 office or residential buildings.

The concept of lowering the temperature of air by evaporating water in it is common knowledge. However, the process is adiabatic, meaning the total energy content of the air does not change. The evaporation of water requires energy, which it absorbs from the air. This cools the water, but the energy is still present now in the added vapour that increases the humidity in the room.

In figure 1, the air enters at 113F and is cooled to 90F while the moisture content goes up. The energy lost from the air is

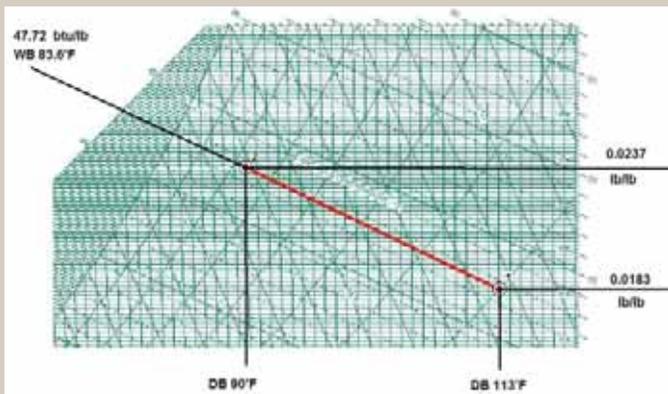


Fig. 1 Psychrometric chart showing direct evaporation process

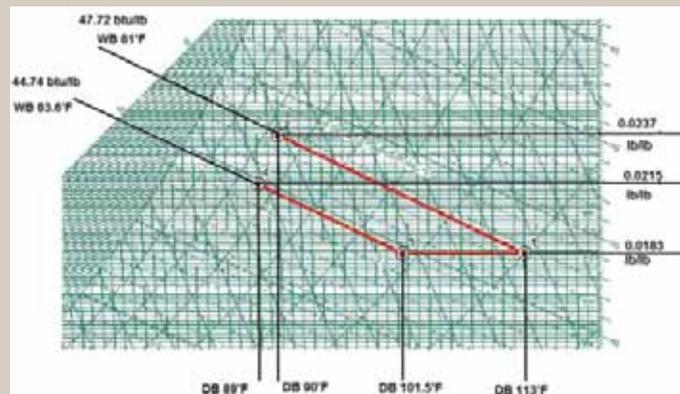


Fig.2 A Two-Stage Process

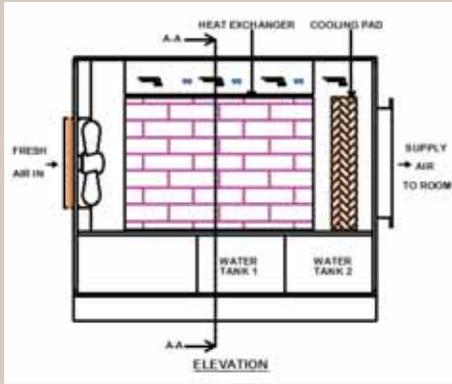


Figure 3: Drawing of 2-stage cooler

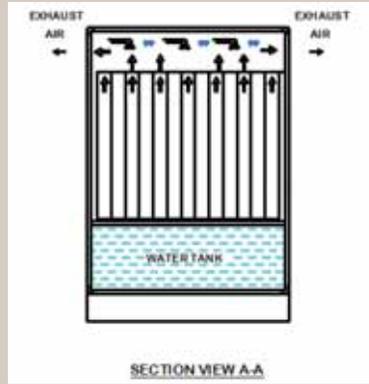


Figure 4: Cross section of the heat exchanger

called the “Indirect-Direct” process. Figure 3 is a drawing of the 2-stage cooler and figure 4 is a cross section of the heat exchanger.

The Two-Stage Cooler

As the drawing in Figure 3 shows, the two-stage cooler comprises a single fan at one end that pushes the air for both the stages through the galvanized sheet metal heat exchanger in the middle. Here the two air streams pass through alternate channels. A pump (not shown), sprays water on the sides of one channel. The air and the sheet metal in that channel are directly cooled by the evaporating water. The metal then cools the indirect portion of the other stream by heat transfer. That air is then discarded. The cooled second air stream leaves the heat exchanger and enters the direct stage, which is a cellular cooling pad. Here, it is cooled by direct contact with water and enters the supply duct.

Application

Figure 7 shows that this unit is working in the office of M/s Indigo Architects, Ahmedabad. It is installed at the roof and the air is ducted in. Both the unit and the duct are insulated in order to prevent any heat pickup from the exposed surfaces.

The Target

Figure 7 depicts the view of the cooled office space. The air enters from a grille near the top, next to the picture. It cools the entire double height space. The walls and the roof are designed such that they also resist the entry of heat through the structure. The cool surfaces also enhance the feeling of comfort provided by the cooling system that maintains conditions at about 32C and 60 per cent relative humidity at the peak of summer.

Disclaimer

This product is not readily available in the market. Being hand-made, it requires skilled craftsmen, a rare commodity these days since they are being replaced by machines. ■

equal to the energy required for evaporation. So, the total energy content does not change. This is known as an ‘Adiabatic’ (No heat transfer) process.

When an air cooler is operating in a poorly ventilated room, the increase in humidity reduces the body’s ability to remove its metabolic heat by perspiration. The problem is compounded by radiation from the walls and the ceiling. Therefore, an exhaust fan must also be provided to keep the humidity down. Also, direct exposure to any hot interior surface must also be avoided.

The feeling of comfort would be enhanced if some heat were to be removed before starting the water evaporation. This is called ‘Non-adiabatic’ (With heat transfer) process. By using a two-stage design, we could achieve the same

temperature reduction with lower moisture content in the supplied air.

Figure 2 is a psychrometric chart showing the Two Stage process.

In the two-stage process, the upper line shows one air stream directly cooled by evaporation. This, in turn, partially cools the second stream, as shown in the horizontal line in the chart, through a heat exchanger. Notice that there is no increase in the moisture level up to this point. This is the non-adiabatic portion of the second air stream. The second stream then enters the direct, adiabatic stage, and is cooled to a supply temperature that is lower than the ambient wet bulb temperature. The upper stream is then discarded.

In this process, the horizontal line represents the “Indirect” stage and the slant line is the “Direct” stage. Hence it is



Fig. 5 Roof top installation



Fig. 6 Supply Duct

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The article describes the efficacy of BMS for constantly monitoring the performance of the building assets and offering the ability to facility management personnel to control the various assets thus optimising their operations.

BMS Tracking Energy Performance

Belapur Railway Station Commercial Complex (BRSCCL) is one of the largest commercial complexes in Navi Mumbai. It is a sprawling complex of over one million square feet, stretched across its 10 towers, it sits atop the CBD Belapur station in Navi Mumbai. It also happens to be the recipient of the prestigious National Award for Excellence in Energy Management, in building and service sector from the President of India. It is also the winner of the National Energy Management Award at the CII National Energy Management Conference. One of the principal enablers of this success is that BRSCCL has been retrofitted with Building Management System (BMS). "Despite being a building over 40 years old, many of the electrical assets and systems have been connected and are managed through BuildTrack's BMS system which uses the latest IoT technologies to achieve significant efficiencies for us," said Vaibhav Mahajan, Manager of BRSCCL complex.

Buildings, both residential and commercial, account for a significant portion of the overall energy consumption of our country. They account for more than 30 per cent of the total energy consumption in the country. Additionally, the Royal

Institute of Chartered Surveyors (RICS) believes that almost 450 million square metre of space is likely to be added every year on average for the next 20-30 years. Each year the energy consumed by buildings is anticipated to grow by about 8 per cent. New building codes such as Energy Compliance Building Code, introduced in early 2000s and updated in 2017 by the Bureau of Energy Efficiency, have been introduced with the intent to ensure that the new building stock that is coming into existence in the next decade will be more energy efficient than the traditional buildings. But the existing stock of residential and commercial buildings is very large, and most of them like BRSCCL, have been in operation for many years and cannot quickly or drastically change any of the electrical equipment and systems that they use. Not only would the cost associated with such changes be prohibitive, it is also not feasible often to shut down or disrupt the operation of the building to make changes without significant inconvenience to the tenants or residents of the building. There is no doubt that significant wastage occurs in the energy consumption within a building, but given the disparate and disconnected electrical assets and systems in a building

it is a challenge to monitor and control them on a daily basis, so that corrective action can be taken to conserve energy and eliminate waste. This is where a Building Management System, which is also sometimes known as a Building Automation and Control systems, comes in to facilitate such a level of monitoring and control.

A building consists of many systems and assets that are needed for the operation of the building and for the comfort, safety and security of the occupants of that building space. These include the lighting systems, air conditioning systems which include chillers and AHUs; pumps and motors for getting water into overhead tanks, surveillance cameras and perimeter security system; fire safety panels and smoke sensors to monitor fires; diesel generators, renewable energy systems such as solar panels or wind turbines and server rooms and inverters and batteries; elevators and escalator systems. Not only do buildings require systems, but they also require meters for monitoring critical utilities and operating parameters. These can include energy meters, BTU meters and water meters. All these assets and systems either consume energy in

achieving their objectives or they generate energy for the use within the building or they simply monitor the consumption of energy and other utilities like water.

All these systems typically operate independent of each other and are not connected together. Each typically has its own dashboards or management center that allows users to interface with that system to monitor its parameters or to change them as required during the course of the operations. These systems operate on their own protocols as well, which in the case of building systems the most commonly used protocols have been BACnet and MODbus. In recent years, IP as a protocol has joined this list in recent years. Typically, the components of an HVAC system use the BACnet protocol to communicate with each other. MODbus is more common protocol for many of the other systems. A BMS system has to be able to connect to these various systems despite their protocols so that it can be the single point at which all these systems are accessible for both monitoring and some degree of control. In recent years, new technologies such as the 'Internet of Things', commonly known as 'IoT', have appeared on the scene. One of the benefits of the latest technologies like IoT, is that the BMS system that uses these technologies can retrofit existing buildings easily allowing for superior monitoring and control of all their assets to achieve both energy efficiency and greater operational effectiveness with fewer labor resources. It can also provide access to these systems not only on the premises of the building but also remotely over the internet. "The introduction of IoT technology based BMS systems have created a retrofit option for existing residential and commercial buildings and certainly for new one, for achieving energy efficiency as well as substantially improved safety and security," commented Dr Narendra Bhat, President, BuildTrack, whose BMS system received The Internet and Mobile Association of India's (IAMAI) prestigious 'Best of IoT' award.

One of the primary reasons for energy wastage in buildings because buildings



are very complex to manage and maintain, especially with constant changes in occupancy, tenants, tenants operating hours and assets being utilised and more. One of the key ways to ensure control of the building energy performance is to have a system that is constantly monitoring the performance of the building assets and offering the ability to facility management personnel to control the various assets in a manner that optimises their operations without inconveniencing the needs of the building occupants. Such a system is typically known as a Building Management System or a Building Automation and Control systems. Such a system not only threads together all the electrical assets and systems that serve the building, but also monitors the various meters responsible for monitoring energy, water and other utilities for the building.

Since the BMS system is the nexus of all the varied systems and assets in the building, it serves as the vantage point from which to manage aspects of safety, security and energy management. One of the most powerful tools for energy management is the ability to create schedules. These would allow elimination of wastage for many of the building systems that consume energy. The building lighting is one of the major

consumers of energy and this can include common area lighting in lobbies, hallways and aisles. It can also include landscape lighting, façade lighting and street lighting and signage around the building.

Air conditioning is one of the major consumers of energy in buildings often contributing to more than 40-50 per cent of the energy consumption of a building. It is also an area where significant wastage of energy occurs and huge opportunities for improvement in energy consumption exist. Most buildings use VRF systems or some buildings typically use a large number of split ACs distributed throughout the facility which BMS can control. Dr Narendra Bhat, provided an example, "RG Kar, Medical College Hospital based in Kolkata, had dozens of distributed split ACs from multiple brands spread across their buildings, and using a BuildTrack BMS, we were able to centralise control and monitoring for both energy efficiency and safety. For buildings where wiring is not feasible, we have deployed wireless systems."

Overall, the use of a BMS system offers operators of the building a single point of control of all the assets and systems of the building, providing one of the best methods to reduce the energy footprint of a building and optimise the operating cost. ■



Systemair envisages good momentum in HVACR with infra projects



Systemair was founded in 1974 with a pioneering idea in developing and introducing the circular in line centrifugal duct fan which has simplified ventilation systems.

Asokdas M D, Managing Director, Systemair gives the glimpse of the company, products and services, opportunities envisaged by the company due to the government's emphasis on infra development and much more through the interview with **Cooling India**.

Please take us through the company's journey in India.

Systemair started business in India in the year 1999 through a distributor, primarily dealing with ventilation fans in Indian HVAC market. We have the privilege of introducing the underground ductless carpark ventilation system in Indian market. In the year 2006, Systemair AB decided to establish its direct presence in India by opening regional offices in Delhi, Bangalore, Pune and Kolkata, marketing its products and services. With the acquisition of RAVISTAR in 2009 and subsequently IAPL (International Air conditioning Products Limited) in 2011, Systemair expanded the business in India by widening the product portfolio to air distribution and air handling units. After completing the construction of state-of-the-art 12000 square metre factory in Greater Noida in 2014, Systemair integrated its production facilities

in North under one roof which is a platinum rated green building and presently the headquarter of Systemair in India. In the year 2017 Systemair moved to a bigger factory premise at Hyderabad measuring 6000 square metre to expand the production capacities for South Indian market.

What are the solutions and services offered by the company catering to HVACR segment?

Systemair India offers ventilation solutions to its customers in HVACR segment divided into three business areas, ventilation fans, air distribution products, and air handling units.

In ventilation fans, we offer circular inline fans, rectangular inline fans, box type centrifugal fans, kitchen exhaust fans, wall mounted propeller fans, axial fans for normal and high

temperature applications, car Park Jet fans. We have in house capability to offer design support and CFD simulations for basement carpark applications to our customers. We also offer tunnel ventilation fans for metro and road tunnels having high thrust levels.

In ADP (Air Distribution Products), we offer wider range of air distribution products to our customers ranging from linear bar grills, single and double deflection grills, non-vision grills, egg crate grills, square diffuser, circular diffuser, swirl diffuser, slot diffuser, low leakage damper, louvres, UL listed fire dampers for fire as well as fire and smoke rated as per UL 555 & UL 555 S for Class 1 leakage, circular and square attenuators, VAV and CAVs etc.

In Air Handling Units, there are 2 series of Eurovent certified AHUs which are manufactured in Indian facility. BA- Plus & BA – Hygiene.

Eurovent certified AHUs with highest class of leakage L1, Deflection class D1, Thermal Bridging TB2 come with plug and play smart solutions with factory build controllers & sensors.

We have the privilege to be the first manufacturer to introduce Eurovent Hygiene certified AHUs in Indian market. Systemair is a known name on the pharma and clean room industry and we feel that hygiene certification will further strengthen our position as a quality and reliable supplier in the industry offering certified products. The units are tested for anti-corrosive and anti-microbial growth and are equipped with corrosion resistant materials suited for Pharma and clean room applications.

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

Systemair offers products and solutions to different sectors like infrastructure, IT, pharma, commercial etc. We strongly believe in quality and reliability which is our growth driver. The quality we maintain on the manufacturing process and the certifications we have on our products compliments the reliability and trustworthiness of Systemair products. We are one of the market leaders on the pharma segment with our air handling units widely accepted in the market. We see a stable growth in pharma sector despite of the USFDA regulations. With the launch of Eurovent Plug and play BA-plus AHUs, we see a good growth on the IT and

commercial market who were looking for high end quality solutions. The market is moving from traditional concept of low efficient belt driven solutions to highly efficient EC fan technologies which is helping the industry to offer factory assembled AHUs with integrated controls and instrumentation. The awareness of certified products and smart solutions are increasing and we feel this will be the future. The newly launched Access control solution of Systemair offers touch screen with connectivity to cloud for remote monitoring which complements the future demands. With the government emphasising on infrastructure development, we see a good momentum on upcoming metro projects and airport expansions in different cities. This is good for us with our products and solutions and also will benefit the entire HVACR industry in India.

How has industrial ventilation market evolved in India as compared to the global market?

With the revision of ventilation standards on the latest release of NBC (National Building Code) the awareness for need of ventilation is increasing. But in my opinion, we have a long way to go as compared to global markets. There is a need for stringent regulations for requirement of ventilation on occupied areas which is directly related to health, productivity and comfort. Occupants are more aware and educated on the IAQ with terms like PM 2.5 and PM 10 commonly used in medias now a days. This will push the need for ventilation and awareness for common man who are now relying on indoor air purifiers.

What kind of technical innovation would you like to incorporate in your products to create optimal indoor air quality (IAQ)?

Since the industry is more concerned about the IAQ, we were constantly looking to improve the offering on our AHUs. There are different technologies available to create a healthy indoor climate on the occupant space. Increasing the level of mechanical filtration is the most economical way to increase the IAQ, but this will increase the system pressure drop and in turn the fan will consume more power to overcome the pressure.

We have equipped our AHUs with electronic filters to overcome the pressure drop which is a good way of

Systemair finds a good opportunity to be a part of upcoming underground metro and airport projects with a vast experience with solutions offered on the existing projects like Delhi Metro, DIAL, HIAL etc.

maintaining a good PM 2.5 level in occupant zone. We also offer UV filtration systems for maintaining a good indoor air quality by eliminating germicidal growth on the cooling coils. Systemair AHUs are equipped with smart controller for monitoring the PM 2.5 level and CO2 with sensors and the life of UV system with intensity meter for easy maintenance.

What opportunities would you envisage for your company with the Indian Government's focus on development of infrastructure like smart cities, urban transportation projects?

With the Indian government's focus on infrastructure development with smart cities and urban transportation, Systemair finds a good opportunity to be a part of upcoming underground metro and airport projects with a vast experience with solutions offered on the existing projects like Delhi Metro, DIAL, HIAL etc. Most of the airports are undertaking

the expansion project to increase passenger capacities and Systemair looks for opportunities to partner with them to offer entire ventilation solutions based on customer needs. We are equipped to cater to the requirements with regard to quality and timeliness with our product certifications and two factories to meet the customer expectations.

What are the expansion plans of Systemair in India?

Systemair invested on the R&D facility in India with a team of 12 engineers and 2 laboratories. We have air terminal testing lab to measure the aerodynamic performance of air distribution products at varying climatic conditions. All measurements are done as per EN 12238 and Ashrae 72 standards.

We have received AMCA accreditation for air and sound for our Acoustic lab in India where we can measure airflow, and sound levels as per AMCA 210 and 300 standards. ■

Since the industry is more concerned about the IAQ, we were constantly looking to improve the offering on our AHUs. There are different technologies available to create a healthy indoor climate on the occupant space.

interview

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Foodpro to provide platform for food industry

To cater to the need of Indian Food Industry, Confederation of Indian Industry (CII) has been organising Foodpro - exhibition and conference on food processing, packaging and technology. Since its inception in 1995, the 13th edition of the event is scheduled from 23 – 25 August 2019 at Chennai Trade Centre, Chennai India will be excellent business platform for the Food industry.

Foodpro

The 13th edition of India's biennial event on food processing, technology and packaging - Foodpro 2019 will focus on the current trends in food processing, packaging, technology, ready to eat and cook food, food ingredients along with conference, training sessions and traditional food demonstrations.

ColdStoRe

CII is presenting ColdStoRe India 2019, a focused exhibition on cold storage, cold transportation and cold supply chain, on the sidelines of Foodpro 2019. ColdStoRe India will provide an interactive platform for manufacturers and users along with deliberation on technology, scope and future trends in cold chain.

T-Food

To bring the awareness about the traditional and local foods in India, CII is launching 'T-Food' (Traditional Food Festival & Expo) along with Foodpro 2019, which will showcase the processed traditional food in healthy way, newer recipes of cooking traditional foods and will provide an opportunity to entrepreneurs to showcase the developments in processing of traditional food.

Event Highlights

- 3-day exhibition with more than 10,000 sqm of display area
- Concurrent Shows: ColdStoRe India 2019 and T-Food
- More than 300 exhibitors
- More than 30,000 business and trade visitors
- Conference on emerging technologies in food processing sector
- Conference on fisheries technologies
- Traditional food competition for new product development
- Focused participation in bakery, food ingredients, beverages, organic food, millets and food aggregators.
- Networking with CEOs and B2B meetings.
- Product launches and presentations.

Conference

The objective of the conference is to promote and provide technology-based knowledge among the stakeholders of the agro and food processing sector.

The conference on emerging technologies in food processing sector will cover the topics like future of food processing industry, recent advances in food processing technologies, frozen foods and food safety and awareness.

The conference on fisheries sector in South India will have the deliberations on opportunities in Fisheries Sector in South India, aquaculture: best practices for production and management, cold chain trends, post-harvest management and new technology trends and finance for the sector. schemes available under MoFPI, NABARD, banks. ■



The 13th edition of the event is scheduled from 23 – 25 August 2019 at Chennai Trade Centre, Chennai



Climate Control by Use of Desiccant Cooling

The article sheds light on desiccant cooling systems having an efficient method of controlling the moisture content in the humid climate while carrying out air conditioning. They do not use any ozone-depleting coolants and consume less energy as compared with the vapour compression systems.



Nowadays, most of the conventional air-conditioning (AC) systems are based on the traditionally used mechanical vapour-compression cooling technology which is driven by an electrical

energy. Since the major part of the global electricity comes from fossil fuels, it causes the rising awareness of environmental and sustainability issues. One of the alternatives to the mechanical

vapour-compression systems is the desiccant assisted cooling (DAC) process, based on the dehumidification of moist air in present of solid or liquid desiccant material. This results into substantial energy saving for conditioning-built environment as shown in figure 1.

Research conducted by International Institute of Refrigeration in Paris led to the conclusion that the proportion of energy used by the air-conditioning systems in the household and commercial buildings now accounts for nearly 47 per cent. Air-conditioning systems today account for almost 21 per cent of the total energy consumption of India as shown in figure 2. Rising standards of living, technological advancement and increasing population have led to a significant increase in per capita energy demand and thus, total energy consumption in the last few decades. Even though human beings have made much progress in almost every field, but still, we rely on fossil fuels as the primary source of energy to meet our demands.

Desiccant systems can be categorised based on the type of desiccant used:



Energy consumed in kW

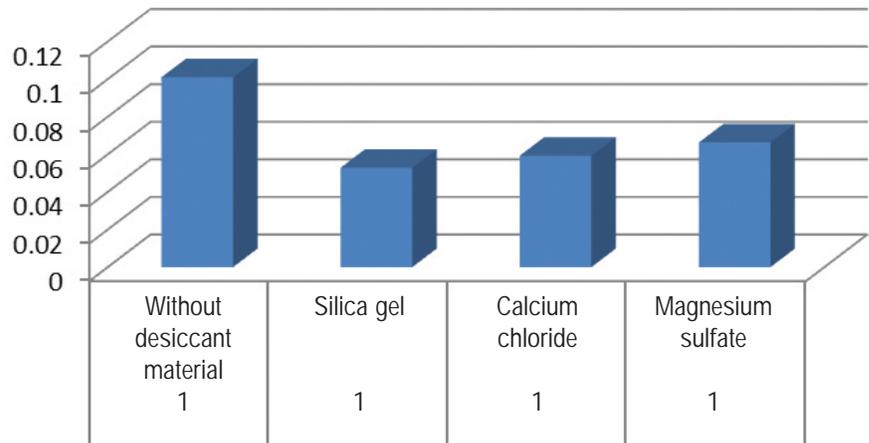


Figure 1: Comparison of energy consumption of various solid desiccant materials.

- Liquid desiccant systems,
- Solid desiccant systems,
- Advanced desiccants which include polymeric desiccant, composite desiccant, bio-desiccant.

Working Principle of Desiccant Cooling

Solid desiccant-based dehumidification system working on principle of adsorption

of moisture. In its operation, moisture laden ventilated or recirculated air is first passed through channels of rotary dehumidifier so that the water vapour presented in it is adsorbed by a rotating desiccant wheel due to the pressure difference between them. During the process of dehumidification, adsorption heat rises the temperature of process air at dehumidifier exit. The temperature of this dried process air is then lowered further to the desired room supply conditions by use of heat recovery wheels and vapor compression cooling coil. To make the system working continually, amount of water vapour adsorbed by the rotating desiccant wheel must be driven out of the desiccant material so that it can be dried enough (reactivated) to adsorb water vapor in the next cycle. This is done by

heating the desiccant material to its temperature of reactivation which is dependent upon the type of the desiccant used. Energy required for reactivation of rotary dehumidifier is supplied via reactivation heat source either by electrical heater or solar or waste heat. A desiccant based hybrid space cooling system as shown in figure 3, therefore, comprises principally four components, namely the reactivation heat source, the rotary dehumidifier, heat recovery wheel and the traditional vapor compression cooling unit. The comparison of different desiccant used in the desiccant dehumidifier tabulated in Table 1.

The drying capability of solid desiccants is higher than liquid desiccants. They can be cleaned easily. However, they require relatively higher regeneration temperature. Figure 4 shows a desiccant wheel used for dehumidification of process air and regeneration of solid desiccant. Unlike liquid desiccants, the dehumidification and regeneration process in the solid desiccant is always simultaneous. Desiccant wheel is divided into two parts with the help of a stunt. In one part, the humid air passes through the desiccant wheel for dehumidification. In another part, hot air is passed to remove the added water from the solid desiccant.

Advanced Desiccant Materials

Both solid and liquid desiccant have several disadvantages. For instance, the adsorption capacity of silica gel is low and requires high regeneration temperature.

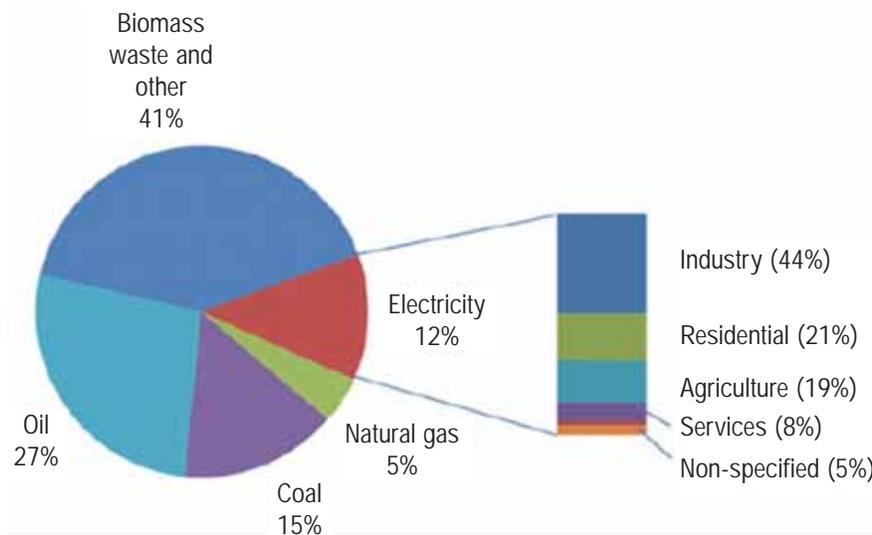


Figure 2: Total energy consumption of India from various energy resources.

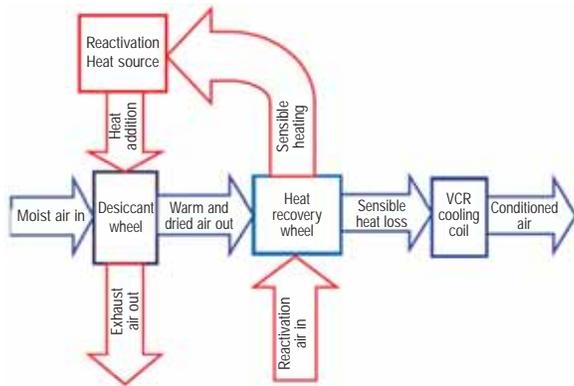


Figure 3: Principle of desiccant cooling

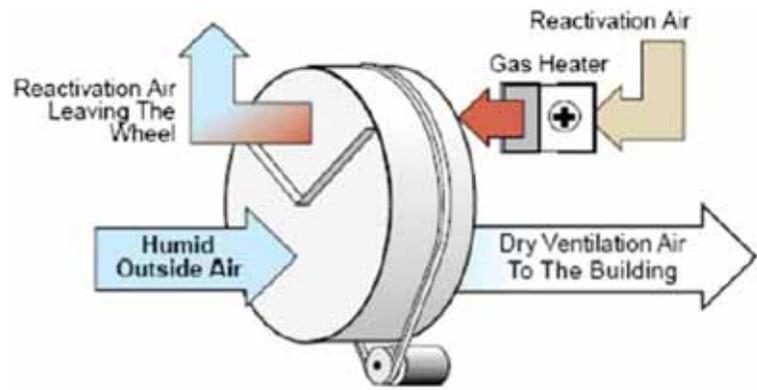


Figure 4: Working of rotary desiccant wheel

Table 1: Comparison of different desiccants used in rotary dehumidifier

Parameter	Silica Gel	Lithium Chloride	Metal Silicate	Zeolite
Matrix structure	Honey comb	Sinusoidal	Honey comb	Honey comb
Speed (rph)	8-24	20	15-25	5-15
Face velocity (m/s)	2 - 2.5	1.5 - 2	2 - 2.6	1.7 - 2.2
Regeneration temperature (°C)	60 - 120	40 - 70	55 - 85	60 - 90
Adsorbate capacity (kg/kg)	0.37	0.43	0.46	0.22
Adsorption heat (kJ/kg)	2370	2957	3675	3974

Desiccants containing salts of chloride like lithium chloride and calcium chloride may give rise to corrosion problem. In addition, zeolites have low water capacities and a higher cost of regeneration. An intensive research is going on to develop new desiccants with a higher performance. New and advanced desiccant that have been developed with suitable modification in the properties of conventional desiccant like bio-desiccant, composite desiccant and polymeric desiccant has the capability to overcome the limitations of conventional desiccants.

The compound desiccant was developed to ameliorate the performance of desiccant cooling system and concluded that under practical operation a compound desiccant can improve the overall performance of a desiccant wheel by 20–30 per cent over desiccant wheel with silica gel. Number of experimental tests have been carried out by many researchers on compound desiccant materials and they have found that the coefficient of performance of desiccant cooling system may reach 1.28, which is 35 per cent more than the desiccant wheel with only silica gel. Investigation on a novel polymeric desiccant has been carried out and it is found that sorption capacity of super polymer desiccant is 2–3 times higher than

silica gel. A micro-porous coordination polymers (MCP) has been investigated and compared its capacity and efficiency with activated alumina and concluded that polymeric desiccants hold potential of commercial use. However, further research on various parameters of advanced desiccants is yet to be conducted to study behaviour of MCP in extended cycles before coming to an actual conclusion.

Conclusions

Desiccant cooling is relatively an advanced space cooling technology and is a good option for traditional vapour compression air conditioning system especially, in hot and humid climate. The desiccant assisted comfort space cooling hybrid air-conditioning technology can separate the latent heat load from the sensible heat load as compared to conventional vapour compression system, which will substantially ameliorate the evaporator temperature and so lowered the power consumption of the VCR compressor. In hybrid cooling systems, solid desiccant dehumidification system used in conjunction conventional vapour compression system have advantage of high efficiency over solid desiccant based evaporative cooling systems in which moisture is added to the cooled air stream

because process air steams comes in direct contact with the cooling water becomes less efficient as air becomes saturated in humid conditions. It is also found that hybrid desiccant space cooling system consumes low energy when coupled to free energy sources like solar energy or industrial waste heat as well as release less carbon dioxide emission than the conventional vapor compression system. Thus, if economical factors taken into account the application of renewable energy for desiccant regeneration in hybrid space cooling technology would be more beneficial. Therefore, desiccant based hybrid space cooling techniques is economically and environmentally more feasible for the climates which have high cooling demand, and humid summer characteristics. By making the direction of future research on space cooling towards solid desiccant – vapour compression hybrid space cooling augmenting the contribution of desiccant based hybrid cooling which can bring to the amelioration of comfort, energy and cost savings. ■

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ISK-SODEX sets to sail new horizons in Istanbul



ISK-SODEX will unite procurement delegations from EU countries in particular, as well as Africa and South America continents with Turkish manufacturers for new commercial cooperation opportunities.

Being comprised of air-conditioning systems, insulations, fittings and equipment, and heating and refrigeration systems, the air-conditioning industry has turned towards new markets for exports with an export goal of 5.5 billion dollars in 2019. With its promotion activities gaining momentum in strategic countries such as Australia, Argentina, Chile, Tanzania, Pakistan and Egypt, the sector will meet its target markets at ISK-SODEX fair between 2 - 5 October 2019. The fair which will take place at Istanbul TÜYAP Fair and Exhibition Centre will provide great opportunities this year to the air-conditioning sector that seeks to set sail for new horizons in terms of its export goals.

Noting that the Turkish air-conditioning sector has achieved a significant competitive advantage in international markets, Deutsche Messe's subsidiary Hannover Messe Sodeks General Manager Alexander Kühnel said that the investors are now more eager to make investments in Turkey, and added, "The air-conditioning sector is a significant export area in Turkish industry and continues to set new records every year with its growth figures. The sector's shift towards the state-of-the-art products with a focus on R&D activities in the recent years provides a competitive advantage particularly in international markets and draws the attention of the foreign investors. The number of foreign investors wishing to establish commercial cooperation with the Turkish air-conditioning sector has increased significantly. Aiming at raising its exports goal by utilising this increased interest, the sector especially focuses on

farther markets with low exports volume. It is of great significance that the sector comes together with target markets at international exhibitions and demonstrates its said potential."

The sector diversifies its export markets. Noting that they will be bringing the air-conditioning sector and the target country markets together at ISK-SODEX 2019, Kühnel commented, "The Turkish air-conditioning sector has started to extend its presence to strategic markets such as Australia, Argentina and Chile. We are aware that Africa continent is also one of the new targets of the sector. We will be increasing the number of foreign buyers from existing countries on one hand with mainly from Germany, UK, Italy, France, Spain which are parallel to the top five export countries of Turkey's HVACR industry and on the other hand we will be providing a great opportunity for Turkish manufacturers to meet important procurement delegations from the said markets that are the new export targets of the sector in Istanbul. We will also be hosting sector professionals from many strategic markets including in particular the USA, United Arab Emirates, Iran, Iraq, Qatar, Northern and Western Africa, Russia and Poland within the scope of the 'International Buyers' Delegation' program. During the fair, we will also be conducting supportive programs focusing on the advantages of the sector, and providing new opportunities to the exhibitors and visitors for networking, establishing business connections, and exchanging information and experience."

With over 42.000 square metres of its exhibition area already sold out, 2 - 5

October International 'ISK-SODEX' 2019 will host exhibitors from countries such as Germany, China, India, Japan, UAE, South Korea, Lebanon, Pakistan, Russia, Thailand, France, Italy, Netherland, Greece, USA and Turkey. This year the national and international companies will have the opportunity to promote their wide range of new trendy products and services such as heating, refrigeration, air-conditioning, ventilation, insulation, pumps, valves, fittings, water treatment, fire prevention and solar energy systems. 2 - 5 October 'ISK-SODEX' 2019 Fair organised by Hannover Messe Sodeks Fuarçılık, the Turkish office of Deutsche Messe - a leading global fair organisation company, will be held with the cooperation of with the cooperation of ISKAV (Heating, Cooling, Air-Conditioning Research and Education Association), DOSIDER, (Natural Gas Appliances Industrialists and Businessmen Association), İSKİD (Air-Conditioning and Refrigeration Manufacturers' Association), İZODER (Heat, Water, Sound and Fire Insulators Association), TTMD (Turkish Society of HVAC and Sanitary Engineers), POMSAD (Turkish Pump and Valve Manufacturers Association), SOSİAD (Association of Refrigeration Industry and Businessmen), ESSİAD (Aegean Region Refrigeration Industry and Businessmen Association), MTMD (Mechanical Contractors' Association) and KBSB (Boiler and Pressure Vessel Manufacturer's Association). ■

Green Innovative HVACR Products



The new innovative HVACR products and solutions include the technologies which are energy efficient, technically proven and economically viable; last but not the least, is on adapting technology, to continually minimise the negative effects on the environment.

VRF & Inverter Ductable Air Conditioners

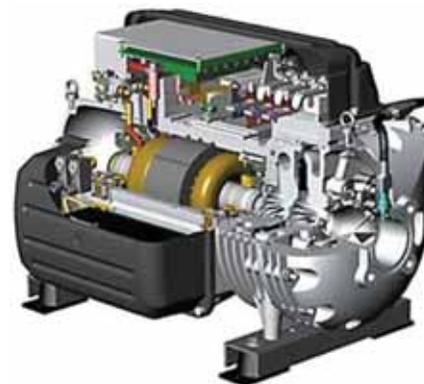
The new VRF (Variable Refrigerant Flow) method of refrigeration can be used in various air-conditioning applications. There are two basic types of VRF system — cooling or heating-only and energy recovery. Cooling or heating only can provide just cooling with the incorporation of a heat pump, cooling or heating to the space — but not both at the same time. The energy-recovery type can, however, provide cooling and heating simultaneously to different parts of the building. This feature has the potential to deliver maximum energy savings. Further, a heat-recovery system can transfer the heat extracted from those spaces requiring cooling to areas demanding heating — resulting in extremely high primary-energy ratios and low operating costs.

The market growth of VRF system is the highest in the cooling industry and has recorded a 14 per cent CAGR.

Voltas has recently introduced inverter ductable air conditioners, which is a low-cost product compared to VRF system, but equally energy efficient. The commercial spaces like showrooms, restaurants, etc. are the identified customers for this product. The refrigerant used in both of the above products (R-410a) has zero ODP and thus, are environment friendly.

Magnetic Bearing Compressor Chillers

The conventional centrifugal compressors use anti-friction sliding bearings. These bearings tend to cause friction between the moving parts with resulting high sound levels and lubrication problems. Thanks to



technological advancements made, oil free magnetic bearing compressors are now available in the market. The revolutionary magnetic bearing compressors, the world's first totally oil-free compressors, are specifically designed for the HVAC industry. The magnetic bearing, variable-speed centrifugal compressors and advanced electronic technologies, enable these compressors (60-150 TR nominal

capacity range) to achieve the highest compressor efficiencies for water-cooled, evaporatively cooled and air-cooled HVAC applications.

Voltas has introduced water cooled chillers with this technology. The market is catching up, although high cost, compared to conventional chillers, is the present constraint.

Working Principle

The magnetic bearing compressors' rotor shafts and impellers, levitate during rotation and float on a magnetic cushion. Two radial and one axial magnetic bearings are employed. Centered rotation is instantaneously self-corrected and maintained. When not powered, the rotor is supported by carbon composite, touchdown bearings designed for many years of use.

Magnetic bearing compressors have outstanding energy savings from digitally controlled, frictionless, two-stage centrifugal compression. This results in significant reductions in operating cost and also environmental emissions associated with electrical energy usage and its generation.

The magnetic bearing compressors are the quietest compressors in the industry. They operate at a sound level of 70 dBA (conversation level) with virtually no vibration. Given normal, background sound levels of plant-room, one literally cannot hear the compressor operate.

Co-generation Vapour Absorption Chillers

Co-generation is the new concept becoming popular due to increasing cost and shortage of grid power. The hot waste exhaust gases and hot water produced by DG sets or Gas Turbines (waste-heat) is used as source of energy for vapour absorption chillers. The chilled water, thus, produced in these chillers is used for air-conditioning purpose. Hence, free cooling, with negligible use of electricity is generated with this technology. With this concept, the efficiency of co-generation vapour absorption machines increases from 30 per cent to 70 per cent.

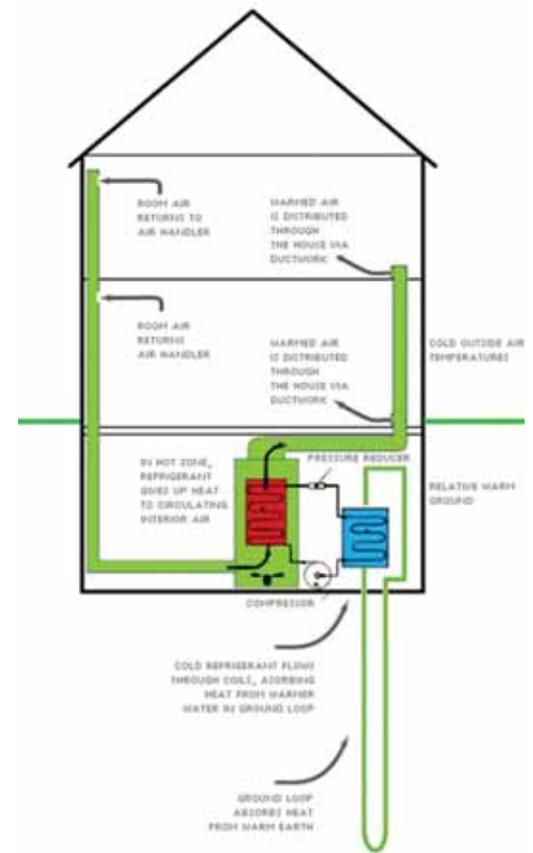
In some countries abroad, it is

becoming the norm to use co-generation concept along with captive power generation plants. It is gaining popularity even in India. Voltas has a complete range of Co-generation Vapour Absorption Machines from 40 TR to 2000 TR capacity.

Geo-Thermal Air Conditioning

Geothermal air-conditioning system is today's most energy efficient and lowest running cost air-conditioning system in the world. This system totally changes the way air-conditioning or heating of buildings is conceived at the initial design stage.

Geo-thermal air-conditioning systems are considered to be the most efficient air-conditioning systems available till date on this planet. This works on the basic principle that the temperature remains constant below earth throughout the year, irrespective of the temperature above ground. The temperature below earth is generally constant at around 20C to 27C at a depth of 5 to 20 feet below ground level, depending upon the geographical location of the place and its soil condition. Geothermal systems remove the requirement and dependence on mechanical systems such as cooling towers, heating systems, furnaces and boilers etc. This reduces long term maintenance costs. Since all other cooling systems depend on the temperature of ambient air, whose summer temperature can vary from 27C to 50C in tropical climates, the efficiencies of cooling towers and other heat removal systems are grossly affected due to the wide temperature fluctuations. This also increases the requirement of power systems and energy consumption in buildings. Geothermal systems instead, use water or refrigerant which is naturally cooled or heated by the earth, to remove heat from the heat exchangers. Geothermal air conditioning system gives very high



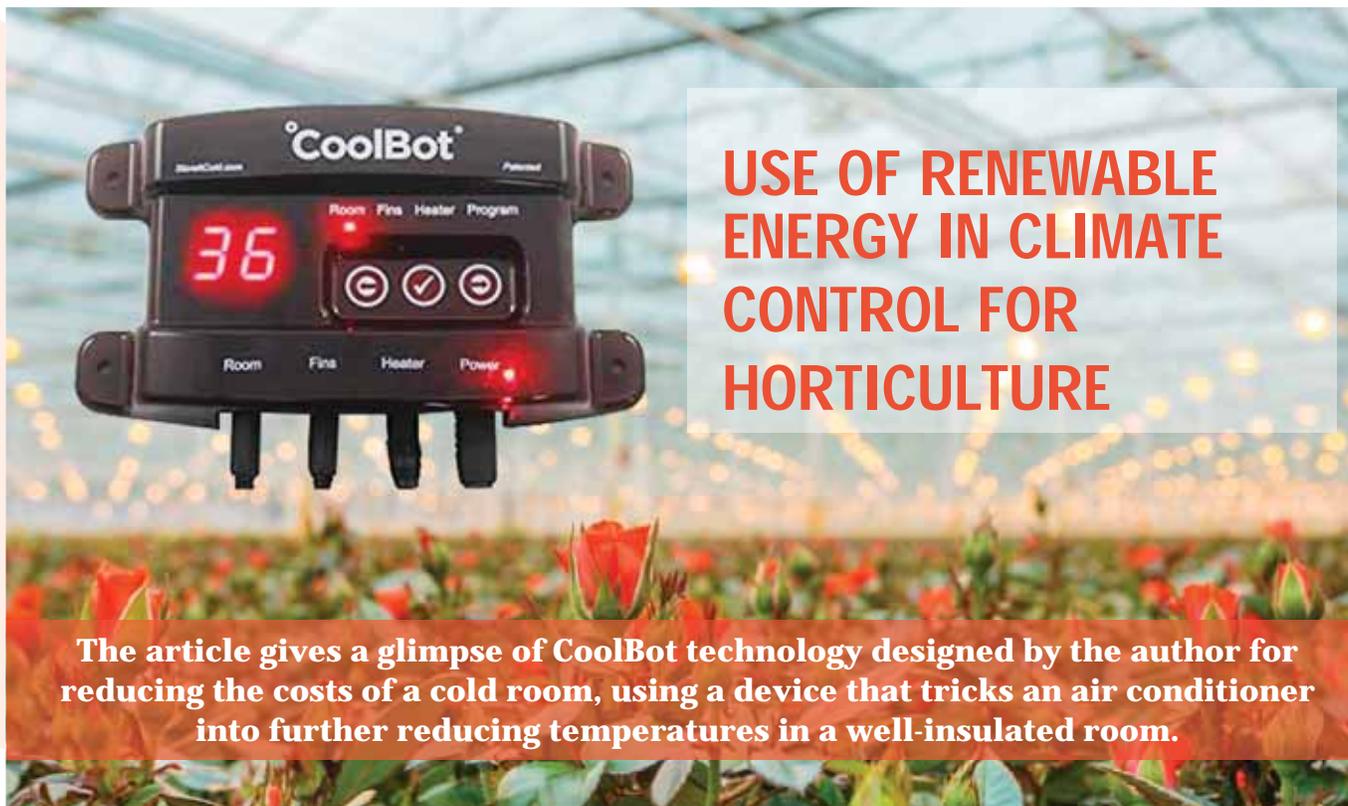
thermal efficiency as compared to conventional systems; thus, reducing operating energy costs as well as maintenance costs. These cost reductions have been found to bring about 30 per cent to a phenomenal 60 per cent savings in running costs. Apart from this, this system also provides hot water for all requirements in the building at a negligible extra running cost, removing the need for boilers or solar water heating systems.

Conclusion

The technological advancement in today's scenario is taking place by keeping in mind hazardous effect on the earth. R&D at Voltas is developing eco-friendly, energy efficient and cost-effective technologies the described in this article for domestic and export market. There is also an increased focus on using waste thermal energy to produce cooling. ■



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USE OF RENEWABLE ENERGY IN CLIMATE CONTROL FOR HORTICULTURE

The article gives a glimpse of CoolBot technology designed by the author for reducing the costs of a cold room, using a device that tricks an air conditioner into further reducing temperatures in a well-insulated room.

Scientists with the Horticulture Innovation Lab are testing and adapting a range of technologies aimed at significantly improving the profitability of fruit and vegetable production throughout the world. Given the complexity of horticulture, technologies such as these can reduce constraints that limit the ability of small holder farmers to achieve maximum profitability with high-value horticultural products. The goal is to develop and test technologies that can overcome common limitations in land, labour, capital and infrastructure.

Problem: Post-harvest losses

In much of the developing world, rates of post-harvest loss exceed 50 per cent, and cold storage is virtually non-existent due to the high cost of equipment and limited electricity. Quickly cooling produce after harvest extends shelf life by reducing metabolic activity, water loss and microbial growth. Farmers who can store their produce longer can access better prices, as market prices fluctuate.

Problem: Poor seed quality

In tropical climates, high humidity causes rapid seed deterioration that results in poor

stand establishment, lower productivity, reduced market value and a disincentive to invest in improved seeds.

Drying beads:

- Provide a widely adaptable method for drying seeds and are reusable.
- Maintain high seed quality during storage.
- Lead to higher germination rates and increased yield capacity.
- Increase farmer incentive to invest in improved cultivars.
- Can be integrated with local seed systems to increase market for local and improved cultivars.
- In many developing countries, the rate of post-harvest loss for fruits and vegetables exceeds 50 percent. Cool storage can greatly reduce these losses, but is virtually non-existent in many places due to the high cost of equipment. The CoolBot is one option for reducing the costs of a cold room, using a device that tricks an air conditioner into further reducing temperatures in a well-insulated room.

The ideal solution would be to use solar drier for drying the seeds under controlled condition so that the germination

would be assured.

The next most important concern is about the post-harvest storage for long period or for short period till the producer gets proper value for his produce. Here the author has designed a very good technology.

The CoolBot

- ✓ Converts an insulated room and an inexpensive, readily available window air conditioner into a cool room.
- ✓ Substantially reduces the cost of cool storage for horticultural produce.
- ✓ Overrides the air conditioner's temperature gauge, maximising cooling power.
- ✓ Makes cold storage a viable option for developing-world farmers, cooperatives and market groups to increase their competitiveness.

What is the CoolBot?

The CoolBot was developed by Store It Cold as an affordable way for small-scale farmers to cool crops on their farms. This electronic device overrides an air conditioner's temperature gauge, tricking it into working harder while preventing components from freezing.



With an air conditioner and a CoolBot, an insulated room can be converted into a cool room to store fresh produce before sale, to maintain quality and extend shelf life.

Researchers with the Horticulture Innovation Lab have now tested cool rooms equipped with the CoolBot on three continents, using a variety of configurations related to insulation and power sources for the cool room. Helping farmers find ways to access cold storage to reduce post-harvest losses and maintain fresh produce quality (and thus value) is one important way that the Horticulture Innovation Lab helps fruit and vegetable farmers improve their practices and increase income.

How does a Coolbot work?

Most importantly, when the CoolBot begins to lose efficiency when accessing BTUs of cooling power (when the air conditioner is close to freezing), it is programmed to shut off the compressor on air conditioner unit, so one does not need to pay for electricity to make BTUs that can't be used.

What is the cooler temperature?

The ideal refrigerator temperature is 35F (1.6C). The user is not hugging the danger zone like he would be at 40F (4.4C), and the user is distancing himself sufficiently from 32F (0C) that he doesn't freeze half the stuff in the refrigerator.

Because it is not absorbing enough heat, the refrigerant running through a dirty evaporator coil doesn't warm up as much as it should. This very cold refrigerant causes water vapour in air to freeze rather than condense into a liquid. Eventually, the whole evaporator coil can frost over.

Commercial refrigeration systems are available in most parts of the world and are used for restaurants, stores and other small-scale cold room needs. The system consists of an air-cooled compressor or condenser unit installed outside and an evaporator unit (refrigeration coil) installed inside the cold room. A complete installation also requires electrical connections, a thermostat controller, refrigeration piping to connect the compressor or condenser with the evaporator, and a charge of refrigerant. A system installed in the United States costs about \$7000 for 3.5 kW (1 ton) of refrigeration capacity. A small-scale option is to use a modified room air conditioner, a method originally developed by Boyette and Rohrbach in 1993. The control system of the unit is modified to allow it to produce low air temperatures without building up ice on the evaporator coil. The ice restricts airflow and stops cooling. Recently, a company has developed an easily installed controller known as the CoolBot that prevents ice build-up, does not require modifying the control system of the air conditioner (Store It Cold, LLC), and works by overriding the air conditioner's temperature gauge, tricking it into working harder.

Design Options & Materials Needed

The better the insulation used to build a cold room, and the more air tight it is, the lower the operating costs will be for keeping the room cold. As a general rule, insulation with a minimum rating of R20 should be used in the walls, floor and ceiling. The floor can be covered with plywood or any sturdy surface covering that is easy to clean. Rigid polyurethane foam insulation (available in 4 x 8-foot sheets) or spray-on foam will provide excellent protection from outside heat if a thickness of 3 to 4 inches is used during

construction or for retrofitting of an existing cold room. Three inches is enough insulation if the user intends to operate the cold room at 5C (41F) or above. Reflective metal foil bubble insulation (available in rolls in 24" or 48" widths) is a bit more expensive, but provides approximately R30 in insulation rating when using only a single very thin layer. Caulking and weather stripping can help seal any gaps and cracks. Don't forget to insulate the door and check the door seals for air leaks.

Benefits

- ✓ Farmers can store produce to sell in the off-season when prices are higher.
- ✓ Improved cold storage possibilities will stabilise fruit and vegetable prices, giving consumers access to nutritious fresh produce all year.
- ✓ Farmers are better protected from erratic market prices.

Next step

The same above cooling system has been operated with solar PV power generation with LiFePO4 battery bank as energy storage devices. The author's special patented technology of cell balancing and intelligent charging system enhances the life of the battery to more than 10 years. Thus, the total system can be 100 per cent grid autonomous. According to the vision of Dr A P J Abdul Kalam, grid autonomy is the most essential to make the farmer proper in his agriculture or horticulture. The energy for irrigation or climate control for extended storage life or post-harvest value addition of produce must be totally based on renewable energy sources. Grid dependency has made their life miserable. Kalam also has said that, the experts and technologists must take latest innovative and cost-effective technologies to the doorstep of farmers adding to this his strong belief was "if farmer's economy improves then and then only the nation's economy will improve." ■

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An Advanced Approach to Air Purification



The article discusses on IAQ improving advanced process by which volatile organic compounds (VOCs), bacteria, mold and fungus is destroyed by incorporating photon and ultraviolet (UV) energy activating a catalyst.

Indoor air quality (IAQ) is one of many factors that determine building functionality and economics. A building with good IAQ is more desirable place to work, learn and conduct business, as it affects building occupants and their ability to conduct their activities and creates positive or negative impressions on them. IAQ directly affects occupant health, comfort and productivity. Serious health impacts resulting from poor IAQ include - Legionnaires' disease, lung cancer from radon exposure, and carbon monoxide (CO) poisoning.

More widespread health impacts include increased allergy and asthma from exposure to indoor pollutants, molds and other infectious diseases that are

transmitted through the air, and sick building syndrome symptoms due to elevated indoor pollutant levels as well as other indoor environmental conditions. These more widespread impacts have the potential to affect large number of building occupants and are associated with significant costs due to healthcare expenses, sick leave, and lost productivity.

Photo Catalytic Oxidation (PCO)

Photo Catalytic Oxidation (PCO) is an advanced process by which volatile organic compounds (VOCs), bacteria, mold and fungus is destroyed by incorporating photon and ultraviolet (UV) energy activating a catalyst thereby, creating photo catalytic oxidation (PCO).

What is UV

The electromagnetic spectrum

- **UV-A:** The most abundant in sunlight; responsible for skin tanning and wrinkles
- **UV-B:** Primarily responsible for skin reddening and skin cancer; also used for medical treatments
- **UV-C:** Naturally blocked by the earth's ozone layer and is the germicidal wavelength.

How Photo Catalytic Oxidation (PCO) works

PCO is achieved when you combine UV light rays with a TiO_2 coated filter or surface. TiO_2 refers to Titanium di-oxide.

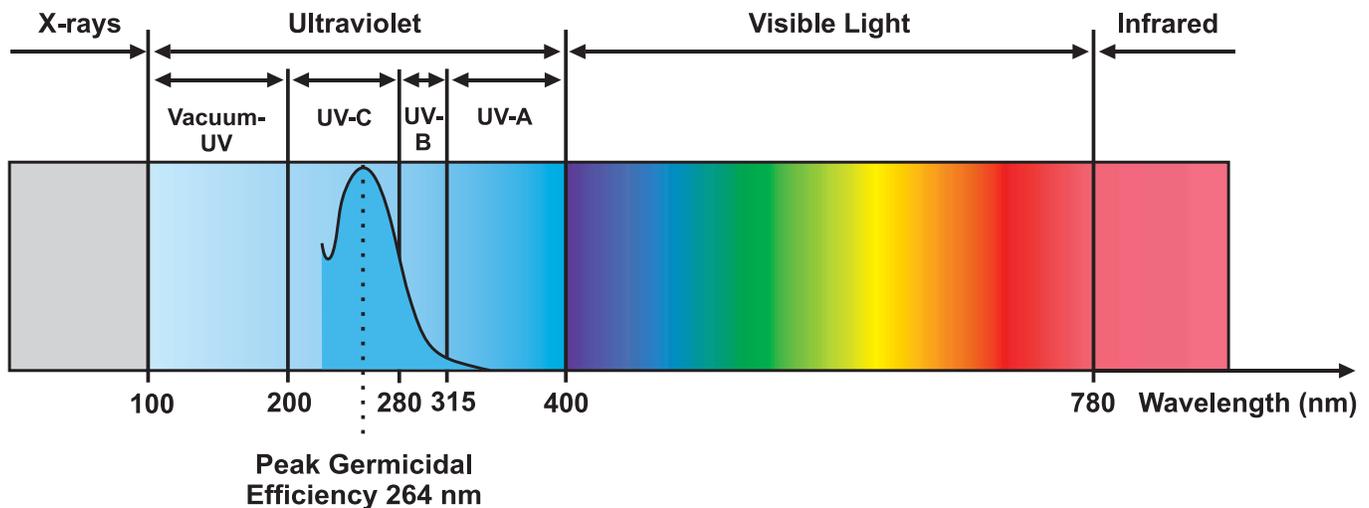


Figure 1: Ultraviolet Graph

This process creates hydroxyl radicals and super-oxide ions, which are highly reactive electrons.

These highly reactive electrons aggressively combine with other elements in the air, such as bacteria and Volatile Organic Compounds (VOCs). VOCs include harmful pollutants such as formaldehyde, ammonia and many other common contaminants released by building materials and household cleaners.

Once bound together, the chemical reaction takes place between the super-charged ion and the pollutant, effectively 'oxidising' (or burning) the pollutant. This breaks the pollutant down into harmless carbon dioxide and water molecules, making the air more purified.

Air Purification with PCO and Gas Phase Filtration

UVPCO often utilises a honeycomb configured, reactor coated with titanium dioxide (TiO₂ or titania) as the photo-oxidative catalyst. This design potentially can have high conversion rates with low pressure drop making it suitable for use in building HVAC systems.

The coated screen is irradiated with UV light near 254 nm UVC. Air containing organic pollutants flows through the screen where the VOCs adsorb on the catalyst. The UV light interacting with the catalyst in the presence of oxygen and

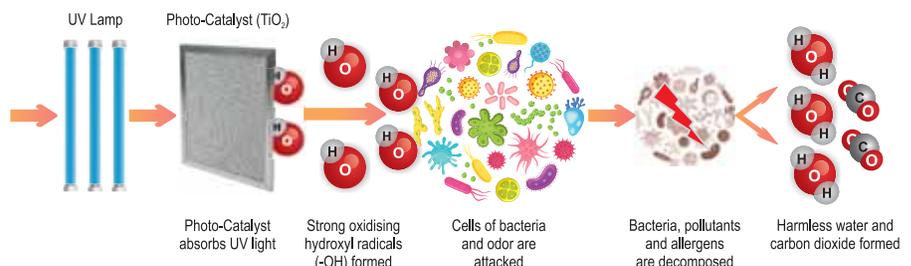


Figure 2: Principle of photo-catalytic oxidation

water vapour, produces hydroxyl radicals. Hydroxyl radicals are highly chemically reactive and, in-turn, breakdown the adsorbed VOCs, ideally producing only carbon dioxide and water as by products.

Gas Phase Filtration with photo catalyst oxidation systems are tailored precisely to project needs and operate with the highest efficiency. The multi-stage design allows for selection of the required filters in a specific sequence to meet the requirements of each application as described in following sequence:

Stage 1: Pre-filtration

Air entering the system passes first through particulate filter which captures many of the larger biological contaminants and small airborne particle. This also protects the UVPCO stage.

Stage 2: Photocatalytic Oxidation (PCO)

Combining UV light rays with a Titanium di-oxide coated filter or surface creates photocatalytic oxidation. This process creates hydroxyl radicals and super-oxide ions, which are highly reactive electrons.

This breaks the pollutant down into harmless carbon dioxide and water molecules, making the air more purified.

Stage 3: Gas Phase Filtration

The blend of carbon and KMnO₄ on alumina filled in media cassettes in right proportion removes the odours and VOCs. Any intermediate products of PCO section are captured by carbon and converted to CO₂ and water vapour. In this section, regeneration of activated carbon also takes place enhancing its active life as shown in figure 3.

Stage 4: Catalyst filter

This is an additional stage which safeguards against any media dust that may cross the previous stages.

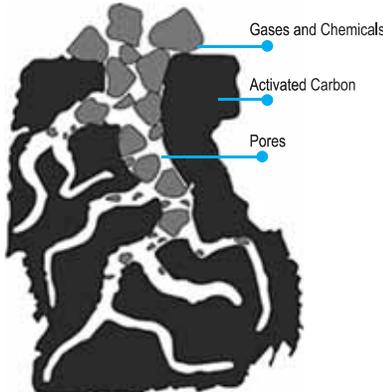
Stage 5: Automation

This stage provides necessary power to PCO section and switch off UV lamps when doors are open. Sensing, monitoring and BMS connectivity is also provided through this section.

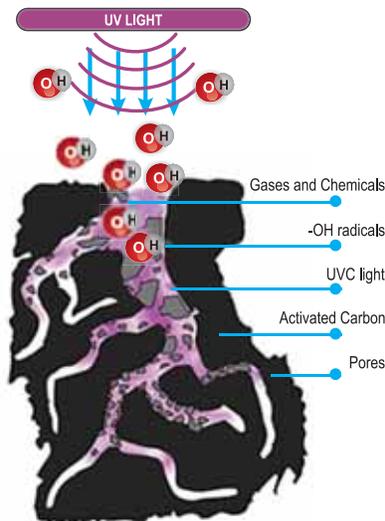
A rightly designed system with adequate controls and safety can provide following benefits:

- Elimination of molds, viruses, bacteria and allergens etc.
- Maintaining desired levels of particulate matter
- Efficient regeneration of media
- No harmful emissions
- Reduction of all odorous and hazardous air pollutants
- Very high single-pass efficiency of gas removal
- Prevention of corrosion or breakdown of electronic equipment.

General activated carbon gets blocked very quickly and loses its effectiveness



Activated carbon adsorbs gases and chemicals



Activated carbon adsorbs gases and chemicals much better with UVC light whilst -OH radicals neutralise them.



Dinesh Semwal
Managing Director,
Ensavior Technologies

Doors Make the Difference for Cold Storage



Advancements in freezer or cooler door technology and a recent study from the Door and Access System Manufacturer's Association (DASMA) now make it easier to choose which kind of door to use on a freezer or chilled room in a cold storage distribution center (DC).

Regardless of how official government policy is finally decided on the issue of climate change, the industry has realised that going green saves money and businesses have embraced sustainability to bolster the bottom line. There are major retailers that have encouraged their supply chain partners to come on board as well.

In most DCs, the building's interior consists of wide-open, unwallled spaces. In a cold storage DC, the freezer and chilled rooms have to be their own separate environments in order to maintain product quality and prevent food spoilage. Being a low-margin business and any waste of course comes out of profits.

Nowhere is the cost of energy more keenly felt than in cold storage. Plant management at these facilities focuses on making cold air systems work as little as possible to optimise energy usage.

The Envelope

When it comes to saving energy, management talks about the 'building envelope' and that term isn't limited to merely the exterior. Facility managers work diligently to make sure every crack and gap in the walls of cold storage rooms are sealed to prevent the escape of precious

cold air. Of course, these rooms have doorways and energy loss through them is a major issue.

Temperature differentials between the shipping or receiving docks and the cold storage rooms can be considerable—as much as minus 35C and more. This difference is comparable to that between a standard building interior warmed to plus 5C and the below-freezing weather outside.

Confining Cold Air or Letting in Traffic

Cold storage plant managers have been wrestling with the question of what kind of door works best for a cold storage room. After all, doors have two uses on this or any kind of facility – to allow access and to protect the activities taking place in the room in order to protect product quality. The two are seemingly in conflict.

When it comes to specifying cold storage doors, the plant manager faces two questions. Do I cover the opening with a door that is as thick as the wall itself to prevent heat transfer? On the other hand, do I use high-speed doors to prevent traffic back up into and out of cold storage?

In a growing number of facilities, the

roof is being raised to 40 feet off the floor in order to reduce the roof area for minimising energy loss. Down at the floor level, there is a minimal wall perimeter, leading to less area for doorways, hence, fewer doorways. Fewer doors can bring on traffic during busy periods, which for most 24/7 facilities means possible traffic jams – 24/7.

Some facilities seek out the fastest sliding-panel door they can get, but this style can attain speeds only half as fast as a true high-speed door, which can operate at nearly 125 inches per second. If the doorway is frequently accessed, these added seconds can accumulate to the equivalent of two days or more over the course of a year spent waiting for the door to open. Not a time good investment for forklifts or their drivers.

Research

So, how should the management in a cold storage facility decide when it comes to door selection? After a two-year project featuring third-party lab testing, DASMA developed a method to demonstrate the efficiency of high-speed doors in building envelope energy calculations. The model for performance testing and evaluation was a prototypical, high-speed fabric door.

These findings follow research from 2012 on the relationship of high-speed doors to the provisions of American Society of Heating, Refrigerating, and Air-conditioning Engineers (ASHRAE) 90.1, Energy Standard for Buildings except Low-rise Residential Buildings, for non-residential buildings. Overall, DASMA noted that high-speed doors are the type of product that can significantly help achieve energy-saving goals.

The DASMA research revealed a new perspective in evaluating door energy efficiency and took into consideration common U-factor, air leakage, and motor horsepower values in a comparison of high-speed doors to conventionally operating insulated doors. The study showed that high-speed doors become more efficient when cycled 55 or more times per day, with that crossover point illustrated below.

Here's how the study makes sense. The protection thicker doors provide against heat transfer is eventually negated if the doors are rarely closed. At that point, minimising air infiltration becomes more of a factor for that doorway.

The kinds of high-speed doors the study had in mind have a roll-up design with a heavy-duty plastic fabric panel. For some measure of heat transfer resistance, there are models with double panels enclosing a layer of insulating foam.

Cold Air Stops at the Seal

Along with reducing air infiltration, high-speed roll-up doors offer a superior seal around the full door perimeter with side guides covering the vertical panel edges, a floor-hugging seal, and a brush seal along the top. Roll-up doors are better designed than solid-panel doors at sealing the door when closed.

The door's operating life in an industrial or commercial setting pretty much involves getting out of the way of traffic that passes through the opening. Solid panel doors, being slower, are more likely to be hit by forklifts and other material handling vehicles. The damage that results can vary. Panels can be knocked out of alignment, forming gaps in the seal, have holes punched in them, or be totally



knocked off the wall.

When that collision happens, the result is massive air infiltration and energy loss. If the door is totally disabled, the loss of one doorway in a busy cold storage facility can considerably cripple delivery schedules and wreak havoc with productivity.

If a high-speed roll-up door is hit and the panel knocked out of its guides, results are less severe. Most models have a self-repairing feature; the door is activated to roll up and then the panel rolls back into its guides. This design protects both the doorway and the facility's ability to meet customer demands.

Sliding Doors Speeded Up

As to the speed problem with solid panel doors: Over the last few years a new sliding door design has come to market with a juiced-up performance of 2.5 metre per second — twice the speed of a standard sliding door — to handle traffic in busy DCs. The panels on these are used in minimising both heat-transfer and infiltration. In addition, these doors can withstand accidental collisions from material handling vehicles, ensuring that the doorway is always available.

The question becomes, where would using a high-speed solid-panel door make sense versus a roll-up model?

Is the facility idle one shifts a day or one day a week?

During those periods, a solid-panel door would prevent significant heat transfer. If the operation is essentially 24/7, the door

is rarely closed and the ultra-high-speed roll-up doors keep traffic moving and heat transfer is less of a factor.

How much wall area is available?

To facilitate sliding door operation, the wall area where sliding panels travel must be kept clear of racking and obstructions. For those facilities where management wants to use every inch of wall space, the roll-up style door, which is totally confined within the area of the doorway, will be the choice.

Does the facility have high ceilings?

To accommodate high-mast forklifts that reach product stored on racking up to 40-foot above the floor typically requires 16-foot doorways, making these openings more suitable for the lighter-weight roll-up door panels. Bear in mind that with the high ceiling scenario, the sliding door would be ruled out because wall space would likely be used for racking.

Choice

The introduction of quick-operating sliding doors combined with DASMA research on suitability of high-speed doors means that doors can be specified according to the operation. Now management can make a door selection and be comfortable with it based on the needs of the operation. Whatever the requirements of the facility, industrial door expert Gandhi Automations Pvt Ltd can provide advice and insight to tailor a door that delivers the performance and protection every doorway need. ■

TIPS TO REDUCE YOUR AC BILL



INSULATION

Use these tips and pay less to cool your house and keep a comfortable indoor environment.

In summers, people don't only sweat due to scorching heat but also due to rising electricity consumption caused by air conditioners. The developmental activities cannot be put on the reverse track, and rapid urbanization is rather a need than the compulsion to accommodate more than six billion people. These structural changes in human habitation have also brought drastic changes in societies and the lifestyle of the people. Now, even in rural areas of the country, many households are switching from air coolers to air conditioners, and in cities, ACs are no more a luxury, but a genuine need. Of course, some costs are always associated with comfort and ACs are no exception.

Advanced means Effective

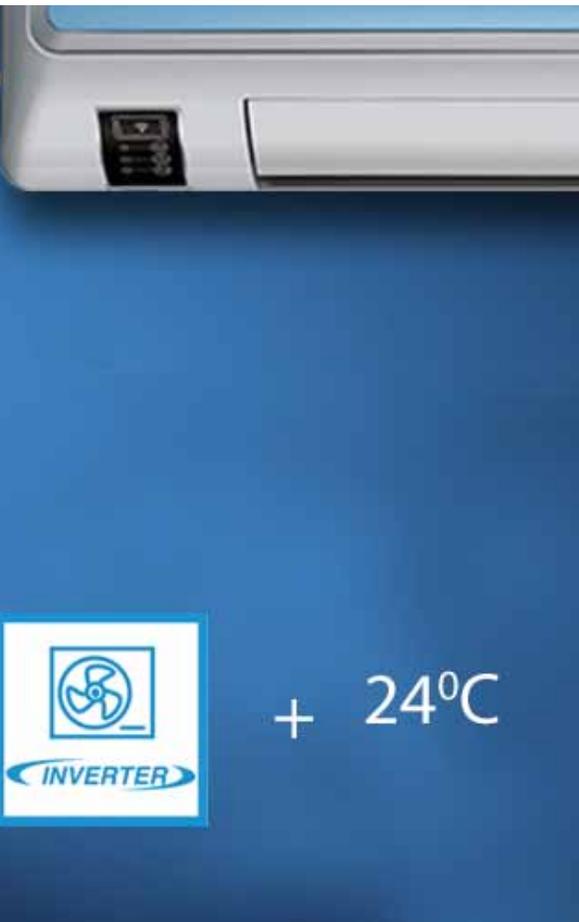
A household cannot control the

energy pricing, but a household can make smart initiatives to control the monthly electricity bill, especially in the summer season. The power consumption of today's air conditioners is around 30-40 per cent of total consumption of electricity. Besides, any reduction in the amount of energy consumed in smaller units can eventually add up and produce visible changes in the environment. Using air conditioners that consume less electricity are one such step towards a greener future.

Today's ACs are friendly to the environment as well as people's pockets and the right decision in choosing the right AC can keep the customer happy years after years. Below are the few easy tips that will help you stay cool and calm throughout the summer.

Tonnage and star rating

First of all, the selection of the AC



should be based on room capacity. One-tonne AC is sufficient for 100 square feet, and 1.5-tonne for 150 sq ft area (under test conditions) Hence, the tonnage should be in accordance with the capacity of a room. Mitsubishi Electric room air conditioners products have good capacity range from 0.8 tonne to 2.2 tonne for providing best suitable capacity to different room size. The next important thing to consider is the rating of an AC. These days, our markets have seen a surge in products that are labelled with “Energy Star” rating systems. The better the rating, the more energy efficient will be the AC. Buying AC and other home appliances with the highest star rating is in the best interest of the consumer and the environment. Not only they consume less electricity, but higher energy efficiency means – a step towards a greener tomorrow. So, instead of using a 3-Star labelled AC, go for the 5 Star-rated machine and curtail your monthly electricity bill.

Proper insulation of the room

Apart from room capacity, ambient temperature and length of the pipe installed are also the detrimental factors in the consumption of energy. Both ambient temperature and piping length are inversely proportional to power consumption. That’s why the insulation of the building is the best remedy to deal with high ambient temperature. Not only is a well-insulated building more comfortable and cost-efficient to maintain, but it is much quieter too. Common beliefs about insulations say that they make your house comfortable in all seasons and reduce your energy bills. While all this is true, but the aspect where insulation control outside noise and help you in creating a peaceful environment is often overlooked. So, insulation is beneficial in multiple ways. You must ensure that all your doors and windows have special attachments that prevent any air leakages. As a lot of energy losses around ducts, so be quick to have them fitted well.

Embrace Inverter technology

As there is not any gross price difference between non-inverter ACs and inverter ACs the shift in consumer preference is quite obvious. Apart from power saving, the other distinguishing feature of inverter ACs is their better performance for comfort cooling, hence, they perform more efficiently in the Indian subcontinent. Inverter air conditioners have variable-speed drive fans that synchronize perfectly with compressor’s speed. So, after reaching set temperature they slow down automatically with maintaining set temperature and help to save the electricity bill.

Keep your AC at 24C

Setting the AC temperature at 24-25-degree C as against the

conventional 20-21-degree C results in around 25 per cent of average energy saving. In guidelines, issued by Bureau of Energy Efficiency (BEE), Ministry of Power, Government of India, the bureau advises commercial and public buildings to optimize temperature setting at 24-25-degree C. As per BEE estimate, India can save about 23 billion units of electricity only by simple measure of temperature setting to 24-degree C. In contrast, if the temperature is set to a lower level, the workload for the compressor will increase, and it will have to run for a longer duration. Basically, more electricity will be required to maintain the desired temperature.

Basically, there are four major factors -- room temperature, outdoor temperature, desired temperature from the AC, and thermal insulation of the particular room -- that determine the electricity load in ACs. Hence, if there is a big difference between the desired temperature and the outdoor temperature, then the compressor will work for a longer duration, i.e., electricity consumption will also be more.

Preventive Maintenance

Last, but not the least, preventive maintenance is a trustworthy remedy to ensure smooth functioning of the machine. For the existing installed equipment, timely preventive maintenance by an experienced professional is a highly recommended exercise that a household should follow at least twice a year. Besides, cleaning of the filter, which doesn’t require the need of an engineer should be done regularly at an interval of 7 to 15 days. Without doing preventive maintenance for more than six months leads to an increase in the electricity bill by 25 per cent. ■

Yozo Ito,
Director and Business Unit Head –
Living Environment,
Mitsubishi Electric India (MEI)





Mist Creation as Precise as Nature

The article talks about on innovative mist and cool system for comfort cooling, humidification and dust suppression applications.

Mist Resonance Engineering Pvt Ltd (MREPL) is recognised as pioneer of revolutionary Mist Cooling System having more than 25 years' experience and over 350 installations in various industries. Now, MREPL offers an innovative mist and cool system for comfort cooling, humidification and dust suppression applications.

Our specially designed misting nozzles create ultrafine mist which immediately evaporates as it comes in contact with the air, cooling it to the required level of comfort. Also, for humidification requirement, M&CS is the best suited system due to its high efficiency and trouble-free performance. The desired level can be quickly achieved without dripping irrespective of operating at very high pressure of 70 bar.

The specially designed nozzles produce water particle around 5 Micron, which cover the designed distance so that uniform level of Rh is maintained. Number of nozzles and pipe routing is designed as per requirement and complete automated system can be supplied.

MREPL has various various applications as below:

Humidification and Cooling in Green or Poly House

Mist and cool system installed in green or

poly house shall maintain desired Rh and drops ambient temperature by 4 to 6C which helps to avoid the excess evaporation of the water from the plants due to dry weather conditions. Also, it helps to boost the growth of plants and size of flowers.



It is possible to spray insecticides like chlorine through mist and cool system that kills all germs in atmosphere and hence, plants are well protected against diseases like botrytis etc.

Uniform misting can be done by saving around 10 per cent on consumption of chemicals and fertilisers and sprayed chemicals shall reach to every leaf of the plant. Since the chemical can be sprayed in few minutes time, it saves both power and time. All above benefits ensures the higher yield and with improved quality of plants and flowers, thus ensuring ROI in less than a year.

Humidification and Cooling in Textile Industries

Humidity plays crucial role in textile

industries. As ultrafine mist is produced by the system without using any compressed air having droplet size of 2 to 10 microns evaporates easily to achieve desired Rh and helps to improve the properties of the textiles such as elasticity, rigidity, tensile strength and thickness of the fibre or yarn also helps to gain the weight of the textiles or jute to get best price in the market.



Simultaneously achieving the desired Rh level, mist and cool system also drops ambient temperature by 4 to 6C and suppress dust which helps to maintain the good working environment for the employees.

Ambient Cooling



Mist and cool system drops ambient temperature up to 8C with proper

ventilation suitable for the indoor or outdoor cooling. So, the mist and cool system can be used for ambient cooling in:

- Marriage halls, lawns, restaurants, pubs, party halls,
- Industrial factories
- Sports fields
- Private residence, guest houses.

Dust Suppression



Dusty working area becomes hazardous and impacts directly on the health of the employees. The mist and cool system creates a high concentration of ultra-fine water mist of 2 to 10 microns. Due to this, dust particles get mixed with water particles, become heavier and settle down to the ground, hence scattering of dust in the atmosphere shall be much limited. At the same time, this water mist shall help simultaneously to reduce the nearby ambient temperature.

Applications: foundries, steel industries, power plants, cement industries, tobacco industries, etc.

Mist Spray Support System for Air Cooled Condensers

Now application is extended for Mist Spray Support System to ACC units in power plants. While ambient temperature crosses >38 to 40°C , steam does not condense fully and hence, it leads to a drop in vacuum, giving a loss of power generated. MREPL can install misting nozzles below each fan of ACC. While ambient temperature crosses >38 to 40°C , the misting system will start and cool down the inlet air temperature by 4 to 6°C . This helps to improve ACC performance and desired vacuum levels are promptly maintained. It gives immense steam saving, making investment payback in less than one year.



Specialty of Mist & Cool System

MREPL offers complete system in SS 304

pipework and high-pressure fittings. The special mist creator nozzles are non-clog type with anti-drip mechanism. They have an inbuilt cleanable filter ensuring a longer life of system.

European make high efficiency pump-set.

Salient Features of Mist & Cool System

- Guaranteed cooling of ambient temperature up to 8°C
- Maintains required Rh with very low consumption of water.
- Increase in quality and productivity when installed at green house, poultry sheds, animal farms etc.
- Lowest consumption of electricity.
- Totally maintenance free operation due to use of high-quality stainless-steel material of construction.
- No wetting of surface due to Ultra Fine Mist formation. ■

Makarand Chitale
Director (Technical)

Mist Resonance Engineering
Pvt Ltd, Pune



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Belimo Energy Valve Transparent energy monitoring with the Belimo Cloud

The Belimo Energy Valve is an Internet of Things (IoT) device – a smart connected pressure-independent valve that measures and manages coil energy consumption by utilising an embedded flow meter along with supply and return water temperature sensors. The Belimo Energy Valve also has power control and Delta T Manager logics built-in that monitor coil performance and optimise the heat transfer of the coil by maintaining the Delta T.

Transparent: Integrated logic and sensors provide accurate coil performance data. Energy monitoring data is used to verify system performance during commissioning and acts as a baseline



standard for system performance over time. Transparency with respect to energy consumption for heating and cooling is achieved.

Connected: Cloud connection to control, optimise, monitor energy usage and provide advanced system data reporting driving product and system functionality delivering optimal

performance. Enhanced communication allows for expanded system integration and BMS control with the addition of Modbus RTU and TCP/IP. Other integration possibilities include BACnet MS/TP and BACnet IP, Belimo MP-Bus, and one analogue connection.

Efficient: Belimo Delta T Manager algorithm reduces pumping and chiller or boiler operating costs by increasing plant efficiency and mitigating low Delta T syndrome. Power control allows the user to set the power output to a specific value in a linear response. Coil and valve characteristics become irrelevant. Coil control is now both pressure- and temperature-independent. ■

For more information: www.belimo.com

Extech 407119: Heavy Duty CFM Hot Wire Thermo-Anemometer

The 407119 Heavy Duty CFM Hot Wire Thermo-Anemometer uses a telescoping probe (extends up to 3 ft) which is ideal for use in ducts and ventilating systems. It can accurately measure air flow (CFM/CMM), air velocity and temperature. Air Flow can be displayed as an instantaneous value or up to a 20-point average.

- Air velocity measurements as low as 40 ft/min
- Telescoping probe is ideal for use in ducts and ventilating systems; extends up to 3ft (940mm) long
- Measures air volume in CFM (ft³/min) and CMM (m³/min) plus temperature simultaneously
- Air Flow displayed in 2 modes: Instantaneous value or up to 20-point average
- Record or recall MIN and MAX readings
- Large 1.4" (99,999 count) LCD display
- Data hold plus auto power off
- Comes complete with telescoping probe with 5.5ft cable, and 4 x AA batteries. ■



For more information: flirindia@flir.com.hk

C6015 Ultra-compact Industrial PC for IoT

Advanced Industrie 4.0 concepts additionally demand space-saving Industrial PC solutions, which are extremely flexible to install.

The ultra-compact C6015 IPC, Beckhoff is currently most compact Industrial PC. The IPC offers all common industry standard features such as a high temperature range, EtherCAT compatibility and high resistance to vibration and shocks.



The multi-core IPC, measures only 132 x 132 x 67 mm and integrates Intel Core i processors of the 6th and 7th Generation with up to four cores and 3.6 GHz per core, and provides a new level of computing power to suit even the most demanding requirements. With 30 GB 3D MLC M.2 SSD storage and Windows Embedded Compact 7 operating system, it is fully operational in the basic configuration. Windows 7 or Windows 10 operating systems are optionally available.

TwinCAT 3, the latest version of the Beckhoff automation software that was specially developed for support of multi-core processors, can fully utilise the two-core and four-core processors of the new PC generation. ■

For more information: www.beckhoff.com

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Forthcoming Events At A Glance

Foodpro 2019

Venue: Chennai Trade Centre, Chennai

Date: 23rd to 25th August 2019

Website: www.ciifoodpro.in

Dairy Tech India 2019

Venue: Bangalore International Exhibition Centre, Bangalore

Date: 30th August to 1st September 2019

Website: www.dairytech.in

ISK-SODEX Istanbul

Venue: TÜYAP Fair Convention and Congress Centre

Date: 2nd to 5th October 2019

Website: www.sodex.com.tr/en

Refcold India

Venue: Hitex Exhibition Centre, Hyderabad, Telangana

Date: 21st to 23rd November 2019

Website: www.refcoldindia.com

India Cold Chain Show 2019

Venue: Bombay Exhibition Centre, Mumbai

Date: 4th to 6th December 2019

Website: www.indiacoldchainshow.com

Sustainable silk production in Milan

Ratti understands the importance of quality, respect for the environment, safety and social responsibility. In fact, it is actively pursuing path of sustainable development with a focus on environmental protection. In fact, thanks to self-produced energy through sustainable technologies such as the photovoltaic plant, in 2017 Ratti avoided the emission of 310 tons of CO₂ and 58.230 kWh of electricity was produced from renewable sources. Ratti's headquarters and Italian production facilities are located in Guanzate, near Como.

Ratti, founded in 1945, is one of the world's leading manufacturers of printed, plain, yarn-dyed and jacquard fabrics



for international luxury and pret-à-porter brands. Its yearly production exceeds four million metres of fabric. Exports account for approximately 70 per cent of total sales. Ratti has been listed on the Milan Stock Exchange since 1989 and has been part of the Marzotto Group since 2010.

With these successful sustainable actions in mind, when it came time to update the HVAC system of their offices, Ratti chose Climaveneta brand air-cooled chillers with 4th generation HFO eco-friendly refrigerants, specifically, 2 FX HFO/SL-A/S 2722 chillers. The refrigerant HFO 1234ze selected ensures GWP levels near zero (compared to GWP values of 1430 for R134a gas) and no toxicity, while continuing to guarantee high energy performance levels. ■

Facebook's Data Center becomes energy efficient

Facebook announced that the Clonee Data Center will continue to be one of the most advanced, energy efficient data centers in the world and will be supported by 100 per cent renewable energy.

Nortek Air Solutions, a manufacturer of custom air handlers, is pleased to announce the use of its patented StatePoint Technology in two buildings at the Facebook data center in Clonee, Ireland. The StatePoint system uses a liquid-to-air membrane exchanger in which water evaporates through a membrane separation layer to cool the data center. "This new exchanger technology addresses some of the fundamental



disadvantages of open spray and wetted media evaporative cooling systems and opens up new possibilities for high performance liquid cooling in data centers and other applications," explains Philip LePoudre, Fellow Engineer of Nortek. The liquid-to-air membrane exchanger prevents cross contamination between the water and

air streams, greatly reducing the risk of water side fouling and aerosol carryover in the exhaust air stream. In addition, the StatePoint Liquid Cooling system achieves exceptional levels of water usage efficiency while maintaining industry leading energy efficiency. ■

First Smart Factory in Mexico

Schneider Electric opened its first smart factory in Mexico, a showcase for customers and partners to witness how digital transformation can help them make informed, data-driven decisions that bring about improved profitability, asset management performance, operational efficiency and a smarter productive workforce while keeping the operations secure, agile and environmentally sustainable.

Schneider Electric integrates its EcoStruxure solutions spanning connected products into its manufacturing operations to show the value of transitioning to a smart factory and how easy it is to start its digitisation journey. Smart Factories form a core



component in its own Tailored Sustainable Connected 4.0 supply chain digital transformation within its global supply chain organisation, where it leverages digitisation to deliver end-to-end integration and visibility across its supply chain operations to enhance overall performance.

Enrique Gonzalez Haas, Country President Schneider Electric Mexico and Central America, said, "At Schneider Electric, we continue to bring the digital transformation to the Mexican economy, so the new smart factory in Monterrey, as an innovation showcase, is an example of how manufacturing facilities can be more efficient, profitable and sustainable with the use of technology, and a look at the new era of Industry 4.0." ■

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- Extremely easy operation
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installations

Typical case study data of a 1200 TR Chiller

Sr. No.	Parameter	Cooling Tower (Induced Draft)	LTMCS
1	Wet Bulb Temperature	29°C	29°C
2	Chilled Water Temp in °C (Assumed)	5°C	5°C
3	Supply Temp. from CT / LTMCS	33°C	30°C
4	Approach to WBT	4°C	1°C
5	ΔT for Chiller	28°C	25°C
6	Chilled Water Compressor Motor Kw for 1200 TR	720	643
7	Energy Saved in %	-	10.7%
8	Energy Saved in Kw	-	77 Kw/Hr
9	Total Running Hours per Annum	8640	8640
10	TOTAL POWER SAVED PER ANNUM	-	6,65,280 Kw



Mist Resonance Engineering Pvt. Ltd.

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