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February 2018

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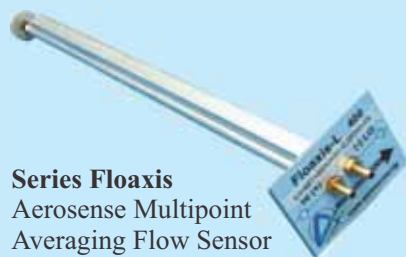
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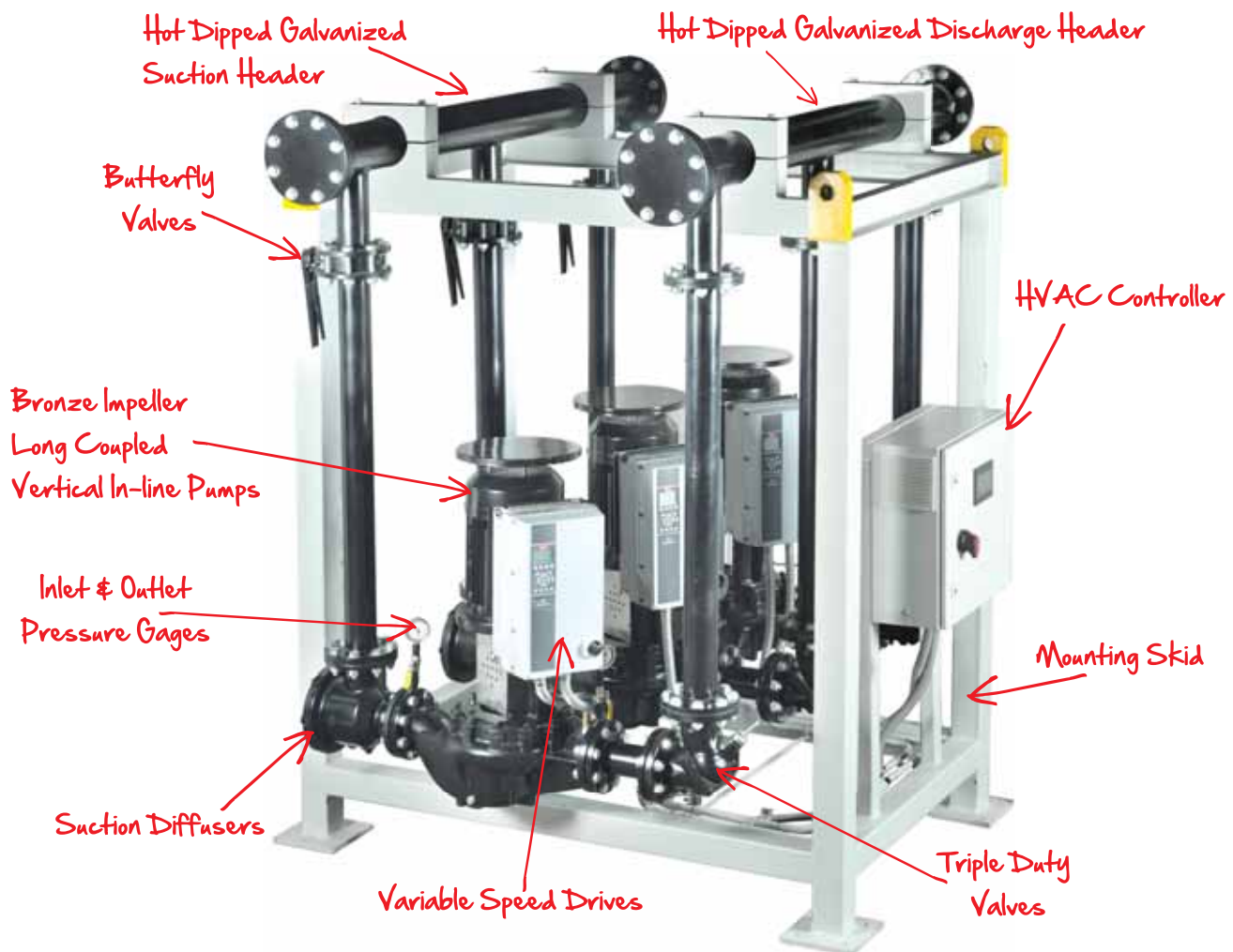
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# Publisher's Letter

Hello and welcome once again to *Cooling India*, the leading publication on the HVACR industry in India. ACREX India 2018 is round the corner and *Cooling India* will be there at the exhibition in Bangalore. India is a huge country on the move, her economy is one of the fastest growing in the world and the consumer market in our country is in the upswing. The Modi-led government in the Center, which is in its last year of its current term, is investing heavily in infrastructure. This will certainly bring in a lot of foreign investors and companies to invest in the country to tap the large middle class population. After all, India is still a huge untapped market. With respect to the HVACR industry, being a sub-tropical country, with scorching heat in summers, the penetration of ACs is still very low.

As I have mentioned many times in the past, despite being the world's leading milk producer and second largest fruits and vegetables producer, the vast population in our country is not benefitting from its produce as a fifth of that go to waste due to lack of proper cold chain. This is in spite of having the biggest cold storage facility in the world. Another aspect is the penetration of refrigeration in the Indian household. The 2016 ICE 360° survey showed that only about 30% of Indian families have a refrigerator. But the reality is that more Indian families have two wheelers in their house than a fridge and the cost of former is many times more than the latter, which clearly shows that refrigeration is not given proper preference.

Economically speaking too, the importance of refrigeration is paramount. Today, refrigeration-related jobs are growing in both developed and developing countries, be it in food, healthcare, energy-related industry or environment. This must be taken into account while formulating policies by the government.

I hope you enjoy going through this issue as much as we have in bringing this to you. *Cooling India* will be there at Acrex 2018. Our booth number is **R-2 in Hall 3-A**. Do drop in at our booth. Our team will be there to assist you with any media-related issues ranging from contributing an article for the magazine or placing your company's advert. Or just to say a Hello! You are most welcome. Do drop an email to me at [pravita@charypublications.in](mailto:pravita@charypublications.in) for any queries or suggestions. Till then, bye and have a wonderful month ahead.

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



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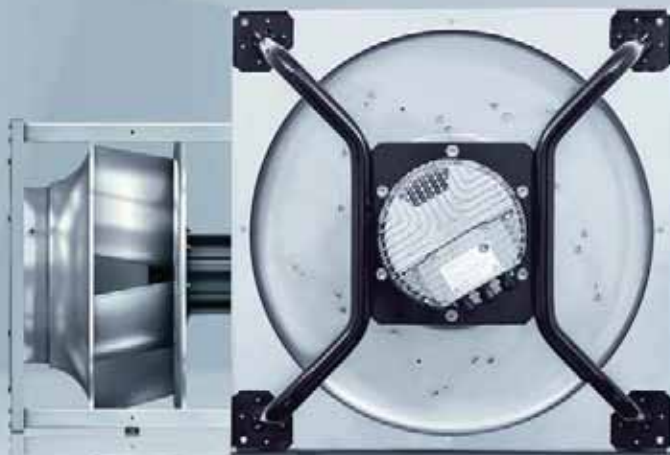
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## Ingersoll Rand & Mitsubishi Electric to Establish JV



**I**ngersoll-Rand, a world leader in creating comfortable, sustainable and efficient environments, and Mitsubishi Electric Corporation, a leading manufacturer of technologically advanced ductless and variable refrigerant flow (VRF) heating and air conditioning systems, are pleased to announce they have entered into an agreement to establish a 50 percent-50 percent joint venture (JV) pending global antitrust review.

The new joint venture will include marketing, sales and distribution of ductless and VRF heating and air conditioning systems through Ingersoll Rand's Trane and American Standard commercial and residential channels, and existing Mitsubishi Electric distributors and representatives in the United States and select countries in Latin America.

The systems sold by the joint venture will be highly efficient, variable-speed mini-split, multi-split, and VRF air conditioners and heat pumps for homes, light commercial and commercial applications. The joint venture will distribute Trane or American Standard branded products with the Mitsubishi Electric corporate logo to Ingersoll Rand channels. The joint venture also will continue to serve Mitsubishi Electric US distributors and representatives with Mitsubishi Electric branded product.

"We are pleased to enter into a new joint venture with Mitsubishi Electric US," said David Regnery, Executive Vice President of Ingersoll Rand. "Together, our robust offering and ability to serve customers in the multi-billion dollar and growing ductless segment will be superior." ■

## Building Energy Enters Latin America

**B**uilding Energy SpA, multi-national company operating as a global integrated IPP in the Renewable Energy Industry, announces the constitution of Building Energy Andes SpA, a joint venture with Scotta Group aimed to the development, construction and

operation of renewable energy assets in Chile. Scotta Group is an Italian specialized company involved in the design, fabrication and installation of hydroelectric power plants, as well as for industrial automation, with presence in Chile since 2006.

Through the incorporation of Building Energy Andes SpA, based in Santiago, the two companies will contribute to the continuously growing renewable market in Chile, strongly driven by the increase in electricity demand, abundance of natural resources and a supportive regulatory environment. The investment plan is mainly focused on solar photovoltaic and mini-hydro power plants, which benefit from a stabilized tariff dedicated to small-medium sized renewable projects. Building Energy Andes is currently working on a



pipeline of around 30 MW, which will be fully operational by the end of 2018 or beginning of 2019. The projects, which require a total investment of approximately USD 37 million, are located in the central regions of Chile, where the national demand of electricity is concentrated with

significantly higher electricity prices. The first project of the portfolio, for a total capacity of around 3 MW, is located near the town of Hualañé in the VII Region of Maule and is currently under construction. This investment represents the first milestone for Building Energy in Latin America, with the ambition to grow as a stable and solid player in the region. Daniele Moriconi, Building Energy Managing Director LATAM, said, "We are extremely pleased with the closing of this joint venture with Scotta Group, which has provided a strong foundation for us to work together in the Chilean renewable energy market. The alliance brings together two companies with significant experience and a strong commitment to Chile and South America as a whole." ■

## Rogers Place Achieves LEED Silver

**R**ogers Place, home of the Edmonton Oilers in the heart of downtown Edmonton's ICE District, has reached a new milestone: LEED Silver. It's the first NHL facility in Canada that is built to LEED Silver standards, and DIALOG is proud to have a role in making that happen.

As the lead sustainability consultants on the project, we led the client, construction, and design teams through the sustainability strategy. We held early stage workshops with visioning, provided direction throughout the project, and administered the LEED application.

As part of the LEED New Construction certification, a major consideration is the process and materials used for construction. PCL did an excellent job of managing sustainable efforts throughout the construction by committing to green building products and waste management, and



managing air quality throughout the build.

Rogers Place continues to reduce their environmental impact by committing to green operations including cleaning, education, and food waste handling. "Oilers Entertainment Group is a strong advocate for environmental design and operation. We also want to acknowledge the many committed staff at OEG who contributed to this milestone. We are all so very proud of the accomplishment," Susan Darrington, Executive Vice President, Roger. ■





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## ecobee donates over 700 thermostats to Toronto Community Housing

**T**oday, ecobee proudly announced that it has donated 776 ecobee 3 smart thermostats to the Toronto Community Housing Corporation (TCHC). The installation of ecobee smart thermostats will help improve the energy efficiency of TCHC buildings while also improving the comfort of residents and help to advance Toronto's climate change action plan, transform TO.

This partnership with The Atmospheric Fund (TAF) and TCHC is the latest initiative spearheaded by ecobee's A Better Tomorrow, a program that centers on the company's commitment to advancing sustainability and community through technology. Toronto Community Housing is North America's second largest public housing provider, providing homes for almost 110,000 people across 2,100 buildings. The ecobee3 units, installed at 7 and 11 Arleta Ave. and 710 and 720 Trethewey Dr., give residents the ability to adjust temperature based on their preference, helping them to live more comfortably, while using less energy.

This donation is part of a larger energy efficiency demonstration project by TAF called TowerWise. The buildings, which are home to a mix of tenants that includes seniors and families, were retrofitted to achieve energy, emission and cost reductions. Before the pilot project, the buildings were centrally heated, meaning the heat ran no matter how indoor temperatures varied through the winter. The newly installed ecobee3 units use sensors to make intelligent heating and cooling decisions to reduce energy waste and offer TAF and TCHC unique, real-time insights to identify other opportunities for future improvements. "Putting ecobee3 smart thermostats in these homes means we'll be improving comfort for residents in a way they can feel, saving money for public housing and improving energy efficiency," said Stuart Lombard, Founder and CEO of ecobee. ■

## Bitzer Indonesia Celebrates 20-Year Anniversary

**C**ompressor specialist BITZER has been operating in Indonesia for more than 50 years already. In 2017, it celebrated the 20th anniversary of its first site there, strengthening the island country as a BITZER location with production sites and offices. On 14 December 2017, PT. BITZER Compressors Indonesia celebrated with employees, long-standing customers and representatives of associated organisations its 20th anniversary. The BITZER Group's presence in Indonesia started with its compressors being brought onto local markets via agents and distributors. The first office was established in 1996 in the Indonesian capital of Jakarta, with opening festivities taking place in 1997.

Work started with just six employees distributing compressors and spare parts. In 2001, facilities were expanded for the first, but by no means last, time. As the only company to do so in Indonesia at that



point, BITZER started producing racks with screw compressors in 2005. A further pilot project established the first site of the company's service network Green Point in Asia. This made BITZER the first – and only – compressor manufacturer with its own compressor repair centre in Indonesia. In 2016, BITZER Indonesia opened another branch, located in the harbour city of Surabaya. Luca Bernini, Managing Director Sales and Marketing South East Asia at BITZER, states: 'We're staying close to our customers in Indonesia and want to broaden our performance for them. Consequently, we have decided to open a sales office in Medan in North Sumatra in early 2018.' ■

## Carrier Donates Home Comfort Systems to Habitat

**F**rom ground breaking to dedication, Carrier and its employees are proud to support Habitat for Humanity's latest home on the northeast side of Indianapolis. Carrier supported the construction of the house with hundreds of employee volunteer hours, along with a donation of all of the home comfort products in the home. Carrier, a world leader in high-technology heating, air-conditioning and refrigeration solutions, is a part of UTC Climate, Controls & Security, a unit of United Technologies Corp.

Gee Hunter, who moved into the home with his partner and two children following the home dedication, was on hand earlier this month to watch a handful of volunteers from Carrier and across central Indiana put the final touches on his home. "We've worked so hard to achieve this dream and are so thankful to Carrier and all the other volunteers who made it a reality," said Hunter. "My children can't wait to move into their own rooms." Carrier, through

product donations and the continued investment of employees' time, is committed to working with high-quality non-profit organizations to help build stronger communities around the country. "Carrier has been recognized as expert in keeping people comfortable in their homes for more than a century and helping to build and outfit another Habitat home is a wonderful opportunity to share our expertise," said David Meyers, Vice President, Sales, Carrier. "We've been supporting Habitat locally for more than 20 years and this project again reminds us the power of giving back to the community we call home."

Greater Indy Habitat for Humanity expressed its appreciation for the company's strong support of its mission. "Carrier and its team embody what it means to invest as a company in their community," said Jim Morris, President & CEO, Greater Indy Habitat for Humanity. ■



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## Heat Pump Sales Grow Significantly

According to BWP Market, after setting a sales record in 2016, the heat pump market also grew significantly in the past year. For the first time, the brand of 70,000 units in heating heat pumps has been broken. In total, around 78,000 units were sold. The largest increase was recorded for air heat pumps: a total of 55,000 units were sold, which represents an increase of 20 percent compared to the previous year. As in 2016, monobloc units (31,000 units) were in particular in demand, with an increase of 24 percent. For split units, growth was slightly smaller at 16 percent. Erdgekoppelte systems (including groundwater heat pumps) increased with 23,000 devices over the previous year by 11 percent. The market share between ground-based heat pumps and air heat pumps hardly changed compared to the previous year: Air-source heat pumps accounted for the majority of heat pump sales at around 71 percent (previous year: 69 percent). Geothermal heat pumps and others are thus at 29 percent (2016: 31 percent). In total, around 800,000 heating heat pumps are now installed in Germany. BWP Managing Director Martin Sabel is pleased: "17 percent plus is an excellent result for our industry. The heat pump manufacturers and specialist companies know how to harness the tailwind they get from the good conditions for pumping and the EnEV and can thus partly offset the many obstacles." Sales of hot water heat pumps also grew by 8 percent in 2017 compared to the previous year, with 13,500 units sold. In total, 91,500 heat pumps were put into operation in Germany last year. For the current year, the association expects stable sales figures. Martin Sabel explains: "Of course, the MAP and the EnEV will continue to help us. On the other hand, there are signs that the new construction sector is not growing as fast as in the recent past." ■

## Controlling Multiple Smart Thermostats on Single Dashboard

Emerson, a leader in the thermostat and HVAC controls industry, announced Sensi Multiple Thermostat Manager, the company's latest innovation to leverage Internet of Things technology to help ensure human comfort and energy efficiency.

The Sensi Multiple Thermostat Manager is a software application that can manage and control multiple heating and cooling systems through one convenient online portal. The software solution works with Sensi Wi-Fi Thermostats to create a powerful and affordable HVAC management solution for businesses that typically have multiple HVAC systems across one or several buildings or even locations. The Sensi Multiple Thermostat Manager provides a best-in-class user experience, empowering facility managers to create thermostat groups and make batch setting changes to balance occupant comfort with energy savings and

operational efficiency.

An alternative to costly large-scale building management systems, Emerson's latest offering in its top-rated Sensi platform became a reality as the result of listening to customer needs in the research and development process. While bigger office buildings often require massive commercial HVAC systems, smaller businesses, schools and places of worship often rely on solutions like the Sensi thermostat to keep buildings comfortable year-round. Through the Sensi Multiple Thermostat Manager, facility managers are able to experience significant savings—both in energy conservation and manpower. Facilities no longer have to rely on janitorial or evening staff to adjust every thermostat to keep the system from running overtime on evening or weekends. Now, the facility manager can simply make adjustments in a seamless interface that impacts multiple thermostats at once. ■

## Peter Midgley, Co-founder of Airedale, Passes Away

Leeds-based air conditioning manufacturer, Airedale International, was sad to receive the news of the passing away of Peter Midgley on 11 January 2018. Peter, co-founded Airedale in 1974 with fellow Yorkshireman, Alan Duttine OBE, and remained joint managing director, until the sale of the business to Modine Manufacturing in May 2005.

Airedale began life operating in Batley, before moving to premises off the Leeds West Park Ring Road in 1976 which later became and continues to be known as Airedale House. As the business continued to prosper, Airedale relocated to Park Mills, Rawdon in 1979, with the construction of a new factory completed and opened by HRH the Duchess of Kent in 1984. Airedale remains today at the Rawdon site, with a further redeveloped, state-of-the-art facility, opened by Her Royal Highness The Princess Royal in 2016. During his career Peter will be

remembered for his larger than life character by customers, Airedale staff and all that knew him. Well known, and revered throughout the region and industry, Peter was a real people person, approachable, warm, with an infectious sense of humour.



Commercially astute, Peter, along with Alan, was the heartbeat of Airedale. When Airedale was acquired by US-based thermal management company Modine Manufacturing in 2005, Peter had led the business for over 30 years, and seen it grow into a major manufacturing company, contributing significantly to the local and national economy.

Airedale managing director, Tony Cole, said: "We are tremendously sad at the passing of Peter. He will be remembered fondly by us all at Airedale. He, along with Alan, had a sizable vision in recognising the opportunities for specialized computer room cooling, a market which still sees us prosper today". ■



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## GRIHA Council Signs MoU with PWD, Govt of Maharashtra

**G**RIHA Council signed a Memorandum of Understanding (MoU) with Public Works Department (PWD), Government of Maharashtra (GoM) on January 6, 2018, for promotion and implementation of GRIHA in Maharashtra.

The MoU was signed by Ajit Sagane, Secretary (Works), PWD, GoM and Sanjay Seth, Chief Executive Officer, GRIHA

Council, in the presence of Minister, Public Works, Chandrakant Patil, and other senior officials of PWD and GRIHA Council. PWD had issued a notification dated August 29, 2017, mandating all the upcoming government buildings and proposed retrofitting work of the existing buildings in Maharashtra, to comply with the 'Green building concept' and further to be rated from GRIHA Council. This MoU signing

was a forward looking step towards this notification.

Under this collaboration, PWD is committed to obtain GRIHA rating for its upcoming projects. Whereas, GRIHA Council as a first step, shall be conducting extensive customized training programmes pan Maharashtra, for building internal capacities within the department on this subject. ■

## Honeywell System Enhances Building's Operational Efficiency

**H**oneywell, a global leader in connected buildings, announced that Honeywell Outcome Based Service, a cloud-enabled building management service that helps identify misconfigurations sooner than traditional maintenance now extends to mechanical systems. As a result, key building personnel and other stakeholders can gain even more insight into a building's operational efficiency and comfort while optimize a building's total cost of ownership.

Honeywell Outcome Based Service for Mechanical Systems is the latest addition to Honeywell's Connected Services portfolio of technologies that draws on more than 100 years of global domain knowledge and experience, in combination with today's building connectivity, to help promote improved facility performance. Building on the service's core HVAC controls monitoring; Outcome Based Service for Mechanical Systems uses data analytics and sensor-based Internet of Things (IoT) connectivity to monitor the health and performance of mechanical equipment, helping uncover issues and faults that can impact system performance and efficiency.

"A building is much like a living, breathing organism, from its basic framework to the central nervous system of controls and the very heart of it all — the mechanical hardware that keeps everything operating," said Aseem Joshi, Country General Manager, Honeywell Building Solutions, India. "Keeping watch and maintaining these systems is possible with the right connectivity and knowledge,



which we've made possible with Honeywell Outcome Based Service. It now extends to mechanical systems, providing even more data and insights to promote improved performance and maintenance of building health."

Outcome Based Service for Mechanical Systems monitors mechanical equipment performance in line with key performance indicators (KPIs) closely tied to building comfort and energy efficiency, as well as equipment maintenance. The service uses advanced algorithms that monitor and analyze HVAC controllers, mechanical equipment and their key components, from boilers and chillers to other hardware that make up the core equipment of a building, in near real time, helping uncover

many faults and anomalies faster than traditional, routine maintenance.

The new service module also taps sensor data to monitor the asset health of individual mechanical equipment, comparing actual equipment performance with optimal operational performance values to identify deviations. This helps alert personnel to many issues sooner than traditional maintenance so organizations may have the opportunity to make changes or fixes before they lead to costlier and more disruptive problems. The deviations also help inform condition-based dynamic tasking as to when and how to address mechanical system maintenance needs, such as when to replace air filters on HVAC equipment. ■



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### Breitenbauch to be Advansor CEO

**K**ristian Breitenbauch has been appointed CEO of Danish CO<sub>2</sub> refrigeration systems specialist Advansor. Breitenbauch will focus on developing the organisation, as well as communication to stakeholders and sales. Current Kim G Christensen will continue to work for Advansor, as director of business development, focusing on products and markets. "Kristian Breitenbauch brings new, fresh on March 1. ■



Kristian Breitenbauch

leadership skills to Advansor, and at the same time he will help me secure our position as a leader in the European market. It will also mean that I can concentrate on the tasks where I have my strength," said Kim G Christensen. A master of business in economics and marketing, Kristian Breitenbauch comes from former management positions at Scanenergi and Danfoss. He commences work at Advansor ■

### Barton James Appointed to US Chamber of Commerce Energy

**T**he Air Conditioning Contractors of America (ACCA) announces that Barton James, ACCA Senior Vice President of Government Relations, will represent the HVAC contracting industry on the US Chamber of Commerce Energy, Clean Air & Natural Resources Committee.

According to the Chamber of Commerce, the Energy, Clean Air, & Natural Resources Committee develops and maintains Chamber policy on all aspects of energy, clean air, and natural resources. The committee works to promote legal and regulatory reforms and other safeguards against regulatory abuses by administrative agencies. "ACCA's role on the Energy, Clean Air and Natural Resources Committee is important because HVAC equipment is the largest consumer of energy in the United States," James said. "Although



Barton James

today's HVAC equipment is highly efficient, compared to a decade ago, half of the equipment in operation today does not function according to its energy efficiency rating.

Poorly thought out efficiency regulations increase HVAC equipment prices and push many consumers toward unqualified people who don't understand proper HVAC design and installation requirements. The result of this is

an HVAC system that uses 30 to 40 percent more energy than necessary."

According to the EPA, half of all HVAC systems in the US are not installed according to manufacturer specifications. The result of faulty installation practices, according to the National Institute of Standards and Technology, is equipment functioning at 60-70 percent of its labeled energy efficiency rating. ■

### Danfoss Names Middle East, Africa President

**D**anfoss, a global leader in manufacturing heating, ventilation, air-conditioning and refrigeration solutions, has appointed Ziad Al Bawaliz as its new regional president for Turkey, Middle East and Africa (TMA) region, following the departure of Levent Taskin. Al Bawaliz brings with him a wealth of knowledge and expertise to the role, with over 25 years of experience working in the refrigeration and air-conditioning industry.

He has management experience from leading positions in global industrial companies and will now have responsibility for over 243 regional employees. Al Bawaliz joined Danfoss in 2012 and has held the position of



Ziad Al Bawaliz

regional sales director for five years. In 2015 he was welcomed as Danfoss Mena General Manager where he held responsibility for all Danfoss segments. On his new role, Al Bawaliz said, "This is an exciting time for Danfoss in the region and I am delighted to be taking on this role.

As a management team, we have now defined the strategy and future direction for Danfoss here in TMA, and we are committed to driving the business forwards in the region by continuing our investments and growth in order to stay ahead of the competition and serve our customers in the best possible way." ■

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## ACR News Awards: Honoring the Industry's Elite

Organised by Datateam Business Media, the ACR News Awards is designed to recognise innovation in the industry and reward the companies and individuals that demonstrate excellence in the way they operate or in what they produce. Neil Hitching of Toshiba Air Conditioning presented the SkillFRIDGE trophy to the winning 2017 apprentice, Jack Culhane. The SkillFRIDGE shield was awarded Eastleigh College. The Shield recognizes the exceptional work and support the college offers their apprentice. The first award of the night, the prestigious Alan Moor Award, sponsored by Bitzer UK, went to Dave Pearson of Star Refrigeration.

The Alan Moor Award is presented in memory of the late one-time managing director of Bitzer UK, recognising the contributions of one individual whose efforts on behalf of the air conditioning and refrigeration industry have largely gone unrecognised. Next up was the Apprentice of the Year award, sponsored by Hawco, which was deservedly awarded to Stephen Taylor of Kooltech. This award recognises an apprentice that demonstrates commitment to personal development and progression and contributes to the workplace. Chirs Bailie of BL Refrigeration and Air Conditioning scooped up Service Engineer of the Year, designed to reward the most outstanding engineer in the industry. The winner of Wholesaler/Distributor of the Year 2018 was TF Solutions, demonstrating an impressive overall company performance over the past 12 months.

The Online Initiative of the Year award, which celebrates an innovative online platform, went to Mitsubishi Electric for The Hub. Environmental Project of the Year 2018 was scooped up



by Panasonic Heating & Cooling for the Marina Village Greystones Project. This accolade rewards a project that has environmental benefits and a commitment to sustainability.

Gunter's Masterpanel was the winner of Ancillary Refrigeration Product of the Year. The Refrigeration Product of the Year, meanwhile, went to Bitzer for its Ecoline Plus CO<sub>2</sub> compressor range. These awards recognise the most innovative refrigeration products and accessories in the industry. Ancillary Air Conditioning Product of the Year, sponsored by Hitachi, was scooped up by Daikin UK for the Auto Cleaning Duct Accessory. The final award of the night, the Air Conditioning Product of the Year award, sponsored by Bitzer, was awarded to Samsung for its AR9500M.

### Winners 2018

- **Alan Moor Award, sponsored by Bitzer UK**  
Winner: **Dave Pearson** of Star Refrigeration
- **Apprentice of the Year, sponsored by Hawco**  
Winner: **Stephen Taylor** of Kooltech
- **Service Engineer of the Year**  
Winner: **Chris Bailie** of BL Refrigeration and Air Conditioning
- **Wholesaler/Distributor of the Year**  
Winner: **TF Solutions**
- **Online Initiative of the Year**  
Winner: **Mitsubishi Electric – The Hub**
- **Environmental Project of the Year**  
Winner: **Panasonic Heating & Cooling – Marina Village Greystones**
- **Ancillary Refrigeration Product of the Year**  
Winner: **Guntner – Guntner Masterpanel**
- **Refrigeration Product of the Year**  
Winner: **Bitzer – Ecoline Plus CO<sub>2</sub> compressor range**
- **Ancillary Air Conditioning Product of the Year**  
Winner: **Daikin UK – Auto Cleaning Duct Accessory**
- **Air Conditioning Product of the Year, sponsored by Hitachi**  
Winner: **Samsung – AR9500M**

## Robinson is Woman of the Year

Joanna Robinson, MD of contractor Mansfield Pollard was named Woman of the Year at National Air Conditioning, Refrigeration and Heat Pump Awards. The presentation to Joanna kicked off the celebrations at the Titanic Hotel, Liverpool, which saw a number of key awards to companies in the air conditioning and refrigeration industry.

A champion of women in engineering, Joanna Robinson is chair of the Building Engineering Services Association (BESA) Ventilation Group. She was appointed MD of the Bradford-based bespoke air management company in



2013, working her way up from financial controller after joining the company in 2000. Daikin's SkyAir A-series air conditioning range using lower GWP refrigerant R32 picked up a further accolade winning the Air Conditioning Product category.

The Refrigeration Product of the Year went to consultants Star Technical Solutions for its performance optimisation and energy management service. The 300 guests at the event also saw RW Refrigeration Wholesale named as Wholesaler/Distributor of the Year, and JD Cooling winning the ACR Contractor of the Year category.



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# Cold Storage Construction Market worth USD 10.47 bn by 2021

Growth in the trade of perishable foods globally, technological advancements in refrigerated storage & transport, and the increase in demand for perishable foods is expected to drive the growth of the market in the near future...



**T**he report “Cold Storage Construction Market by Storage Type (Production Stores, Bulk Stores, Ports), Application (Food & Beverages, Medical Products, Chemicals), and Region (Asia-Pacific, North America, Europe) - Global Forecasts to 2021”, the global cold storage construction market is projected to reach USD 10.47 billion by 2021, at a CAGR of 14.0% from 2016 to 2021.

Growth in the trade of perishable foods globally, technological advancements in refrigerated storage & transport, and the increase in demand for perishable foods is expected to drive the growth of the market in the near future.

## Food & Beverages was the fastest-growing application segment of the global cold storage construction market

The food & beverages segment of the cold storage construction market is expected to witness significant growth in the coming years.

Increasing food wastage worldwide is motivating the government of countries worldwide and they are providing subsidies to food producers to utilize cold stores to avoid such a scenario.

## Production stores was the largest segment of

## the cold storage market

Based on type, the cold storage construction market has been segmented into production stores, bulk stores, ports, and others. Production stores were the largest segment of the market in 2015. Production stores are used to keep raw material, semi-finished, and finished products in the cold stores. It is intended for cold processing and the storage of chilled or frozen food products. Production stores are usually constructed near areas where products are manufactured.

## Asia-Pacific was the largest market for global cold storage construction market in 2015, globally

Asia-Pacific was the largest market for cold storage construction in 2015, owing to the increasing demand of cold storage construction in developing economies such as India and China. Companies in this region are investing to develop and operate innovative and cost-competitive cold storage constructions. India, China, and Japan are the region's top cold storage construction players. Key players operational in the cold storage construction market include AmeriCold Logistics (US), Proffered Freezer Services (US), Burris Logistics (US), Lineage Logistics Holding LLC (US) and Nichirei Logistics Group, Inc. (Japan), among others. ■

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# Solar Energy in Refrigeration & Air Conditioning

Solar energy is the result of electromagnetic radiation released from the sun by the thermonuclear reactions occurring inside its core. Thus, the use of solar energy to produce refrigeration and air conditioning can be a viable option to replace conventional cooling systems...



**T**he conventional air cooling systems around the world are dominated by Vapour Compression Refrigeration (VCR) machines, which have high electricity consumption and contribute to high peak loads during hot seasons. Solar assisted refrigeration and air conditioning

systems represent sustainable and environment friendly alternatives to traditional air cooling systems. Interest in solar cooling systems first began in 1970s when the energy crisis occurred throughout the world. Within a few years, many development projects were started.

However, in the recent years, the need for solar cooling systems has gained increased momentum due to greater awareness of the necessity to reduce emission of greenhouse and ozone depleting gases which are released from the conventional refrigeration systems. Solar energy is the

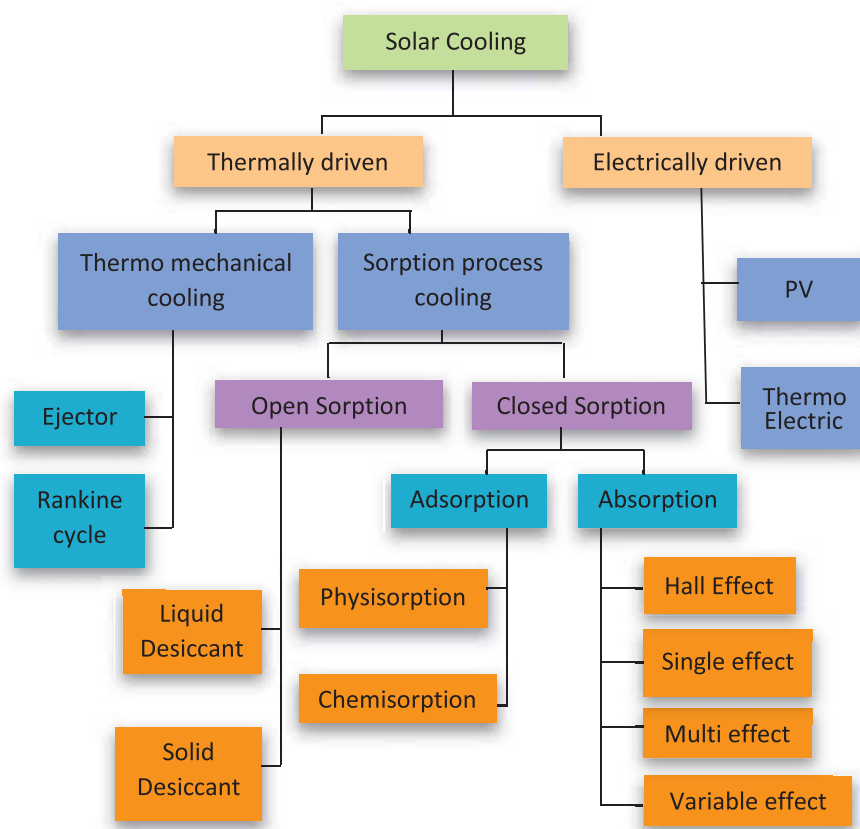


Figure 1: Classification of Solar Cooling Systems

result of electromagnetic radiation released from the sun by the thermonuclear reactions occurring inside its core. Thus, the use of solar energy to produce refrigeration and air conditioning can be a viable option to replace conventional cooling systems. Solar refrigeration offers a wide variety of cooling techniques. The classification of solar cooling systems has been shown in figure 1.

### Electrically Driven

The solar electrical powered refrigeration systems can be categorised into photovoltaic and thermoelectric cooling. The photovoltaic (PV) based solar energy system converts solar energy into electrical energy and then utilises it for producing the refrigeration, similar to conventional methods. The solar powered thermo electric cooling devices work on the principle of 'Peltier Effect'. A practical thermoelectric cooler consists of two or more elements of semiconductor material that are connected electrically in series and thermally in parallel. These

thermoelectric elements and their electrical interconnects typically are mounted between two ceramic substrates. The substrates serve to hold the overall structure together mechanically and to insulate the individual elements electrically from one another and from external mounting surfaces. Thermoelectric devices contain no chlorofluorocarbons, so it is environment friendly and it is fully reversible cycles, precise temperature control, and work efficiently in sensitive application. The main disadvantage of thermo-electric is low COP but it does have high potential in specific application, such as cooling electronic devices, where thermo-electric is preferred due to small size and consume very less electricity.

Figure 2 shows a representation of the solar PV cooling system. A PV cell is basically a solid-state semiconductor device that converts light energy into electrical energy. To accommodate the huge demand for electricity, PV-based electricity generation has been rapidly

increasing around the world alongside conventional power plants over the past two decades. While the output of a PV cell is typically direct current (DC) electricity, most domestic and industrial electrical appliances use alternating current (AC). Therefore, a complete PV cooling system typically consists of four basic components: photovoltaic modules, a battery, an inverter circuit and a vapour compression AC unit. The PV cells produce electricity by converting light energy into DC electrical energy. The battery is used for storing DC voltages at a charging mode when sunlight is available and supplying DC electrical energy in a discharging mode in the absence of daylight. A battery charge regulator can be used to protect the battery from overcharging. The inverter is an electrical circuit that converts the DC electrical power into AC and then delivers the electrical energy to the AC loads. The vapour compression AC unit is actually a conventional cooling or refrigeration system that is run by the power received from the inverter. The PV system can perform as a standalone system, a hybrid system (working with an oil/hydro/gas power plant) or as a grid or utility intertie systems. Though the efficiency of PV modules can be increased by using inverters, their COP and efficiency are still not within the desirable range. Due to the advantages of solar thermal systems over solar photovoltaic systems, recently more research has been carried out in the field of solar thermal cooling systems.

### Thermally Driven

During the past decade, the efficiency of the solar photovoltaic collectors increased only slightly (10–15%), contrary to that of the solar thermal collectors. Also, the electrically driven systems are characterised by the limited useful power that can be achieved by solar means and by their fairly high initial cost. Thus, more attention has been paid to the solar thermal-driven refrigeration technologies in the recent years. The thermo-mechanical and sorption systems are the popular subcategories under solar thermally driven systems.

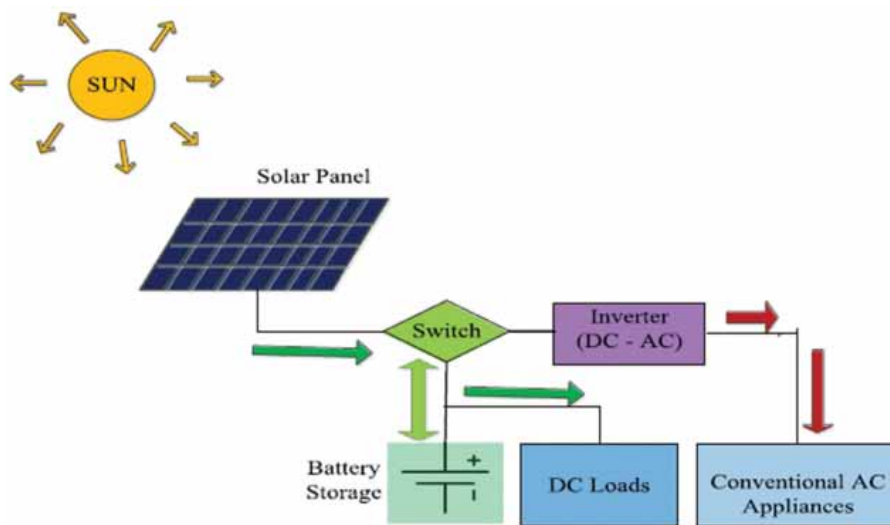


Figure 2: Solar Photovoltaic Cooling System

### Thermo Mechanical

Solar thermo-mechanical cooling systems have received a renewed attention in recent years due to their advantages such as ability to produce low refrigeration temperatures by using appropriate working fluids, ability to produce electricity when cooling is not needed by coupling the prime mover with an electric generator, maintaining high performance at off-design conditions and utilization of a wide range of temperatures from solar collectors. Also, the new environment-friendly refrigerants proposed for thermo-mechanical cooling cycles make thermo-mechanical cooling technologies attractive to investigate. In a thermo-mechanical cooling system, the heat gained from a solar collector is converted into mechanical work, which is used to compress the working fluid in a vapour compression refrigeration (VCR) cycle directly i.e. ejector cooling cycle or indirectly i.e. coupled with an Organic Rankine Cycle. Hybrid solar thermo-mechanical cooling with conventional cooling systems also offers a great potential for reduction in energy demand for buildings.

### Solar Ejector Cooling Systems

Solar ejector cooling cycles are a suitable option to harvest the solar energy with low-temperature collectors and fulfill the cooling requirements of the building. Ejector cooling systems are basically the same as conventional vapour compression based cooling systems. The only difference

is substituting the mechanical compressor with an ejector, which is considered as a thermally driven compressor. The solar ejector cooling system has three circulating loops as shown in figure 3(a). The solar loop consists of a pump, solar collector, generator heat exchanger and heat storage tank. The solar loop provides heat to the generator. This heat is absorbed by the working fluid in the power loop, producing high temperature, high pressure vapour. The high pressure vapour flows through the ejector where it accelerates as it passes through the nozzle. Flow pressure decreases as its velocity increases. At the nozzle exit, the primary fluid pressure becomes lower than entrained flow pressure. At this point, the entrained flow is sucked into the ejector and is mixed with the primary flow. The fluid

mixture emerges from the mixing chamber, and as it enters the diffuser its velocity decreases and pressure increases. The pressure of the emerging flow is slightly above the condenser pressure. In the refrigeration loop, the fluid inside the condenser becomes liquid by rejecting heat to the environment. A portion of the liquid is pumped to the generator to complete the power loop. The rest of the liquid is expanded through a throttling valve and enters the evaporator as a mixture of vapour and liquid. By absorbing heat from the cooled space in the evaporator, all the fluid transforms to vapour, and enters the ejector, which completes the refrigeration cycle.

According to literature available, the COP of ejector cooling systems is low compared to other heat driven cooling systems. However, simple construction and low maintenance requirements make them appealing for building cooling. Design variables including the ejector geometrical parameters, operation conditions and working fluid affect the performance of a solar ejector cooling system.

### Solar Rankine Cooling Systems

These systems were investigated widely in the 1970s and 1980s. Research on these systems was almost on hold over the past two decades. But due to recent advancements in Organic Rankine Cycle (ORC) equipment and introduction of new environmentally friendly working fluids in recent years, the research on this topic is receiving more attention. The main idea

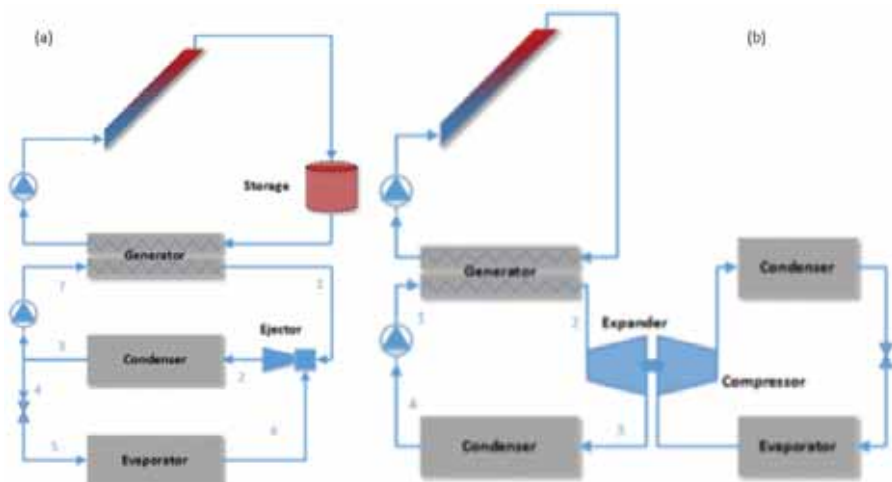


Figure 3: Representation of (a) Solar ejector cooling system and (b) Solar Rankine cooling system



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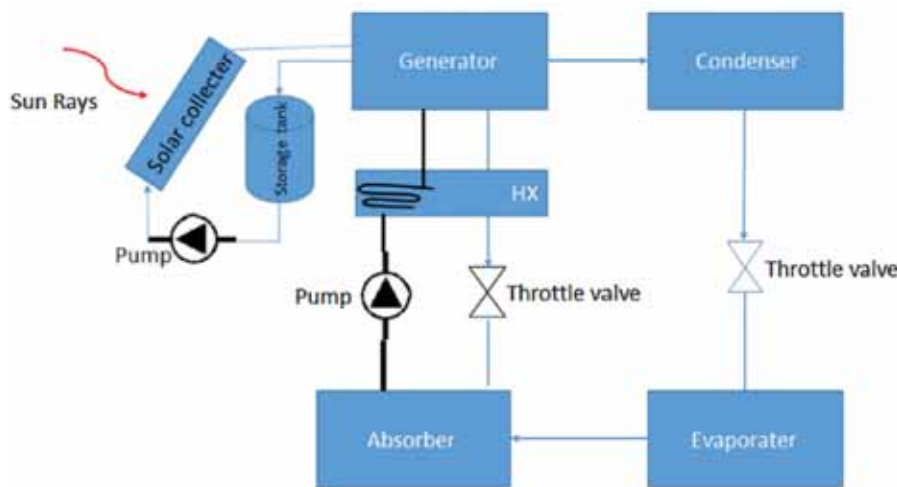


Figure 4: Solar Absorption System

behind the Solar Rankine Cooling System is utilization of solar heat to produce mechanical work and drive a conventional VCR Cycle. The schematic representation of Solar Rankine cooling system has been shown in figure 3(b).

There are two common arrangements of solar Rankine cooling system designs presented by different researchers. One configuration is using separate power and cooling cycles where the expander of the ORC and the compressor of the VCRC are coupled mechanically. In the latter design, same working fluid is used in both the loops that eliminate leakage and mixing problems. Integrated design is also simpler. Rankine cooling systems can utilize higher generation temperatures to produce cooling and, whenever the cooling demand is low, to produce electricity. In addition, hybrid solar thermo-mechanical cooling with conventional cooling systems offers a great potential for energy demand reduction for buildings.

## Sorption

Sorption refrigeration uses physical or chemical attraction between a pair of substances to produce the refrigeration effect. A sorption system has the unique capability of transforming thermal energy directly into cooling power. The sorption technology can be classified into open sorption system and closed sorption system.

## Closed Sorption Absorption

Absorption is the process in which a

substance assimilates from one state into a different state. These two states create a strong attraction to make a strong solution or mixture. The increase of heat in a solution can reverse the process. The absorption process has been represented in figure 4. The first evolution of an absorption system began in the 1700s. It was observed that in the presence of  $H_2SO_4$  (sulphuric acid), ice can be made by evaporating pure  $H_2O$  (water) within an evacuated container. In 1810, it was found that ice could be produced from water in a couple of vessels connected together in the presence of sulphuric acid. As the  $H_2SO_4$  absorbed water vapour, ice formed on the surface of water. However, difficulties emerged with leakage and the corrosion of air into the void vessel. In 1950, a new system was introduced with a water/lithium-bromide pairing as working fluids for commercial purposes.

The primary advantage of an absorption system is that it has a larger COP (coefficient of performance) than other thermally operated technologies.

## Adsorption

Faraday first introduced vapour adsorption technology in 1848, using a solid adsorbent. Adsorption cycles were first used in refrigeration and heat pumps in the early 1990s. The disadvantages of liquid-vapour systems were overcome by using solid-vapour cycles; this technology was first marketed in the 1920s. Adsorption refrigeration technology has been used for many specific applications, such as purification, separation and thermal refrigeration technologies. The important point to be noted is that the absorption is a volumetric phenomenon, whereas adsorption is a surface phenomenon. The working of the solar adsorption cooling system has been shown in figure 5. Adsorption is a process in which molecules of a fluid are attached to a surface. The surface is composed of a solid material. The molecules do not perform any chemical reaction; they merely discard energy when attached to the surface. The phase change is exothermic and the process is fully reversible. On an exposed solid surface with a gas, the gas molecules are forcibly thrust upon the surface of that solid. Therefore, some molecules adhere to the surface and get adsorbed, while some of them rebound back. At the onset of an adsorption process, the rate of adsorption is greater because the full

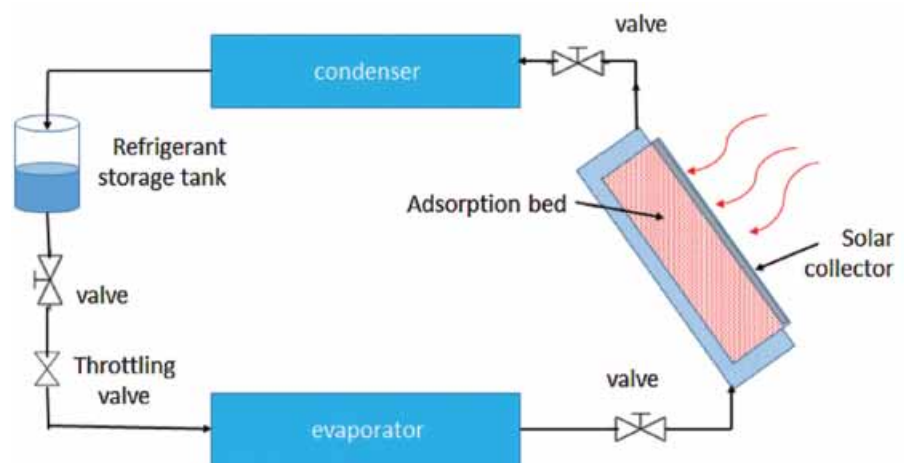


Figure 5: Solar Adsorption Cooling System

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Table 1: Comparison between solar absorption and adsorption systems

Specification	Closed sorption cycle	
System	Absorption	Adsorption
Sorbent type	Liquid	Solid
Working pair	H <sub>2</sub> O/LiBr, NH <sub>3</sub> /H <sub>2</sub> O	H <sub>2</sub> O/silica-gel
Operating temperature	60–110 °C (single-stage)	53–82°C
COP	0.50–0.73 (single-stage) < 1.3 (two-stage)	0.59
EER [Btu/(Wh)]	1.71–2.49 (single-stage) < 4.44 (two-stage)	2.01
Advantages	Only one moving part (pump) with possibly no moving part for a small system. Low temperature heat supply is possible.	No moving part (except valve) Low operating temperature can be achieved. Thermal COP is quite high compared to other heat operating systems.
Disadvantages	It cannot achieve a very low evaporating temperature. The system is quite complicated.	Very sensitive to low temperature especially the decreasing temperature during night-time. It is an intermittent system

surface is uncovered. The adsorption rate gradually decreases as the surface becomes more inundated with the adsorbate. Meanwhile, the rate of desorption increases in parallel with the decrease of adsorption, as desorption occurs from the exposed solid surface. However, equilibrium is achieved when the adsorption rate and desorption rate are equal. This is called adsorption dynamic-equilibrium, as the number of striking molecules on the surface and rebounding molecules from the surface are equal.

Adsorption technology can accommodate high temperature heat sources without corrosion. Adsorption technology is better equipped to handle vibration issues in a cooling system than absorption technology. Because of the liquid absorbent present in an absorption system, vibrations can cause serious problems, such as flow from the absorber to condenser or from the generator to evaporator, potentially polluting the refrigerant. Adsorption is immune to this condition and can thus be used in locomotive and fishing boats. An adsorption system is simpler to design than an absorption system. For example, to design an absorption system with a H<sub>2</sub>O/NH<sub>3</sub> working pair, extra equipment (dephlegmator) is required, because the boiling points of water and ammonia are very close. The comparison between the solar absorption and adsorption systems has been presented in table 1.

The adsorption cycle can be operated at lower heat source temperatures than the absorption cycle, but its COP is also lower. Based on the coefficient of performance, the absorption cooling systems are preferred to the adsorption cooling systems, and the higher temperature issues can be easily handled with solar adsorption systems. Solar thermal with single-effect absorption system appears to be best option, closely followed by solar thermal with single-effect adsorption system and solar thermal with double-effect absorption system options at the same price level. Solar-powered adsorption refrigeration devices can meet, among things, the needs for refrigeration, air-conditioning applications and ice making, with great potential for the conservation of various goods (medicines, food supplies) in remote areas. Nevertheless, the purpose of each system and the ambient conditions dictate its configuration (type of solar collector) and working pair, and performance. Compared to the absorption systems, adsorption systems can be powered over a larger range of heat source temperatures. The adsorption systems are more robust and less sensitive to physical impacts, do not present corrosion problems due to the working pairs normally used and are less complex because they contain fewer moving parts.

#### Open Sorption

Open system refers to solid or liquid desiccant systems that are used for either

dehumidification or humidification. Basically, desiccant systems transfer moisture from one airstream to another by using two processes. In the sorption process, the desiccant system transfers moisture from the air into a desiccant material by using the difference in the water vapour pressure of the humid air and the desiccant. If the desiccant material is dry and cold, then its surface vapour pressure is lower than that of the moist air, and moisture in the air is attracted and absorbed to the desiccant material. In desorption (regeneration) process, the captured moisture is released to the airstream by increasing the desiccant temperature. After regeneration, the desiccant material is cooled down by the cold airstream. Then, it is ready to absorb the moisture again. When these processes are cycled, the desiccant system can transfer the moisture continuously by changing the desiccant surface vapour pressures. To drive this cycle, thermal energy is needed during the desorption process.

#### Liquid Desiccant System

Materials typically used in liquid desiccant systems are lithium chloride (LiCl), calcium chloride (CaCl) and lithium bromide (LiBr). A liquid desiccant cooling system has been shown in figure 6. The system usually consists of a conditioner and a regenerator. The conditioner handles the process air to be dehumidified. The liquid desiccant is sprayed into the air and

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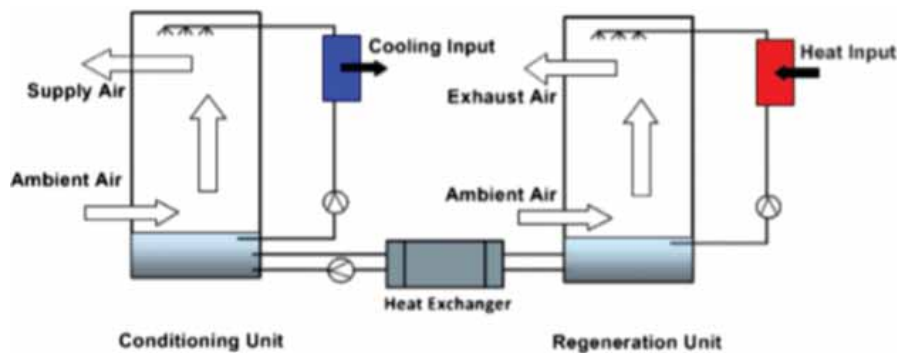


Figure 6: Schematic of solar liquid desiccant refrigeration

directly absorbs the moisture from the process air. Afterward, the liquid falls to a sump, is pumped, and is sprayed back into the air. While absorbing moisture, the desiccant becomes warmer and the partial vapour pressure is increased. The concentration of desiccant decreases and the water content increases. A small amount of liquid desiccant is taken continuously from the sump to the regenerator to remove the water that is picked up. The desiccant is also sprayed into the air. The desiccant is heated before it contacts the air so that the partial pressure of the desiccant is higher than that of the air. Therefore, the moisture is transported to the regeneration air. The regeneration air leaves the regenerator in a hot and humid condition. As the liquid desiccant solution returns to the sump of the conditioner, it is drier, more concentrated and still at high vapour pressure and temperature. Before being sprayed into the air, the liquid desiccant is cooled to the required temperature by a cooling tower or chiller. The favourable feature of the liquid desiccant system is the fact that the liquid desiccants can be regenerated at temperatures below 80°C so that low temperature heat sources can be utilized. In efforts to reduce a building's energy consumption, designers have successfully integrated liquid desiccant equipment with standard absorption chillers. In a more general approach, the absorption chiller is modified so that rejected heat from its absorber can be used to help regenerate liquid desiccants.

### Solid Desiccant System

The solid desiccant system is constructed by placing a thin layer of

desiccant material, such as silica gel, on a support structure. The desiccant wheel rotates slowly between the process and the regeneration airstreams. It is divided into two sections for the regeneration air and the process air. Process air flows through the first part of the wheel, and the moisture is removed due to the lower partial vapour pressure in the desiccant material. To regenerate the desiccant, the wheel passes the hot reactivation air, and the process can start again. For solid desiccant materials, the increase of dry bulb temperature of the process air is a result of the adsorption heat. This consists of the vaporization latent heat of the adsorbed moisture and the heat of wetting. The heat of wetting is approximately 20% of the vaporization heat. Both liquid and solid desiccants may be used in equipment designed for drying air and gases at atmospheric or elevated pressures (schools, theatres, restaurants, hospitals). Regardless of pressure levels, basic principles remain the same, and only the desiccant towers or chambers require special design consideration. Desiccant

capacity and actual dew-point performance depend on the specific equipment used, characteristics of the various desiccants, initial temperature and moisture content of the gas to be dried, reactivation methods, etc. Factory-assembled units are available up to a capacity of about 38m<sup>3</sup>/s. Several studies performed on the description and operation of desiccant cooling systems by different researchers. Systems that use rotary desiccant wheel to dehumidify the air are the most popular desiccant cooling systems and studied by different researchers. The desiccant cooling systems are viable alternative to vapour compression systems.

### Case Study

The comparison of various solar cooling techniques has been made by different researchers. Balaras *et al.* (2007) provided an overview of solar air-conditioning in Europe. For this purpose, they collected information on 54 solar powered cooling projects conducted in various locations in Europe. Figure 7 describes the annual thermal performance for the evaluated projects. The annual thermal COP is defined as the ratio of the annual cold production expressed in kWh and the annual heating input also expressed in kWh. According to the available data on actual performance, the average annual thermal COP is 0.58, slightly lower than the design thermal COP (0.65). The H<sub>2</sub>O/LiBr systems show the best performance, while the adsorption systems are generally less efficient. The lowest performance is shown by the NH<sub>3</sub>/H<sub>2</sub>O diffusion system. The grey bars indicate the systems that

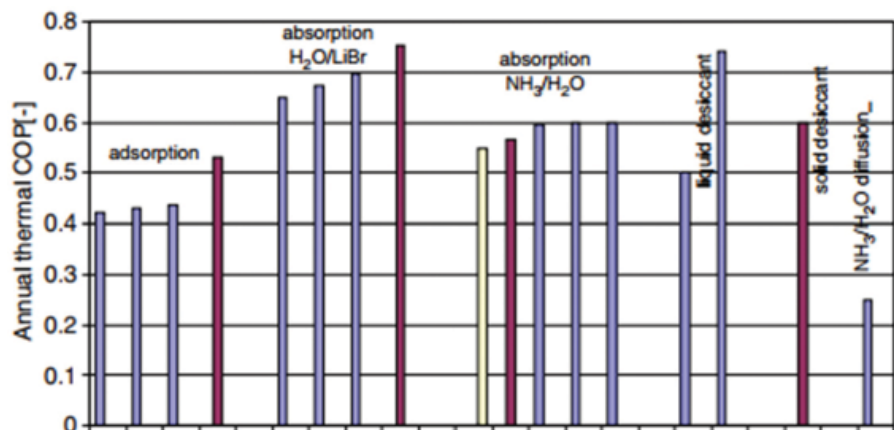


Figure 7: Annual Thermal Performance for different solar projects





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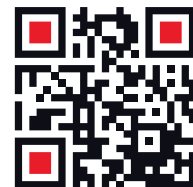
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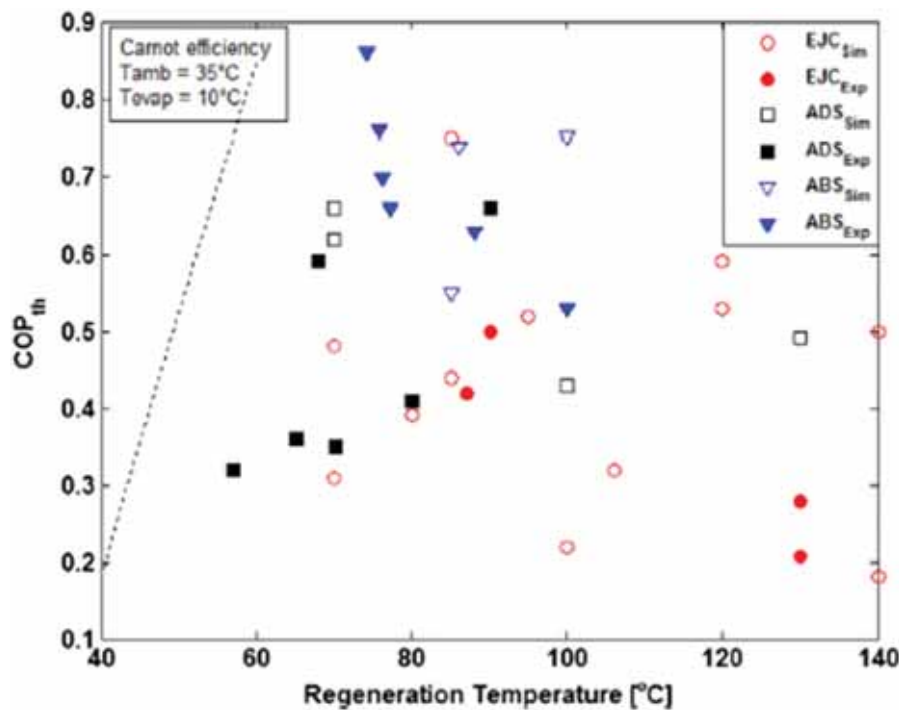


Figure 8: Comparison of different thermal cycles' COP vs. regeneration temperature

use flat plate collectors, the dark bars indicate the systems that use evacuated tube solar collectors, and the light bar indicates a system that uses stationary concentrating collectors.

They concluded that the single-effect absorption systems have a COP in the range of 0.50–0.73, adsorption systems have a lower thermal COP of 0.59, a liquid desiccant system have a COP of 0.51, and a steam jet system has a relatively high COP of 0.85. Regarding the operating temperature of the systems, absorption systems operated at 60–165 °C, adsorption systems operated at 53–82 °C, a liquid desiccant system operated at 67 °C, and a steam jet system operated at 118 °C. For most of these systems operated below 100 °C, the flat plate solar

collectors could be used, while concentrating solar collectors had to be used for driving temperatures higher than 100 °C. They also compared the annual EER, which is defined as the ratio of the annual cold production and the annual heat input, both expressed in Btu/(Wh). The average annual EER was around 1.98 for all systems investigated. The H<sub>2</sub>O/LiBr absorption systems have the best annual performance, while the adsorption systems have low annual performance. This result reflects the fact that 70% of the systems employed absorption technology and 75% of the solar assisted absorption systems used H<sub>2</sub>O/LiBr as their working fluid.

Figure 8 compares the solar thermal cooling cycles' COP versus the regeneration temperature as reported from a study by Al-Ailili *et al.* (2014). One can see that the adsorption cycles are operated using lower regeneration temperatures than other two cycles, while the ejector cycles require higher driving temperature. In addition, the absorption cycle COPs

are the highest, while the ejector cycle COPs are the lowest. Also, the adsorption cycle can be operated at lower heat source temperatures than the absorption cycle, but its COP is also lower. Similar to the solid desiccant material development requirement, additional enhancement of the adsorption system's COP is needed through new material development, system loss reduction or multi-stage approaches. Ejector cycles showed comparatively higher COP than other energy conversion technologies investigated in this study, but it requires higher operating temperatures.

## Conclusion

Several potential researches have been carried out on solar refrigeration systems. Although, the total number of working solar cooling units is very small at present, interest in solar cooling technologies is increasing again due to a combination of environmental consciousness and increasing prices of fossil fuels. The solar thermal cooling technologies, however, have their overall efficiencies lower than that of the vapour compression refrigeration systems. In order for the solar thermal cooling cycles to penetrate the market, their performance has to improve to a level that competes with the electric vapour compression cycles. Therefore, improving efficiency of solar thermally operated cooling technologies is an essential future research topic. The closed sorption refrigeration systems present as a good alternative to replace the classical refrigeration and air-conditioning systems with more environmentally friendly systems that can be powered by solar energy.

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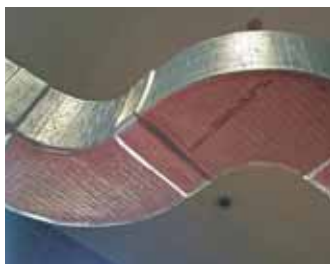
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# Growth Potential for Cold Chain Industry

The cold chain sector in India is still in the nascent stage with enormous growth potential on the back of climatic diversification and geographically vast size of the country...



## Meeting Changing Priorities

Modernization of society has increased the human list of essentials from food (*ROTI*), clothes (*KAPADA*) & shelter (*MAKAN*) to be depended largely on information tools (smart phones), transportation and medicines etc. To cater to this growing materialistic demand of the people at different locations in time with all product values intact, industry in general and cold chain industry in particular is coming up with new horizons. The utilization of cold chain logistics includes

both cold storages and refrigerated transportation and is used to increase the shelf life of food produce. Thus, catering the growing need and demand of different products in a nation with a population more than a billion and with growing economy, there is a shift in focus from increasing productivity to providing better storage and transport facility, for which the Indian cold chain industry with time has gained importance. The industry has become an important part of the supply chain of products from farm to door. The

cold chain industry is developing at a faster pace in India due to shift in focus from increasing the production to better storage and transportation facility of the commodity. The industry has now become an integral part of the supply chain industry, comprising of refrigerated storage and refrigerated transportation.

## Role of Cold Chain Industry

India ranks first in the world in production of fruits and second in vegetables accounting 10 and 15 per cent,

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respectively, of total global production. Despite this, the per capita fruit and vegetable availability of fruit is low due to post harvest losses and those losses can account for almost one-third (25-30 per cent) of the total production. The quality of products also diminishes by the time they reach the end consumers. The prime reason for this huge wastage and inferior produce is the lack of infrastructure – cold chain arrangement, from the source of produce to the end point of sale where the perishable goods can be stored after harvest.

With the Indian production and consumption of food products seeing a sharp rise, expect a greater demand and acceptability for cold chain services in near future. One of the main reasons for galloping rate of food inflation in India is the lack of supply chain for food, in which cold chain plays an integral part. Robust cold chain is the need of the day to benefit from larger production capacity and passing it on to consumers in the form of reduced prices as well as producers in terms of reduced wastage. Cold storage does not only ensure quality of the produce and keep it fresh but also extends life of the produce. The absence of cold storage facilities also forces farmers to sell goods at lower prices while consumers are forced to pay more for low quality produce. Thus, it is critical to build a strong infrastructure network and support the

growth of cold storage facilities, which in turn leads to the overall development of the commodity market ecosystem. Rotting of perishable products can be attributed to lack of proper cold storage facilities. This problem is also compounded by the fact that cold storage facilities are usually available only for single commodity items like potato, orange, apples, grapes or flowers. This leads to poor utilization and many perishable items which also needs cold storage facilities perish and die even before they enter the market. This shows the huge potential that is still waiting to be tapped. The need of the hour is to create economically viable cold chain solutions linking production centers to consumption

centers, thereby, reducing physical wastage of perishable commodities and in turn leading to the development of processed food industry.

### Cold Chain Logistics

The term cold chain logistics refers to the process of transporting and storing products and commodities under temperature-controlled conditions. It involves the usage of temperature-controlled warehouses for storage and refrigerated transport vehicles for distribution of products. It is widely used to store and transport fruits, vegetables, drugs, and medicines. Cold storage increases the shelf life and maintains the quality of products. The cold storage infrastructure has the ability to maintain the shelf life of perishable goods by maintaining proper temperature of the products from the farm gate to the end-consumer. The cold chain logistics market in India can be segmented by region into the Northern region, Southern region, Western region, Eastern region, and Central region. Looking at the rise in infrastructure to curb wastage, the cold chain industry in India is expected to grow at a CAGR of 19 percent from 2017-2022. The cold chain market in India is expected to reach INR 624 billion soon. The major revenue contributors in the Indian cold chain industry are cold stores and cold vehicles. With more than 40 percent of agricultural produce being dumped in



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wastage bins due to lack of proper cold storage facilities, a focused effort on the government's part is quite critical for new players to enter the league. The government started promoting a food safety and security bill recently which would require storage and cold chain facilities in order to reduce food wastage.

### Cold Chain Industry Status

Majority of the cold chain infrastructure in India was developed in 1960s which majorly supports the storage of potatoes and potato seeds. About 75% of the total capacity of cold storages is suitable only for potatoes. Cold chain infrastructure for other temperature sensitive goods is at abysmal state right now. On an average, about 30-40% of horticultural produce gets wasted annually in India. Even though India is the second largest producer of vegetables worldwide but its share in global export of vegetables is around 1.3% only. This is mainly caused by the lack of cold chain infrastructure which includes both storage and transportation facilities. To look at it from a broader point of view, the cold chain ecosystem offers a wide array of opportunities. The prime motive of the cold chain industry is to protect the goods from turbulent weather conditions. If the cold chain solutions are applied effectively, they would extend the produce's life and also keep the product nutrients well intact. Market research with around 3500 companies operating currently, the industry is quite fragmented and unorganized in nature. The cold chain

supply base only comprises 8-10 percent organized players. India has a total of 5,381 cold chain storages with 95 percent storage capacity under private players. Out of these cold chain storages, 36 percent have a capacity of below 1,000 MT. The current capacity allows only 11 percent of the total produce to be stored. These numbers, however, look forward to grow in the coming future. If we were to believe the predictions, cold storage capacity in India is expected to grow at 13 percent per annum on a sustained basis for the next few years with the organized market, growing at a faster pace of 20 percent. The report, 'Indian Cold Chain Industry Outlook 2022', portrays the current and future scenario of cold chain industry in India. Report on cold chain logistics in India (cold storage and reefers) highlights present scenario, future prospects, market potential, opportunities, growth drivers, industry size, analysis & forecasts upto 2017. The report highlights the Indian standing in the global context of this industry, followed by the Indian industry trends. The industry has been growing significantly owing to the increasing government initiatives, rising need for the cold chain facilities, increasing private sector investments of both domestic and foreign players, etc.

### Initiatives to Boost Cold Chain Infrastructure

- 100% FDI through government route
- Since 2011-12 cold chain has been given infrastructure status

- Viability gap funding up to 40% of the cost
- 5% concession on import duty, service tax exemption, excise duty exemption on several items. Subsidy of over 25% to 33.3% on the cold storage project cost
- Establishment of National Centre for Cold Chain Development
- Proposed financial outlay for cold chain infrastructure & food parks of US\$335 million and US\$650 million respectively. Over 50%-70% capital grant on projects.

### Challenges

India is one of the largest producers of agricultural products and one of the global leaders in the pharmaceutical sector. Yet, it is known to have a fledgling cold chain, which results in supply chain losses of food and other resources. The challenges witnessed by the cold chain players in the current scenario have also to be highlighted in order to build better understanding of the industry.

- The technical standards taken up are quite unsuitable for Indian conditions, resulting in failure of achieving optimum performance of standard refrigerating systems.
- Inadequate labour knowledge and training in handling temperature sensitive products is also a concerning factor including the cost involved.
- In the west, fuel cost constitutes to 10 percent of operating expenses of cold storage as compared to 30 percent in India.
- Cold storages require steady power supply. Frequent power cuts are a major factor of concern in India. These companies have to invest separately in power back-ups which push the capital investment requirement.
- A lower cost of funding for setting up cold chain infrastructure facility would be helpful.
- The market participant needs proper awareness about the need and demand of the cold chain facility.
- A proper and better understanding about efficient refrigeration techniques



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would play a significant role in promoting the cold chain market in India.

- More than 50 per cent of the cold storage facilities in India are currently concentrated in Uttar Pradesh and West Bengal, while other states struggle with investments from the centre and private operators.
- For private players the high level of initial capital required to construct a cold chain unit continues to be the biggest challenge. But if the government pitches in with a clear plan and promotes more PPP initiatives in this field, we could see a momentum growth in the cold chain industry in India.

### Foreign Collaboration

India is surely a land of opportunities for foreign players looking at the constant, promising growth over the past few years. But, for foreign players to invest in Indian

cold chain industry, Indian Government has to act like an effective catalyst. With a large number of global food and retail chains targeting the India markets, FDI in retail is just around the corner and is likely to be implemented soon. Then government is also promoting the food safety and security bill, which would further demand storage and cold chain facilities in order to reduce the amount of food wastage. With the expected future development in road and rail infrastructure, along with the changing lifestyle of the Indian consumer – Indian cold chain industry is expected to grow at a CAGR of 28 per cent over the next three years and reach a market size of \$13 billion in very soon.

### Conclusion

Indian market is evolving with changing lifestyles, rising urbanization and growing disposable incomes which will be the key benefactors of growth in cold chain user industries like food service industry,

processed food industry and organized retail industry. Additionally, mounting government endeavors towards reducing food wastage and penetrating healthcare in deep corners of the country will help in strengthening cold chain infrastructure in India. The cold chain sector in India is still in the nascent stage with enormous growth potential on the back of climatic diversification and geographically vast size of the country. The cold chain facilities in India are utilized by industries like processed food, dairy, meat & poultry, horticulture and food service industry. Indian cold chain sector has bright future ahead of itself with the much revered governmental support and changing consumer dynamics. ■

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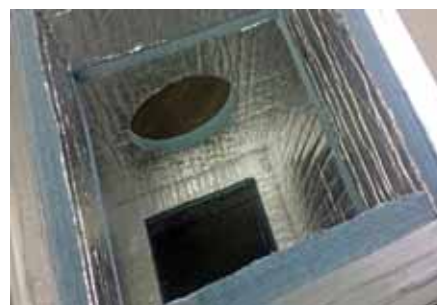
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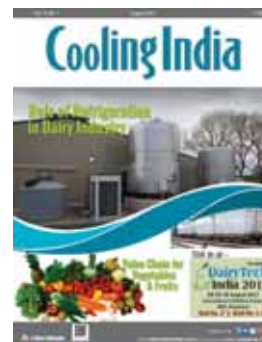
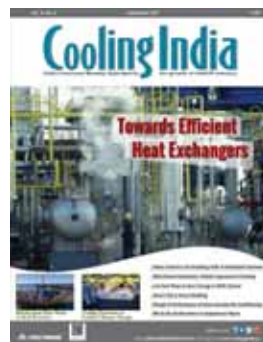
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**“We believe  
that we can  
reduce  
wastage of  
food in India”**

**Lamilux Composites GmbH** has been a family-run business for over 100 years and can look back at nearly 60 years of market and production experience in the manufacture of fiber-reinforced composites. The company caters to the clients around the globe in a wide range of sectors, such as the automotive and recreational vehicle industries, refrigerated store room and cell construction, the construction industry and many other industrial sectors involved in glass or carbon-fiber-reinforced sheets or rolls. Due to our technologically-advanced continuous manufacturing process, our large manufacturing capacities and our wide product range, we as a medium-sized company are the leading European producer, informs **Rohan Bellikatti, Regional Technical Sales Manager- South India & Sri Lanka, Lamilux India Pvt Ltd** in an interaction with **Cooling India...**

**Please take us through the journey of Lamilux in India so far.**

Lamilux is a world leader in providing light-weight glass fiber-reinforced plastic (GRP)/fibre-reinforced plastic (FRP) solutions for a wide range of applications. Lamilux has been offering solutions for customers in the Indian market for sandwich panel

construction for truck bodies and many other applications through its subsidiary Lamilux India Pvt. Ltd. since 2009. Being played an integral role in developing the country's cold chain in close association with the National Centre for Cold Chain Development (NCCD), Lamilux remains committed to the Indian market with renewed thrust on market expansion and deeper penetration.



### What are the major areas where you are catering to?

Lamilux is known for its innovation. In India, we are currently catering to reefer containers, dry containers, cold rooms and commercial vehicles.

### What are USPs of your products?

There are a lot of advantages of GRP as compared to steel.

To name a few product advantages:

- Resistant to chemicals
- GRP and the gel coat layer are solid coloured as compared to painting
- Printing and painting of the GRP is possible
- Easy to handle in the process (sawing, drilling, jet cutting)
- Compared to the sharpness of the edges of steel the risk of injury (cutting) with GRP is much lower (safety)
- High chunking resistance (screws, rivets)
- No breaks or buckling while processing
- Much better thermal insulation than steel
- GRP has a better sound reduction index than steel sheets
- Better environmental balance than other materials
- GRP is (without any special additives) an insulator. So, it adds to the requirement of reefer containers for enhancing efficiency.
- GRP transfers forces only remote
- Repairing possibilities of damages and scratches. Reduced downtime as it is repairable at the site if required
- Consistent quality through continuous production process
- Production width of GRP upto 3.20m
- Qualified for usage in the food industry. Also have HACCP certificated products.
- Moisture resistant & no corrosion

### Do you have any expansion plans in India? Do you have R&D activities in India in order to give better quality of the products?

We currently don't have any expansion plans in India. In India, we have two technical sales offices and one warehouse which cater to the Indian requirements. We do not have any R&D activities in India. But Team India is very much geared up and well equipped with right tools, technical know-how. Most importantly, the team is expertise in repair of GRP which is the need for the hour.

### How Large is your Warehouse and where is it located?

We at Lamilux are working on getting closer to our customers. For this, we have relocated our warehouse in India from Delhi to Bhiwandi, near Mumbai. The new warehouse is almost 300 sq m in size and can store more than 20,000 sq m of material which would suffice for building reefer containers on nearly 400-450 trucks, depending on the sizes. All our customers would benefit from this. If any of our customers has a problem, we immediately



travel to their site and ensure things are back on track as smoothly and quickly as possible. Our aim is to deliver the best quality product and back it up with the most reliable service assistance so that our customers are happy.

### What kind of technological innovations would you like to incorporate in your products considering rising global temperature?

Lamilux, as I said earlier, is always innovating and coming up with various new products like AntiBac, High Impact, Lamifoamtex, LamiGraph etc. We also have HACCP approved products which itself is a new benchmark in the industry. We are also working on new products which I am afraid will not be in a position to share details right now but will be an innovation in coming months.

### What opportunities would you envisage for your company with the Indian Government's focus on development of infrastructure & urban transportation projects?

We have a solution which can help overcome all the existing difficulties in cold chain transport. We can change the operational model completely by offering light weight vehicle, more payload, additional space, excellent insulation and perfect temperature maintenance; so that the food products are in ambient temperature for the required time and thereby remain in good condition till they reach the end user. We at Lamilux believe that we can contribute to reduce the wastage of food in India which is about 35% with the GRP solutions we provide.

### Has India geared up for GRP body vehicles?

India today is not the same as it was 10-15 years back. People understand the need, their requirements and are willing to change. The thought willingness to change is the first step to change.

India is gearing up for GRP body vehicles and will take some time to change the mindset of people which itself is a big task and yes, we are working very closely with our clients so that they understand what value we bring to them in terms of savings and the ROI they can expect. Our India Technical Sales Team is very much happy to help clients who wish to see the GRP we offer as we believe in the saying "Seeing is believing". ■

# Innovative Heat Pump-Based Air Curtain

Unlike conventional electrically-powered air curtains, the new air curtain connects to a high performance VRF or multi-split system, enabling it to deliver outstanding efficiency and providing additional capabilities...



An innovative new heat pump-based air curtain has passed independent tests by the Building Services Research and Information Association (BSRIA) with flying colours, and been accepted onto the Government-backed Energy Technology List.

It was developed by Fred Shaw & Co Ltd in conjunction with engineers from

Toshiba Air Conditioning UK specifically to meet the requirements of the UK market. Unlike conventional electrically-powered air curtains, the new air curtain connects to a high performance VRF or multi-split system, enabling it to deliver outstanding efficiency and providing additional capabilities.

The new system, designed for

mounting over entry doors in shops, hotels and offices, was designed to significantly cut end users' energy costs, and to be exceptionally easy to install and service.

It was subjected to a battery of live tests at BSRIA's laboratories in Bracknell, to evaluate its thermal efficiency, acoustic and air-flow performance under internationally-recognised test conditions.



Thermal performance tests were carried out in BSRIA's specialist twin chamber using the calorimeter method, in accordance with BS EN 14511:2013. This enabled heating capacity and Coefficient of Performance (COP) to be determined.

Airflow tests were carried out in accordance with BS ISO 27327-1:2009 to determine free air airflow rate, uniformity of air outlet velocity, and air outlet velocity projection.

The test rig for the free air airflow rate test was purpose-built by BSRIA to meet the requirements of the standard and the specific dimensions of the air curtain. For the air outlet velocity uniformity and projection tests, the air outlet velocity was measured at 125 locations.

Acoustic tests were carried out in accordance with BS EN ISO 3741:2010 to determine the air curtain's sound power level. Testing was carried out in BSRIA's 210sq m reverberation chamber thermal-acoustic facility.

The results showed the air curtain's air outlet velocity uniformity was 91 percent, against a target of 85 percent. The acoustic test results showed sound pressure to be 54dB(A), while the COP was determined to be 3.0.

The results proved the technology meets the performance requirements of the UK Energy Technology List for air

curtains, and it has been accepted onto the scheme. This gives end users a tax advantage on capital used to purchase ETL-listed equipment, which qualify for Enhanced Capital Allowances (ECAs) under the programme. The air curtain is available in two chassis lengths, 2200mm and 1500mm, both suitable for surface or recessed installation. Surface mounted units have an optional mounting flange accessory enabling use with ceiling tiles.

There is an optional electric back-up heater, which automatically switches in during heat pump defrosts. The heat

pump-driven system gives the air curtain additional optional capabilities, says Toshiba, which users can specify to augment the air curtain's functionality.

Ease of installation and servicing was a key design principle. The unit has a hinged front panel to give engineers full access to the coil, drain tray, filter and electrics. This can be opened by one person for servicing, while other air curtains require the whole front panel to be removed, requiring two people for safe working.

For enhanced energy efficiency and performance, the air curtain uses EC motors with full 0-10V speed control, enabling air speed to be precisely matched to the unit's mounting height. Precise control of motor speed also gives low operational noise.

Other innovative features include a filter clean warning light, and defrost on, power on and operation on lights as service aids. The PCB can be easily accessed via a sliding back-plate. The unit can be powder-coated to any RAL code to match interior decor or branding colourway requirements.

Gary Tingle, Director, Fred Shaw & Co Ltd, said: "Air curtain technology has not moved on for decades. Conventional electrically-powered systems can be costly to run, and difficult and expensive to maintain.

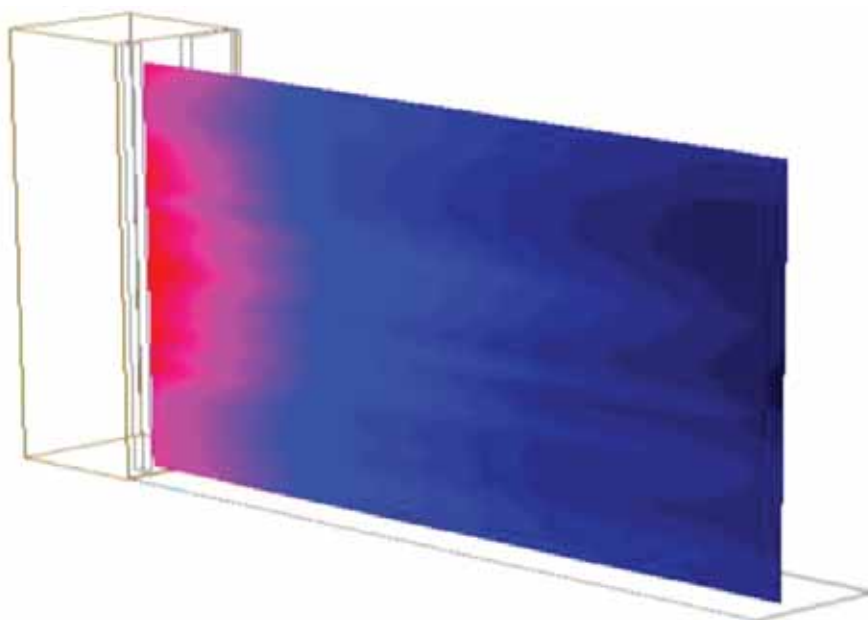


BSRIA researchers analyse data from the testing process





A BSRIA technician sets up the metering system for the air flow tests



Schematic showing airflow distribution

“Working with Toshiba Air Conditioning UK, we have taken a fresh look at this whole area and believe a heat pump-based system, harnessing the inherent thermodynamic efficiencies of VRF and multi-split systems, represents a huge

leap forward. It will save end users on their energy bills, offer quieter running, and be easier and cheaper to install and service.”

He added: “End users not only benefit from lower running costs over the lifetime of the equipment, with the ETL listing they

can claim Enhanced Capital Allowance on the initial purchase, too. We believe that with this new design, the air curtain has come of age, and that it offers a compelling alternative to outdated traditional air curtain technology.” ■

## Understanding Mist Engineering

**M**ist Resonance Engineering Pvt Ltd is an Indian Company operational for more than two decades, based at Pune in Maharashtra. We are pioneers of developing and manufacturing Vacuum Systems & Mist Creation System.

Mist Cooling systems are direct replacement for Conventional Induced draft type cooling towers and can assure cold water temperature close approach of 1°C to WBT with without using any fans. Thus, Mist Cooling System is green & innovative product and is maintenance free for its life of 20 years and more. We have successfully completed more than 300 Mist cooling system installations worldwide.

We have another innovative product for vacuum requirements “Mist Type Water Jet Vacuum Condenser” which can generate vacuum up to 700 MM of Hg by using only water, at pressure of 0.6

Kg/Cm<sup>2</sup> and does not require any steam. Additional vacuum requirement can be met by our advanced combo vacuum system which uses steam jet Ejectors in combination with our vacuum condensers and can guarantee for 759 MM of Hg vacuum requirement giving steam saving of 30 to 50% as compared with conventional steam ejectors. Our another product basket includes “High pressure Mist and Cool System” which have wide applications with textile industries for humidification, Green House humidification open restaurant cooling, Chicken and dairy farms cooling requirements, also can be used as cold water spray support to Air cooled condensers. Our R&D team continuously works on the best innovative and energy efficient products for our valued customers. Soon we are launching “Mist Spray Air Washers” and “Mist Evaporative System for Zero Liquid Discharge for Effluents”. ■



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# Air Conditioning for Future Electric Vehicles

As the world is marching towards phasing out the fossil fuel based IC engine technology for vehicles and replacing them with electric vehicles either using rechargeable batteries or fuel cells, it is inevitable that for cooling of cabin the conventional engine driven compressors will demand efficient technological substitute which would be driven by electric motor...



Current mobile air-conditioning and refrigeration compressors are designed for combustion engine vehicles and belt drive systems; do not meet the technical requirements for electric vehicles and equipment.

## The Hermetically Sealed Compressors

The hermetically sealed reciprocating compressor is widely used for the refrigeration and air conditioning applications. In all the household refrigerators, deep freezers, window air conditioners, split air conditioners, most of

the packaged air conditioners, the hermetically sealed reciprocating compressor is used. The hermetically sealed reciprocating compressor is very easy to handle, and requires low maintenance. They are used with motor power requirements from 1/20 to 71/2 hp.

In hermetically sealed compressor, in one side of the enclosed casing the various parts of the compressor like cylinder, piston, connecting rod and the crankshaft are located. If it is a multi-cylinder compressor, there are more than two cylinders inside the casing. On the other side of the casing is the electric winding

inside which the shaft of the motor rotates.

This motor can be single speed or multi-speed motor. In hermetically sealed compressors, the crankshaft of the reciprocating compressor and the rotating shaft of the motor are common. The rotating shaft of the motor extends beyond the motor and forms the crankshaft of the hermetically sealed reciprocating compressor.

## Advantages of the Hermetically Sealed Compressors

The hermetically sealed compressors are used widely in the refrigeration and air conditioning applications because of



several advantages, here are some of them:

- The hermetically compressors can be moved easily from one place to the other place, they are highly portable. One does not have to disassemble the compressor from the motor and no coupling, belt and pulley arrangement is involved.
- The whole condenser unit of the refrigeration or the air conditioning unit comprising of the condenser and the compressor can be moved easily from one place to the other. Its location can be changed easily.
- Since no coupling, belt or pulley is involved, the maintenance is lesser.
- The lubrication system of the hermetically sealed compressor is inherent and no external lubrication is required, unless the fresh gas charging is done.
- The installation of the hermetically sealed compressor is very easy. The suction and discharge connections and the electrical connections are available externally.
- Hermetically sealed compressors have very long life, the companies offer warranty period of upto seven years for these compressors.

### Disadvantages of the Hermetically Sealed Compressor

Apart from the many advantages, the hermetically sealed compressor has some disadvantages, as mentioned below:

1) When the motor winding of the hermetically sealed compressor burns, the whole compressor has to be replaced. In such cases, though the company gives some compensation for the old damaged compressor, still it's a costly affair to replace the whole compressor of your household refrigerator or air conditioner. Not only you will have to replace the compressor, but fresh gas charging has to be done. In open type of compressor, if the motor winding burns, merely the winding has to be changed.

2) If any parts of the compressor like the cylinder, piston etc, gets damaged, again the whole hermetically sealed



compressor has to be replaced and then one has to do fresh gas charging. In open type of compressor, one can easily replace various parts of the compressor.

The various advantages offered by the hermetically sealed compressor outdo a few disadvantages that they offer. It is due to this reason that they are used so extensively in household refrigerators and wide variety of air conditioners. In fact, the open type of compressors just can't replace the hermetically sealed compressors. The companies have made mechanism offering long warranty periods for hermetically sealed compressor and their easier replacement in case of damages.

### Solution Suitable for Electrical Vehicle Air-conditioning

The researchers have developed an intelligent semi-hermetically sealed electric swash plate compressor for use in mobile air-conditioning and refrigeration applications for passenger and commercial vehicles and equipment.

The smart compressor has Internet of Things (IoT) enabled with onboard diagnostic systems. Data generated from these systems will provide valuable information for quality control, maintenance and development, leading to a shorter

product improvement cycle and providing service provision to end-users.

Designed to be compact, robust, and suitable for harsh environments, the technology will offer transformational services to electric air-conditioned and refrigerated vehicle and equipment operators worldwide. Applied across the value chain, sensors and data analytics include predictive maintenance, logistical tracking for operational efficiencies, quality control and service offering when integrated into the end product.

Advanced materials are new or modified materials that have been engineered to provide superior performance across multiple characteristics such as strength, weight and formability. This can proactively be integrated in the early design phase to offer multiple novel attributes, such as biocompatibility, biodegradability, energy efficiency and self-repairing.

### Research Being Done in This Direction

#### German team presents efficient air conditioning for electric cars:

How can a pleasant vehicle climate be achieved efficiently? Researchers at the Technische Universität München (TUM) pursued this question in the context of the



Since Peltier elements are light-weight, they are also deployed in the central air conditioning unit. The installed Peltier elements have a performance capacity of up to 1.6 kW. The elements installed in the seats have a peak performance of 150 W per seat. On very cold days, a supplemental bioethanol heater with a rating of 4.5 kW can be switched on without sacrificing range.

### Integrated Thermal Management

The Visio.M achieves maximum efficiency not only through temperature control of the passenger space, but also by integrating the performance electronics into a holistic thermal management system. This allows using the waste heat the motor and the performance electronics to heat the passenger compartment in the winter while excess capacity of the air conditioning system can be used to cool the performance electronics in the summer.

The thermal management system is controlled by intelligent, self-adaptive software based on an evolutionary algorithm, developed at Technische Universität München. It evaluates the various sensor signals for temperature and humidity and automatically finds the optimal settings with regard to comfort, safety, and efficiency using a simplified computer model.

A further comfort improvement can be achieved using a remote control of the air conditioning system via a smart phone. Thus, shortly before his arrival, the driver

research project Visio.M funded by the German Federal Ministry for Education and Research (BMBF). The results of their research show that the potential of energy efficient air conditioning is all but exhausted. And this applies also to gasoline powered cars.

Inefficiency has its advantages, too: In the past, waste heat from combustion engines could be used to heat vehicle passenger compartments directly. In warm weather air conditioning provided comfort. But efficient electric motors generate hardly any waste heat. The question of climate control in electric vehicles, thus, needs to be solved anew.

In the context of the BMBF collaborative project Visio.M, scientists of the TU München researched how to create a subjectively pleasant climate for passengers in the most energy efficient manner. The researchers present the results of their work, implemented in the Visio.M prototype, from 13<sup>th</sup> to 17<sup>th</sup> April 2015 in the German government stand (Hall 27, Stand G 64) at the Hannover Messe.

Most previous electric vehicles simply took over concepts from combustion engine vehicles. However, this concept's thirst for energy put a noticeable dent in vehicle range. The researchers, thus, took a new look at all potential solutions, considering their efficiency, comfort and cost.

### Air Conditioning in Direct Proximity to the Passenger

In their research, they quickly determined that cooling in direct proximity to the body provided the most efficient alternative. In contrast to previously

deployed solutions, in which the entire interior is cooled or heated to the same temperature, heat is generated or dissipated only where it can actually be felt by the passengers.

"The trials showed that uniform climate control is not necessary," says Marius Janta, staff member of the Chair for Ergonomics at the TU München. "When we heat the seat of a passenger on cold days, passengers find it pleasant. With only a small amount of energy, we can significantly reduce the sense of discomfort." The temperature control of the seats in the Visio.M is accomplished using Peltier elements. These are semiconductor elements that can be used for both heating and cooling. "Even though Peltier elements are relatively expensive, they warm up or cool down immediately," says Alexander Präbst, a staff member at the Chair of Thermodynamics at the TU München. "Compared to the cold start of a combustion engine in winter, they even improve the level of comfort."





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can start heating or cooling. A preliminary air conditioning during charging could be added as well. Thanks to the open software platform of Visio.M adding of extensions is extremely simple and can take place without workshop visit.

The intelligent coupling of all heating and cooling functions for passengers and performance electronics results in a very compact climate control unit. "Here, we demonstrate an approach that can serve as a model for combustion engine models, as well." In a combustion engine vehicle efficient climate control would generate savings, especially, with regard to air conditioning. Beyond that, the compact system requires less space, which provides additional freedom for design and safety.

Participants in the Visio.M consortium were, in addition to the automotive companies BMW AG (lead manager) and Daimler AG, the Technische Universität München as a scientific partner, and Autoliv BV & Co KG, the Federal Highway

Research Institute (BAST), Continental Automotive GmbH, Finepower GmbH, Hyve AG, IAV GmbH, InnoZ GmbH, Intermap Technologies GmbH, LION Smart GmbH, Amtek Tekfor Holding GmbH, Siemens AG, Texas Instruments Germany GmbH and TÜV SÜD AG as industrial partners. The project was funded under the priority program 'Key Technologies for Electric Mobility – STROM' of the Federal Ministry for Education and Research (BMBF) for a term of 2.5 years with a total budget of 10.8 million euro.

### Conclusion

As the world is marching towards phasing out the fossil fuel based IC engine technology for vehicles and replacing them with electric vehicles either using rechargeable batteries or fuel cells, it is inevitable that for cooling of cabin the conventional engine driven compressors will demand efficient technological substitute which would be driven by electric motor. As the weight and volume

on board is a limiting factor, the energy efficiency will be the top factor of consideration. In addition to this, in hot countries, the cooling of the drive motor and energy storage system would also demand cooling load. For air heating in cold countries, the engine manifold heat is presently used, in case of electric motors they do not generate that heat, but the motor and the energy storage system needs cooling hence the heat can be exchanged for cabin heating application which would considerably prove to be effective.

As such there is huge scope for research in this direction and academia as well as industries must concentrate in this direction. ■

**Dr. OmPrakash G Kulkarni**  
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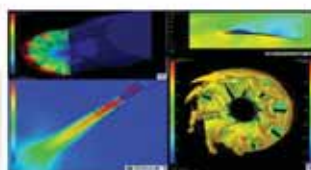


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# Arlington Earns Nation's First LEED for Communities Platinum Certification

Cited for setting goals, deploying strategies to improve residents' quality of life, Creating a more resilient, sustainable future



Arlington's Platinum LEED certification recognizes the County's leadership in creating a sustainable and resilient urban environment

Arlington County has been named the first Platinum level community under the US Green Building Council's (USGBC) newly created LEED for Communities program. The honor acknowledges the County's long-time commitment to environmental stewardship and community sustainability and its many policies, programs and initiatives to create a more sustainable Arlington. "Arlington County understands the value of LEED and its ability to help set goals and deploy strategies that can improve the quality of life for residents across the community," said Mahesh Ramanujam, President and CEO of USGBC. "Arlington's LEED for Communities Platinum certification demonstrates a commitment to improving performance and creating a more resilient and sustainable future."

"It is truly an honor, and a validation of Arlington's commitment to sustainability, to be the first to earn LEED for Communities Platinum certification," Arlington County Board Chair Jay Fisette said. "This has been a community effort, achieved by having a vision of combating climate change and promoting energy efficiency on a local level, and putting in place innovative policies and practices to achieve it. Now, more than ever, the responsibility for progress on climate change rests with local and state governments and with the private sector."

LEED, or Leadership in Energy and Environmental Design, is the most widely used green building rating program. USGBC expanded the scope of its standards to incorporate entire communities and cities last year, enabling Arlington to measure

and communicate high performance in key areas, such as human and environmental health. Progress and outcomes are measured using Arc, a digital platform that benchmarks and tracks performance data at the building, city and community level.

Recognizing Arlington's leadership in sustainability

Arlington's Platinum LEED certification recognizes the County's leadership in creating a sustainable and resilient urban environment that has long-proven success in reducing greenhouse gas emissions, managing stormwater, ensuring economic prosperity and focusing on education, affordable housing, health and safety for residents and businesses.

## Commitment to Sustainability

Arlington's sustainability story began with thoughtful Metrorail planning in the 1960s, followed by the Smart Growth strategies outlined in the General Land Use Plan. The County launched its Arlington Initiative to Rethink Energy (AIRE) effort in 2007. AIRE set a target to reduce Arlington County government's carbon emissions by 10 percent by 2012, compared to 2000 levels, and achieved it by improving energy efficiency in the County government's buildings, vehicles and infrastructure and other efforts. The County's Community Energy Plan (CEP), adopted in 2013, established a goal of reducing greenhouse gas emissions 75 percent by 2050. The CEP is an element of Arlington's Comprehensive Plan, which sets forth the broad goals and policies of a sustainable community over the next 30 to 40 years. Arlington's green building policies support the plan's goals by encouraging the construction of buildings that are energy and water efficient while providing healthy indoor environments. Most recently, the County became the first locality in Virginia to approve an ordinance allowing a Commercial-Property Assessed Clean Energy (C-PACE) program—a public-private partnership to provide affordable, long-term financing for projects to improve the energy or water efficiency of commercial buildings in the County. Open-space planning, solid-waste management, stormwater management, affordable-housing planning and public schools were evaluated by the USGBC for the LEED for Communities Platinum certification.

The Arlington County Board celebrated the Platinum certification at its December 19 meeting, which also marked the retirement of sustainability advocate and long-time County Board Member Jay Fisette. ■



A large blue Aggreko HVAC unit with multiple fans on top, situated outdoors. The unit is modular and portable, with the Aggreko logo visible on its side. It is connected to various cables and hoses, indicating it is in use for industrial or commercial ventilation and climate control.

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## Aggreko: One Stop Shop for HVAC Needs

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**W**e've grown from a local business to a global company, providing power and temperature control to businesses and communities around the world.

We've got a comprehensive temperature control portfolio. Chillers, cooling towers, air-conditioners, air handling units, heat exchangers and accessories, all in a range of sizes, for a variety of applications – both in process and space cooling. Our equipment are modular and mobile, which means they're purpose-built for rental, easy to transport, and quick to install and commission. We designed them this way because we know there are many reasons why your business needs rapid cooling, like, seasonal spikes in temperature, performance improvement, pilot testing, maintenance outages, seasonal demands, and emergency failures in permanent set-ups, early project commissioning and delays in delivery of permanent cooling.

**Knowing what you need is at the foundation of everything we do.** We hire out our cooling and heating, which means no capital outlays for you. Renting helps customers retain capital for much-needed operational activities. They can also get their operations up and running much quicker, often within weeks or even days, which helps start generating profits earlier and maintains production. It's a safer option too. Data centres and IT parks rely on our cooling to be delivered rapidly to maintain safe levels of temperature, and we offer quick and reliable solutions round the clock across India.

**We're well equipped to help, with a huge fleet of energy efficient, localized chillers** - both air-cooled and water-cooled to give you greater flexibility – particularly useful if you have limited space for equipment, or need to meet lower leaving-water requirements. Our engineers are trained to assess your site and required temperatures, then recommend the best type and size of chiller for your needs. Our chillers are designed to work in tough settings and are easy to operate with flexible controls and settings. They're environmentally friendly too, using non-CFC refrigerants and capable of maintaining temperatures up to -40°C.

**We've got the largest global fleet of modular cooling towers and ancillaries.** We've designed our cooling towers to have a small footprint and they can be interconnected to meet any heat load. Our cooling towers can be quickly installed for single unit applications and because of their modular design, we can combine them for use on larger projects. Our engineers can work with you if your cooling towers fail and keep production rolling during planned maintenance and emergencies.

**We promise 100% fresh air for our customers with our industrial air conditioners.** From film sets and events, to offices and industrial settings, we keep temperatures just right. Our air conditioners are durable and built to work alongside your existing heating, ventilation and air conditioning (HVAC) equipment to give the temperature range you need. If low noise is essential, you can choose from our range of quiet air conditioning units. They run at





industry-leading levels of soundproofing – making them perfect for use in the most discreet of locations.

**Our industrial air handlers are ideal for open spaces** – whether you need bulk cooling for an event, storage or distribution facilities, or comfort cooling for offices and factories. If you need to circulate air through your existing HVAC systems we can tailor our equipment to suit you. We also provide all the ducting, hoses and cabling needed to install things correctly, efficiently and safely. Our air handlers can be used with our chillers to provide effective air conditioning for events, workspaces, or in food and beverage manufacturing.

**Heat exchangers** are often pushed to their limits, which can be costly for you. That's where we can help. We have plate heat exchangers as well as shell & tube heat exchangers for variety of process cooling applications. They're refinery-grade, certified contaminant-free and thoroughly cleaned, pressure tested and certified before each use. Our process engineers will visit your site, assess your needs and tailor our heat exchangers to your demands, with minimum disruption to your business.

We've got over 50 years of experience in a wide range of industries like facility management, it parks, events, mining, manufacturing, shipping & shipyards petro-chemicals, refineries, food & beverages, pharma & chemicals, fertilizers. Our experience means, we know providing first-class facilities management is a challenge. As service level agreements become more demanding, your customers expect increasingly high standards – often while your profit margins shrink. We understand that you can't afford routine maintenance or peak demands to get in the way of business.

We've grown to be a top player in Facility Management, especially, in HVAC services for good reasons. We work with you from start to finish, providing backup generators, cooling equipment and dehumidifiers to help you take care of repairs and remove the worry of lost production. So, if you need to cool an office, or power a hospital after a storm, we can be there within hours – no matter where you are. We have been supporting some of the biggest players in large-scale facility management in India. DLF – one of the largest commercial real estate developer in India, has their in-house facility management arm as well. "We are committed to provide uninterrupted power and air-condition to all our clients round the clock. Aggreko has been doing a commendable job in supporting us to ensure the same with their

industry knowledge and quick turnaround capabilities in emergency cooling, not to forget their internationally acclaimed safety standards" – says Ravi Gokulnathan, GM, Building Maintenance Services, DLF India.

When it comes to mining, we helped one of India's leading underground coal mines with a flexible cooling package so the company could continue extraction, after high temperatures kept tripping its coal cutting shearer machines. And when a smelter company needed interim cooling towers urgently to supplement their faulty ones, our team worked round the clock to engineer a complete cooling tower system within eight days.

Data centres are another current growth area where temperature control and power are needed. This sector is growing quickly and grids are struggling to keep pace with the demand for additional capacity. We undertake almost all major events not only in India but also worldwide. For us it is all about you, and finding the best answer to whatever you need. We've got all the answers your business is searching for.



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– says Ravi Gokulnathan, GM, Building, Maintenance Services, DLF India.

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Aggreko is the global leader for temporary power, and cooling equipment, with more than 200 locations worldwide. Read more about us on [www.aggreko.com](http://www.aggreko.com) (With inputs from Aggreko India.)





# Cold Climate Heat Pumps

Air source heat pumps work like refrigerators – but in reverse, absorbing heat from the outside air at low temperatures into a fluid, which is passed through a compressor where its temperature is increased, and transferred at its highest temperature heat to the heating and hot water circuits of a home...



Cold climate heat pumps are one option for consumers to heat their homes.

Home heating is the largest energy expense for most US homeowners and accounts for nearly 30% of energy used in the nation's residential buildings. Millions of homeowners in colder regions of the country do not have natural gas available, leaving furnaces to be fueled with heating oil, propane, or electricity. This can often result in higher heating bills for homeowners. But today there's an option that could heat your home better, reduce your heating bill, and improve your comfort at the same time. Air-source heat pumps (ASHPs), commonly used across the southern parts of the country where winters are relatively mild, are now becoming capable of delivering heating even in cold regions such as New England and the upper Midwest.

## How it Works

Air source heat pumps work like refrigerators – but in reverse, absorbing heat from the outside air at low temperatures into a fluid, which is passed through a compressor where its temperature is increased, and transferred at its highest temperature heat to the heating and hot water circuits of a home. Across all heat pump types, because heat is moved rather than generated, heat pumps can provide equivalent space conditioning at as little as one quarter of the cost of operating conventional heating or cooling appliances. In the past, the heating capacity and efficiency of conventional ASHPs decreased significantly as the outdoor temperature dropped and the demand for home heating rose –

resulting in inefficient and insufficient performance that required additional heating sources to stay warm.

## DOE Research Finds Solutions

The Building Technologies Office within EERE funded research to develop a prototype cold climate ASHP. Emerson, in partnership with Oak Ridge National Laboratory, developed a prototype that is both cost-effective and highly efficient at heating the home. The heart of the prototype is a new scroll compressor, developed by Emerson, which is optimized for low ambient heating performance. The design used tandem compressors and other features to achieve its target performance, which allow the first compressor to provide cooling and heating functions in mild common conditions, but when outdoor temperatures drop, both compressors kick in and comfort is maintained.

This prototype was field-tested in both Ohio and Alaska to ensure it worked as designed. Dan Knoth, a senior project engineer with Emerson Climate Technologies, housed this cold climate heat pump in his Ohio home for the last three years. In Tipp City, Ohio, the temperature varies winter to winter but it's common to have one month where the days are below 25 degrees. By comparing the coldest months year to year, Knoth found a 30% reduction in his bill. Here are just a few reasons why cold-climate ASHPs can be beneficial for consumers:

The Northeast Energy Efficiency Partnerships found that when entire heating units are replaced in the Northeast and Mid-Atlantic regions, the annual savings from an ASHP can be over \$450 compared to electric resistance heaters or over \$900 when compared to oil systems.

With increasingly energy efficient models available on the market, the energy savings from ASHPs can really add up over the winter. Consumers should look for the ENERGY STAR label when choosing an ASHP – and for those in colder climates, they should focus on getting the highest heating season performance factor (HSPF) possible. In warmer climates, choosing a model with a higher seasonal energy efficiency ratio (SEER) is more important.

Unlike ground-source heat pumps (GSHPs), ASHPs can be installed in a single package that doesn't require extensive digging or underground installation. When used in a well-insulated and weather stripped home, an ASHP that has been properly sized and installed can offer similar performance – with lower up-front costs – to GSHPs. ■

(Source: US Department of Energy)

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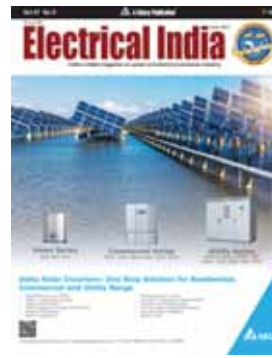
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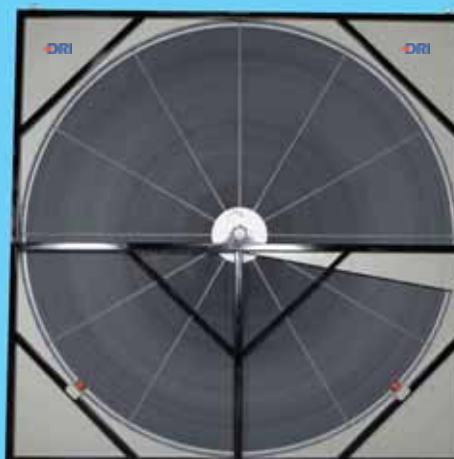
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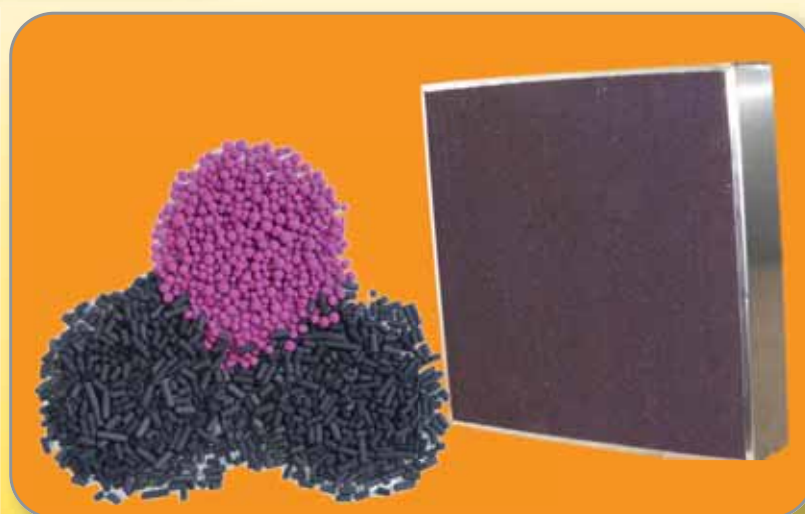
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## “Infra development will drive the growth of HVAC market in India”

**Belimo** is global market leader in the development, production and marketing of actuator solutions for controlling heating, ventilation and air conditioning systems. Actuators, control valves and sensors make up the company's core business. **Sunit V Tanavade, Managing Director, Belimo Actuators India Pvt Ltd** gives a glimpse of the company, industry and products and services with this apt opportunity of interview with **Cooling India...**

### **Please take us through the journey of Belimo Actuators in India so far.**

So far it has been very exciting. Our India journey dates back to January 2006 when BAIPL started its operations today it is over 12 years. In 2006 we began with offices in Mumbai, Bengaluru and New Delhi, 2011 in Chennai and 2013 in Kolkata. 2011 was a very significant year for us; in order to stay close to our customers we started our state of the art Customising center at Kandivali in Mumbai. Today it is from this Customising center we meet the varying needs of our customers for a country so well known for its diversity. We started our India journey with a very strong footing on the air side products; today we are one of leading brands for water side products. Our products and services are known for its quality, reliability, quick delivery times and for the support we provide.

Looking back at the last twelve years and how BAIPL as a

company has grown, we have created a record when it comes to sales volume growth. We strive for mutual success. We are successful when we offer our customers more values.

### **According to you, what are the trends in cooling industry?**

Customers are looking for products/solutions with the latest technology, higher energy efficiency and proven performance. Once these 3 parameters are experienced they endorse your products.

It is these features which has helped us to change the pressure independent valve technology from diaphragm based to the reliable and transparent electronic flow measurement which is gaining more acceptances from the consultants and customers. The award winning Energy Valve 3.0 with the ease of integration, data storage and analytics is making glorious in roads to all customers who want more of smart products.



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Energy Valve

### What are the products catering to HVAC&R industry? How do you envisage the growth keeping in mind rising need for cooling due to global climate change?

Our complete product range air side products, water side products and the recently introduced sensors are largely designed for the HVAC & R applications. For the past 5 years the industry has grown and the future is brighter. Today most of the damper manufacturers offer our spring return, non-spring return actuators, for the stringent UL555S we have the fire and smoke solutions. Today most of the VAV boxes are fitted with our VAV controls. Contractors prefer to use our CCV on account of the price benefit, globe valves, motorized butterfly valves, EPIV & EV, FCU valves and thermostats are all used as per their requirements. We are envisaging a growth of around 18% and are well equipped to take care of this growing need.

### What are the major areas where you are catering to?

CESIM is a companywide methodology approach to improving and developing products and solutions to meet and exceed customer expectations. CESIM ensures Comfort, Energy –saving, Safety and security for people and their property and provides easy Installation and commissioning with reduced Maintenance offering optimum system performance.

Internet of Things – The internet of Things (IoT) is transforming our world. With intelligent cloud connectivity, you can now more easily optimize service and maintain your buildings. We empower our customers in a connected world to do their jobs better, faster and easier. Being market leader is an obligation and a source of motivation. Belimo is the global market leader in the development, production and marketing of actuators solutions for controlling HVAC systems. Actuators, control valves and sensors make up the company's core business. On the air product side our focus is on OEM's- damper, fire damper and VAV box manufacturers, for the water side products we work with OEM- PAC, AHU manufacturers, valve manufactures. For the project requirement we deal with contractors and end users who are kept abreast with our products.

Belimo HVAC sensors offer superior reliability, easy installation and seamless integration with major Building Automation Systems. The innovative tool-less housing design allows for quick installation, easy commissioning and provides NEMA4X/IP65 protection.

### How competitive and energy efficient are your products as compared to your competitors? Do you have any expansion plans in India?

We differentiate ourselves from our competitors through the higher customer benefits of our products and services. Added values for our customers are the measure of our success. Being a responsible corporate we care for the environment; every product developed at BELIMO is viewed from the energy efficiency angle. We were the first ones to introduce the DC brushless motors for the actuators which ensure low power consumption. As all our products are fitted with actuators whose technology we have pioneered, I can confidently say that we are the best when it comes to energy efficiency. We are also committed to the environment. We strive to use our resources sparingly. We are mindful of energy consumption and the environmental impact of our products through their life cycle.

Operational excellence ensures that the products we deliver are top quality, extremely reliable and competitively priced. With our growing business thanks to all our customers who have reposed their faith in us, we have already started looking for a bigger Customisation center; in the next few months we will be moving to our new facility which will have the capacity to handle our business needs for the next 8-10 years. Today we have a representative in Ahmedabad; we will be setting up an office in Ahmedabad in the coming year.

Proximity to customers – Our focus is on our customer's success. We are committed to customer-oriented thinking and acting, expert advice, availability of products, reliable order processing and accommodating behavior. We work as a team

### What is the USP of your products? Do you have R&D activities in India in order to give better quality of the products?

Our product focus is on HVAC systems. Belimo products continue to the efficient fulfilment of basic needs, primarily comfort and security in indoor spaces. We see innovation as one of the most important factor for long term success and technological leadership. Research and development works closely with customers to find innovative approaches and to verify ideas with potential for success. BELIMO has always stood for its quality that is what our products are known for, once our product is installed it gives our





PIFLV



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customers the peace of mind. That is the reason why most of the OEM's prefer our products. We have a strong focus on R&D which is based at Hinwil in Switzerland it is our Innovation which has today made us the technology trendsetters in the HVAC industry.

**What kind of technological innovations would you like to incorporate in your products considering rising global temperature?**

Our recent roll out of products bears testimony that we are making our products smarter, easy to install. At ACREX 2018 you will see how we now plan to revolutionize the way VAV's work. Our products can be safely and easily accessed making commissioning, installation and troubleshooting easier. Rise in adoption of smartphones for controlling HVAC devices –The use of smartphones is gaining importance in the HVAC equipment industry as it enable consumers to connect to technicians easily and get real time maintenance and support for their systems.

**How would you differentiate Indian HVAC markets from the Global markets, while offering your services and products?**

Globally the demand for HVAC products is mainly driven by factors such as rising population, revival in the housing markets and increase in consumer income levels in emerging markets, development of reliable energy resources, growing commercial and industrial units among the others. Asia Pacific is leading the global HVAC market mainly because of high demand coming from emerging economies like China, India and South East countries like Indonesia and Thailand among the others.

The top two emerging market trend driving Global HVAC equipment market

Rise in incorporation of Building Automation systems – BAS are being incorporated in buildings to enhance operations and interact with HVAC, lighting, Fire and security systems in building.

Renewable energy sources for residential heating hinders the gas boiler demand – Strict environmental regulations will pave the way for the adoption of renewable sources which will lead to a change

in the energy mix for residential heating, particularly in Europe

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

The HVAC market in India is set to grow which is mainly driven by the rapid infrastructure development. The growing population combined with government initiatives to promote the "Make in India" concept has heightened manufacturing activities and infrastructure development in the country. The government's policies have kick started a lot of opportunities with the focus on health care good number of hospitals from the government and private side are coming, education and the need for good institutes have opened up the space for institutes, the purpose of making India a manufacturing hub a lot of players are setting up base in the country and the existing ones have expansion plans, the need for rapid transportation system in another area, IT & ITES, Hotels, Commercial spaces are all areas where we see growth. All these will have their own air conditioning needs which we want to capitalize on.

**What are your suggestions to potential clients from HVAC&R industry?**

The industry is well poised for growth with many opportunities we need to make sure that we provide a solution which is well proven and reliable. Cost is not a factor which needs to be brought under the lens but technology products need to be rightly promoted that is where you will find us as your partners.

**What is the impact of GST on the company's business in India?**

GST was long awaited and we as a company are happy that it is been implemented making the playing field uniform under a single tax head. The road from here looks wider and the prospects brighter. ■



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# Low Temperature Hazards in Refrigeration

Human beings' exposure to low temperatures can cause certain serious physiological disabilities. In this article, we examine the various low temperature hazards in refrigerated spaces and the cold atmospheres...



**R**efrigeration involves creation of low temperatures in spaces. Human beings' exposure to low temperatures can cause certain serious physiological disabilities. Human beings are basically warm blooded animals. The blood circulation keeps the body temperatures within very close limits by rejecting the extra heat generated in the body due to calorie intake in the food. Exposure to low temperatures can cause

of excessive loss of body heat and also can cause local damage to the tissues of the exposed skin. In this article, we examine the various low temperature hazards in refrigerated spaces and the cold atmospheres.

The following are the various low temperature hazards of exposure to cold temperatures:

- Frost Bite
- Cold Burns

- Hypothermia
- Cold Shock

## FROST BITE

### What is Frostbite?

Frostbite is the most serious cold weather injury of the foot, as it involves the freezing of body tissue, vascular damage, metabolic changes, and even tissue death. Superficial frostbite injuries involve surface-level skin, while more serious



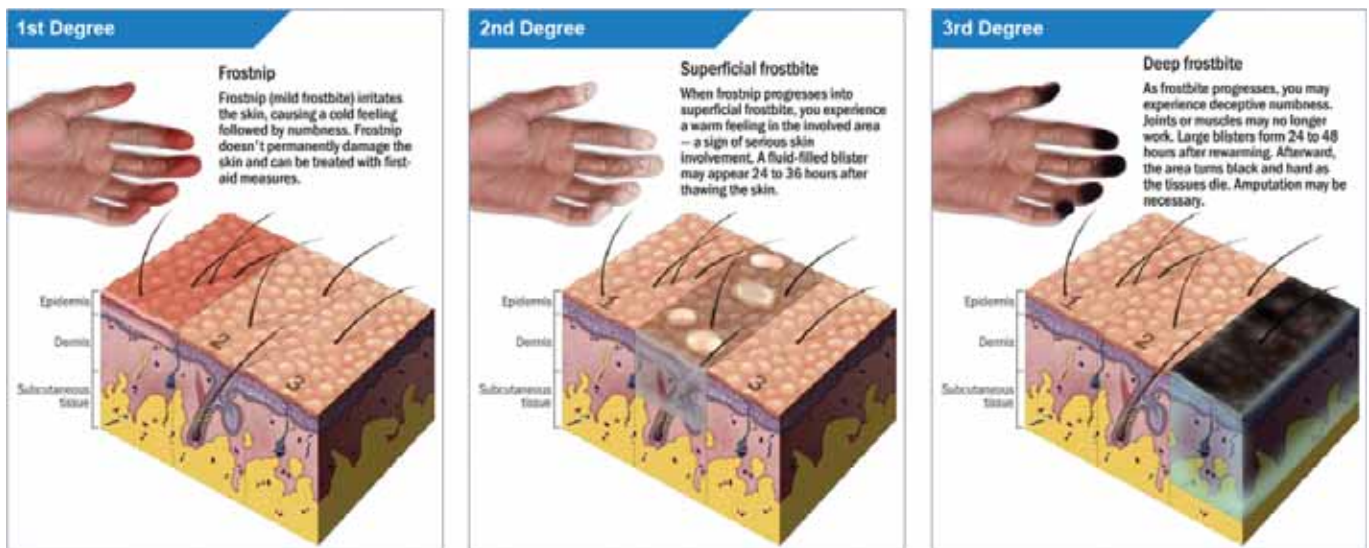


Figure 1: Three Degrees of Frostbite

injuries can affect the muscles, tendons, nerves, and bone. The worst cases involve prolonged exposure to the elements, a slow freeze, and an even slower re-warming process.

Frostbite should be treated in a medical facility. There, the affected area can be re-warmed with heated wet packs and a tub of 104 to 108°C degree water. Pain relievers can also be administered during this process. Once warmed, the affected area can be dressed and splinted. Sometimes blisters and infections require further topical treatment.

Even with proper treatment, it could take 1-3 months to recover. In some instances, the tissue damage is so severe that patients require debridement, skin grafting, or amputation. Some people report persistent issues, such as sensitivity to the cold, burning, tingling, pain, increased sweating, and arthritis.

Direct exposure of body tissues to refrigerant can cause frostbite. Liquid refrigerant suddenly released from high pressure to atmospheric pressure will flash and boil to vapor. Naturally, the temperature of the refrigerant will drop quickly to the boiling point and the refrigerant will quickly absorb heat from whatever it is touching. If the refrigerant is touching skin, it absorbs body heat from that area and causes local overcooling. This can cause frostbite.

Frostbite occurs when tissues freeze. This condition happens when you are

exposed to temperatures below the freezing point of skin. Hypothermia is the condition of developing an abnormally low body temperature. Frostbite and hypothermia are both cold-related emergencies.

In Frostbite, nose, cheeks, ears, fingers, and toes (body extremities) are most commonly affected. Everyone is susceptible, even people who have been living in cold climates for most of their lives.

### Risk Factors for Cold Weather Foot Injuries

Anyone can get a cold weather foot injury, but one may be particularly susceptible if the following risk factors apply:

**Poor circulation:** Conditions like diabetes, cardiovascular disease, and Raynaud's phenomenon make a person more susceptible to winter foot injuries with a greater propensity for blood vessel constriction and inadequate flow to the extremities. Diabetics often suffer from a type of nerve damage called peripheral neuropathy, which makes the feet feel numb.

**Alcohol & tobacco:** Alcohol impairs judgment and dilates the blood vessels to increase heat loss throughout the body, so it's no wonder that it's commonly associated with overexposure. Tobacco alters blood flow to the hands and feet especially.

**Inadequate clothing:** Proper winter weather clothing insulates the body from

cold, allows the evaporation of perspiration, and keeps out wind and wet. Wearing two pairs of socks is ideal — a moisture-wicking cotton blend closest to the skin and warm wool on the outside. Boots should cover the ankles and not be too tight.

**Nutrition:** Dehydration, low blood sugar, low body mass index, and poor nutrition can all affect the body's ability to regulate temperature.

**Moisture:** Excessive sweat or dampness significantly increases heat loss.

### People at greatest risk for frostbite and hypothermia include people:

- who spend a great deal of time outdoors, such as the homeless, hikers, hunters, etc.;
- under the influence of alcohol;
- who are elderly without adequate heating, food, and shelter;
- who are exhausted or excessively dehydrated;
- who are mentally ill.

### Frostbite Causes

The body works to stay alive first, and to stay functioning second. In conditions of prolonged cold exposure, the body sends signals to the blood vessels in arms and legs telling them to constrict (narrow). By slowing blood flow to the skin, the body is able to send more blood to the vital organs, supplying them with critical nutrients, while also preventing a further decrease in internal body temperature by exposing less blood to the outside cold.



Figure 2: Frostbite on Hands

As this process continues and the extremities (the parts farthest from the heart) become colder and colder, a condition called the hunter's response is initiated. The blood vessels are dilated (widened) for a period of time and then constricted again. Periods of dilatation are cycled with times of constriction in order to preserve as much function in the extremities as possible. However, when the brain senses that there is a danger of hypothermia (when the body temperature drops significantly below 98.6°F); it permanently constricts these blood vessels in order to prevent them from returning cold blood to the internal organs. When this happens, frostbite has begun.

Frostbite is caused by two different means: cell death at the time of exposure and further cell deterioration and death because of a lack of oxygen.

### Recognizing Frostbite Symptoms

Initially, ice crystals form in the space

outside of the cells. Water is lost from the cell's interior, and dehydration promotes the destruction of the cell.

In the second, the damaged lining of the blood vessels is the main culprit. As blood flow returns to the extremities upon rewarming, it finds that the blood vessels themselves are injured, also by the cold. Holes appear in vessel walls and blood leaks out into the tissues. Flow is impeded and turbulent and small clots form in the smallest vessels of the extremities. Because of these blood flow problems, complicated interactions occur, and inflammation causes further tissue damage. This injury is the primary determinant of the amount of tissue damage that occurs in the end.

It is rare for the inside of the cells themselves to be frozen. This phenomenon is only seen in very rapid freezing injuries, such as those produced by frozen metals.

### Preventing Frostbite and Other Cold

### Weather Foot Injuries

Frigid temperatures and overexposure to the cold can cause lasting foot problems with injury to the skin and soft tissue. Early signs and symptoms of a cold weather foot condition may include burning, tingling, or changes in skin colour, but often times, the foot simply goes numb—making it even harder to tell how much damage has been done. Cold weather injuries are even possible when temperatures are above freezing, especially when there are high winds or your socks are wet.

Feet and hands are particularly susceptible to frostbite because the body is busy working hard to keep the internal organs warm.

## COLD BURN

### What is Cold Burn?

Cold burn can be described as a kind of skin and tissue damage which happens



Figure 3: Frostbite on toes



Figure 4: Cold Burn on hand



Figure 5: Manifold Gauge set and hose connections



when the skin comes in contact with some extremely cold objects such as snow, dry ice, liquid nitrogen and helium. Blisters are visible and tendons, muscles, nerves and bones are in a potential danger. In some cases gangrene may occur, and the affected part of the body must be amputated. Feet, nose, ears and hand are most prone to frostbites but generally cold burns can be related to every part of the body. When we try to warm up the affected area, pain will follow and some burning or tingling sensation. Cold burns will affect anybody spending enough time in the cold, but diabetics, Raynaud phenomenon patients, or takers of beta-blockers are more prone to frostbites.

### Incidents of Cold Burns

#### Incident 1: Cold Burns during Training

In one of the training sessions, during the exercise of charging refrigerant, some of the liquid refrigerant droplets fell on the hand of the trainee technician. Immediately, there was a bubble formation underneath the skin, with onset of pain. Luckily, the cold burn injury was mild and the

technician recovered with a mild dose of pain killer and superficial ointment. Hence, there is the need for gloves when working on refrigerants and refrigeration equipment.

#### Incident 2: Cold Burns from Refrigerant hose connections

Very commonly, there is a chance of refrigerant in the form of liquid or vapour to come out of the system under pressure when the connections are being fitted or being removed. It is always recommended to have control over the hand operated valves. If the connecting pipes are not fitted properly, due to pressure, the connections may come off, ejecting refrigerant under pressure; pipeline itself moving about uncontrollable causing injuries to the personnel around. There are many different forms of connecting devices, the right adapters have to be used. We find that often people are struggling in making the connections.

#### Incident 3: Cold burns from Domestic Fridge System

The shipboard domestic refrigeration system – compressor was cutting in and

off frequently. There was trouble to maintain the cold room temperatures. Obviously, the Chief Engineer ran around and suspected that the refrigerant return line accumulator filter getting clogged. He instructed the 2/E and 3/E to isolate and clean the filter. The Chief Engineer did mention that he had closed all the valves and sucked the refrigerant from the system. Without cross checking valves or a check for pressure, the second and third engineers slackened the bolts of the accumulator filter.

To their surprise, there was a sudden explosion (minor explosion) and high-pressure refrigerant gushed out into the atmosphere where the place was restricted. The engineers received cold burns on their hands and shoulders, where the colour of their skin changed immediately. Fortunately, it was very minor and they had a protective eye goggles.

#### Incident 4: Refrigerant spray on hand

Source: MARS 201634

After provisioning the vegetable room at port, it was observed that the



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Figure 6: Cold Burn on fingers



Figure 7: Simulation of Refrigerant spray on hand

temperature did not drop to its normal operational range. The electrician was detailed to investigate and determine the problem. While he was inspecting the solenoid valve of the refrigeration gas lines using a wrench, refrigerant gas suddenly released and sprayed on his hand. At first, there was no pain and the electrician did not realize the damage done to his hand due to the cold gas. Soon however, a second degree burn with severe pain manifested.

The company investigation found, among other things, that there had been a failure to complete a permit to work. The permit to work was necessary due to the fact that work was to be done on a line presenting a hazard. This first failure probably contributed to a second dangerous act that of not wearing proper personal protective equipment (PPE), in this case gloves. Also, the normal lock-

out/tag-out procedure was not followed as the inlet and outlet valves were not closed prior to the work and pressure was maintained within the lines.

## Lessons learned

- PPE such as boots, gloves and glasses should be second nature in a truly safety conscious work environment.
- Permits to work are not just a paper exercise, but contain valuable checklists to help crew members stay safe.
- Consulting the Material Safety Data Sheet (MSDS) for the material to be worked on should become second nature.
- While every crew member is responsible for following procedures, safety leadership is also an important element in the system. In this case, both sides of the equation were less than adequate.

## Hypothermia

### What is Hypothermia?

Hypothermia is a condition in which core temperature drops below that required for normal metabolism and body functions which is defined as 35.0°C (95.0°F). Body temperature is usually maintained near a constant level of 36.5–37.5°C (98–100°F) through biologic homeostasis or thermoregulation. If exposed to cold and the internal mechanisms are unable to replenish the heat that is being lost a drop in core temperature occurs. As body temperature decreases characteristic symptoms occur such as shivering and mental confusion.

### Signs & Symptoms of Hypothermia

The signs and symptoms vary depending on the degree of hypothermia and may be divided by the three stages of severity.

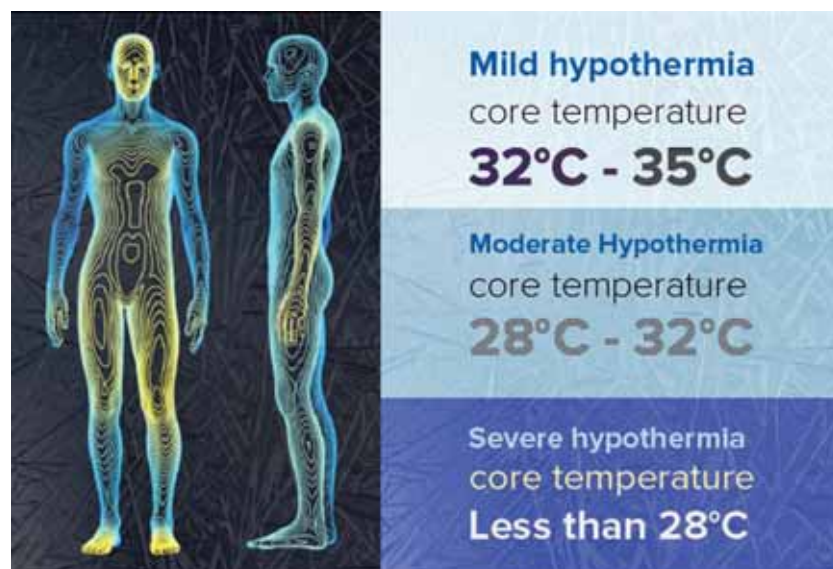


Figure 8: Stages of Hypothermia

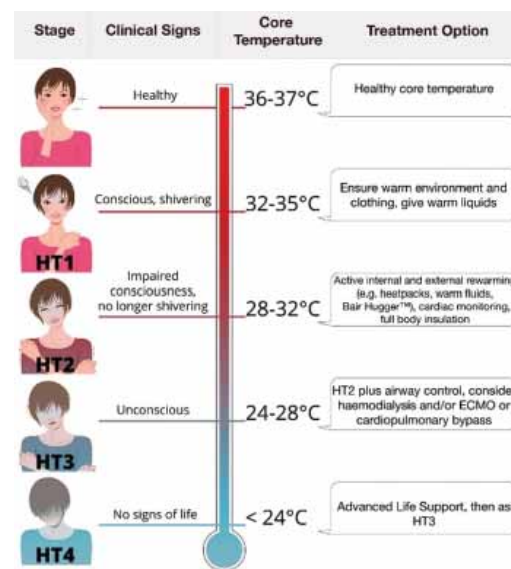


Figure 9: Progressive Phases of Hypothermia

**Mild**

Symptoms of mild hypothermia 32–35°C (90–95°F) are shivering, hypertension and tachycardia. These are all physiological responses to preserve heat. Mental confusion may also be present.

**Moderate**

Body temperature of 28–32°C (82–90°F) results in shivering becoming more violent. Muscle mis-coordination becomes apparent. Movements are slow and labored, accompanied by a stumbling pace and mild confusion, although the victim may appear alert. Surface blood vessels contract further as the body focuses its remaining resources on keeping the vital organs warm. The victim becomes pale. Lips, ears, fingers and toes may become blue.

**Severe**

Body temperature drops below approximately 28°C (82°F) shivering stops. Difficulty in speaking, sluggish thinking, and amnesia start to appear; inability to use hands and stumbling is also usually present. Cellular metabolic processes shut

down. Below 30°C (86°F), the exposed skin becomes blue and puffy, muscle coordination becomes very poor, walking becomes almost impossible, and the victim exhibits incoherent/irrational behavior including terminal burrowing or even a stupor. Pulse and respiration rates decrease significantly, but fast heart rates can occur. Major organs fail. Clinical death occurs. Because of decreased cellular activity in stage 3 hypothermia, the body will actually take longer to undergo brain death.

As the temperature decreases further physiological systems falter and heart rate, respiratory rate, and blood pressure all decreases. This results in an expected HR in the 30s with a temperature of 28°C (82°F).

**Skin Conditions**

A number of skin conditions may be associated with hypothermia or may occur with normal body temperature. These include: cryopedis and frostbite.

**Paradoxical Undressing**

Twenty to fifty percent of hypothermia deaths are associated with paradoxical

undressing. This typically occurs during moderate to severe hypothermia, as the person becomes disoriented, confused, and combative. They may begin discarding their clothing, which, in turn, increases the rate of heat loss. One explanation for the effect is a cold-induced malfunction of the hypothalamus, the part of the brain that regulates body temperature. Another explanation is that the muscles contracting peripheral blood vessels become exhausted (known as a loss of vasomotor tone) and relax, leading to a sudden surge of blood (and heat) to the extremities, fooling the person into feeling overheated.

**Terminal Burrowing**

In the final stages of hypothermia, the brain stem produces a burrowing-like behavior. Similar to hibernation behavior in animals, individuals with severe hypothermia are often found in small, enclosed spaces, such as under the bed or behind wardrobes.

**Causes of Hypothermia**

Hypothermia usually occurs from exposure to low temperatures and is

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frequently complicated by alcohol. Any condition which decreases heat production, increases heat loss, or impairs thermoregulation, however, may contribute. Thus, risk including: any condition that affects judgment (hypoglycemia), the extremes of age, male gender, poor clothing, chronic medical conditions (such as hypothyroidism and sepsis), substance abuse, homelessness, and living in a cold environment. It occurs frequently in major trauma.

### Alcohol

Alcohol consumption increases the risk of hypothermic via its action as a vasodilator. It increases blood flow to the body's extremities, making a person feel warm, while increasing heat loss. Between 33 to 73% of cases of hypothermia are complicated by alcohol.

### Water

Hypothermia continues to be a major limitation to diving in cold water. The limitation of finger dexterity due to pain or numbness decreases general safety and work capacity, which consequently increases the risk of other injuries. Pressurized heliox breathing mixtures have a much higher thermal mass than air, so for diving below 100 meters, not only is a hot water suit required, but the breathing mixture must be pre-heated, or the symptoms of hypothermia can set in without realization and cause death in minutes.

Other predisposing factors leading to immersion hypothermia include dehydration, inadequate rewarming with repetitive diving, starting while wearing cold, wet dry suit undergarments, sweating with work, inadequate thermal insulation (for example, thin dry suit undergarment), lack of heated breathing gas with deep heliox diving, and poor physical conditioning.

Heat is lost more quickly in water. Water temperatures that would be quite reasonable as outdoor air temperatures can lead to hypothermia. Water temperature of 10°C (50°F) often lead to death in one hour, and water temperatures hovering at freezing can lead to death in as little as 15 minutes. Water at a temperature of 26°C

(79°F) may after prolonged exposure lead to hypothermia

### Pathophysiology

Heat is primarily generated in the heart and liver while it is lost through the skin (90%) and lungs (10%). Heat production may be increased 2 to 4 fold through muscle contractions (i.e., exercise and shivering). Rates of heat loss can be affected by clothing and other environmental conditions.

### Prevention of Hypothermia

Appropriate clothing helps to prevent hypothermia. Synthetic and wool fabrics are superior to cotton as they provide better insulation when wet and dry more quickly. Some synthetic fabrics, such as polypropylene and polyester, are used in clothing designed to wick perspiration away from the body, such as liner socks and moisture-wicking undergarments.

### 50/50/50 rule

If someone is in 50°F water for 50 minutes, he/she has a 50 percent better chance of survival if wearing a life jacket. The heat escape lessening position can be used to increase survival in cold water.

## Miraculous Recoveries!

### Incident 1 - Feb 25th, 2001 –

#### Toddler comes back to life after she wandered outside in bone-numbing weather

In Edmonton, Canada, a doctor who helped bring a toddler back to life after she wandered outside in bone-numbing weather says there was a magical element to the girl's recovery. Dr Allan De Caen recalled how a medical team at the Stollery Children's Hospital went into action to revive the 13-month-old whose heart had stopped for two hours.

A toddler who wandered outside in her diaper in sub-zero weather and was found virtually frozen face down in the snow appears to have survived the ordeal without brain damage.

As the child arrived by ambulance, the team began setting up a heart and lung machine - to help warm her body. But before they could start running the machine, the baby's heart started beating on its own. The pediatric intensive care

specialist said "Sometimes it takes something beyond just the personnel and the equipment, I don't know whether you talk about it as a greater being or whatever your personal beliefs are, clearly something or someone was on this little girl's side."

She was looking around her hospital room and smiling. He said her frostbite injuries are extensive and it will take weeks or months before doctors know what the outcome of those will be. Her brain function appears to be normal, although it will require close monitoring as she grows up, he added.

No one knows how long she had been outside in the -20°C weather clad only in her diaper.

Her mother woke up about 3 a.m. Saturday and realized the girl was not in bed with her. She found the baby curled up in the snow in the backyard. The mom and little girl had slept that night at a friend's house. The child's toes were frozen together and her mouth was frozen shut. Her body temperature was 16°C instead of the body's normal temperature of 37°C.

### Incident 2 – 3 December 2014 - Toddler recovered in hospital after being found unconscious in freezing temperatures in Poland.

The two-year-old boy, named in reports as Adam, was discovered lying on the ground in the village of Raclawice, just north of Krakow. He was wearing only pajamas. Doctors said he had been brought out of a medically-induced coma and his health was improving. The boy's grandmother has said she did not see him leave her home. Police found the boy lying unconscious near a river, after apparently wandering outside several hours earlier. The area's temperature had fallen to -7°C (19°F) overnight. The boy's body temperature was 12°C (54°F) when he arrived at Krakow children's hospital, doctors said, and he was placed in an induced coma. He was blinking and moving his limbs but was still on a respirator, as per Janusz Skalski, a heart surgeon at the children's hospital in Krakow.

"We're very pleased with his condition... there are no negative



symptoms, he's improving.

Hypothermia expert Dr. Tomasz Darocha told that until now, the most dramatic case of recovery from hypothermia involved a Scandinavian woman whose body temperature had dropped to 13.7°C.

## Cold Shock

### What is Cold Shock?

Often Cold shock is presented as an afterthought in a discussion on Hypothermia. Actually, Cold Shock occurs before the onset of Hypothermia. It can cause death of a person instantly before hypothermia has a chance to set in. Cold Shock is more immediate. Cold Shock is normally associated with frigid waters; however, a person can also undergo cold shock due to sudden changes in ambient temperatures.

It is almost instantaneous reaction of the body to immersion in cold water. A variety of symptoms can cause immediate incapacitation or even death. Risk and symptoms of Cold Shock start manifesting

when water temperatures are close to 55°F and increase as water temperatures go down. Air temperatures are not relevant. Sudden immersion at these water temperatures can cause uncontrolled gasping which if the head is under water at that time, will lead to nearly instant drowning. This is one reason why kayakers have been found upside down, seemingly never even attempting to roll or wet exit. Cold shock can also play havoc with breathing even if head is above water. It can cause hyperventilation, which can lead to panic and a condition called Alkalosis which can cause confusion, dizziness and possible loss of consciousness before actual hypothermia begins to set in. Some people experience breathlessness or inability to breathe. From here, dizziness, panic and an overwhelming sense of claustrophobia can take hold causing hyperventilation once again. Cold Shock can kill you instantly or slow you down and put you into a state where you will be making bad decisions long before the onset of

hypothermia.

In many maritime disasters, like Titanic, Herald of Free Enterprise and Oceans capsizing accidents, many instantaneous deaths occurred due to cold shock due to the sudden exposure to cold water. Prolonged exposure to cold water caused hypothermia and took toll of many persons. Persons exposed to sub-zero temperatures when carrying frozen cargo can also suffer from cold shock, especially, when it is the first time. By experience, one gets used and is prepared suitably both physically and mentally. It will be a good idea to have a buffer chamber from accommodation to the freezing chambers to prevent sudden change in ambient temperature.

### Conditioning against Cold Shock

It is possible to undergo physiological conditioning to reduce the cold shock response, and some people are naturally better suited to swimming in very cold water. Adaptations include the following:

- Having an insulating layer of body fat covering the limbs and torso without

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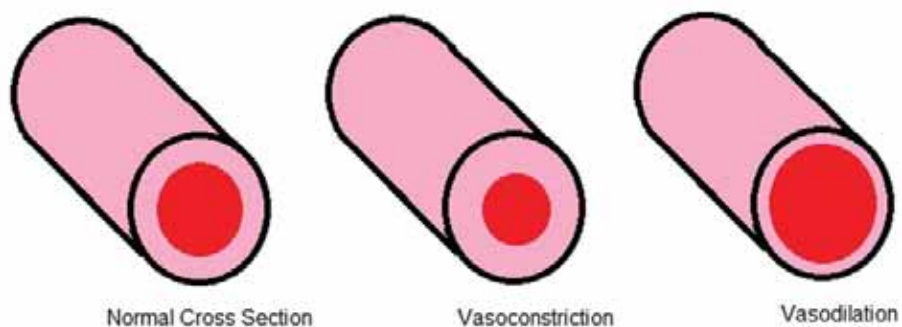
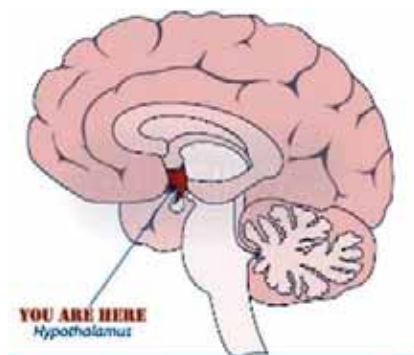


Figure 10: Hypothalamus in Human Brain

- being overweight;
- Ability to experience immersion without involuntary physical shock or mental panic;
- Ability to resist shivering;
- Ability to raise metabolism (and, in some cases, increase blood temperature slightly above the normal level
- Generalised delaying of metabolic shutdown (including slipping into unconsciousness) as central and peripheral body temperatures fall

In these ways, winter swimmers can survive both the initial shock and prolonged exposure. Nevertheless, the human organism is not suited to freezing water: the struggle to maintain blood temperature (by swimming or conditioned metabolic response) produces great fatigue after thirty minutes or less.

### Effect of Sudden Change in Temperature

Sudden change in temperature from extreme hot to cold can have a serious effect on people who have a history of cold-related disorders. Doctors say managers of malls, offices, public buildings, mosques and even hospitals, which sometimes record temperatures as low as 19°C, have a responsibility to ensure that the inside of their establishments is not unhealthy.

The body undergoes a certain amount of stress when it is forced to go from a boiling hot environment into an air conditioned one. It dries off your skin, the mucus membrane and the eyes. We see patients who say they went to the malls or their offices and it was extremely cold. Eye infections, respiratory infections and

muscular spasms are caused by this change in temperature.

The recommended temperature should be between 23°C and 25°C to prevent susceptibility to ailments. The change in temperature can exacerbate coronary heart diseases, vascular cardiac, vascular brain diseases and peripheral vascular [artery and vein] diseases.

Whenever, anybody has to enter an air-conditioned space from outside hot weather, to prevent cold shock from occurring, the person should pass through one or more series of chambers with progressively reducing temperatures. Similarly, drinking cold water immediately after coming from an outside hot atmosphere should be avoided. Warm water or water at room temperature is recommended.

It is also recommended during bathing not to expose the head portion of the body to the stream of cold water first. The temperature change should occur gradually from feet upwards. There have been cases of heart attacks and brain hemorrhages attributed to the sudden change of temperature of heart and brain from hot to cold.

### Why Cold Shock Occurs?

The human body does not adapt to sudden changes in temperature. It likes to keep the temperature within very narrow limits. The hypothalamus is a portion of the brain that contains a number of small nuclei with a variety of functions. One of the most important functions of the hypothalamus is to link the nervous system to the endocrine system via the pituitary gland (hypophysis).

The hypothalamus is located below the

thalamus and is part of the limbic system. In the terminology of neuroanatomy, it forms the ventral part of the diencephalon. All vertebrate brains contain a hypothalamus. In humans, it is the size of an almond.

The hypothalamus is responsible for the regulation of certain metabolic processes and other activities of the autonomic nervous system. It synthesizes and secretes certain neurohormones, called releasing hormones or hypothalamic hormones, and these in turn stimulate or inhibit the secretion of pituitary hormones. The hypothalamus controls body temperature, hunger, important aspects of parenting and attachment behaviors, thirst, fatigue, sleep, and circadian rhythms.

In response to the temperature changes, the hypothalamus stimulates vasoconstriction or vasodilation. Vasodilation occurs when there is increase in temperature to send blood to the skin to cool off before returning to the essential organs like brain, heart, lungs etc. to prevent overheating. Vasoconstriction occurs when there is decrease in temperature to prevent cooling off and keeping the warm blood around the essential organs like brain, heart, lungs etc. to prevent overcooling. When people enter hot areas, the body attempts to adapt to the new temperature quickly and vasodilates quickly. The rapid vasodilation causes rapid drop in blood pressure and there is a chance that a person may faint. When a person enters a cold area, sudden chilling causes vasoconstriction. This can cause increased blood pressure followed by pain and heart attack and brain hemorrhages.

### What causes cold-water shock?

Cold water shock is the first stage of the sudden and unexpected immersion in water which temperature is of 15°C or lower and occurs during the first minute of exposure. Cold-water shock likely causes more deaths than hypothermia. Canada's substantially cold waters are especially dangerous when you fall into them unexpectedly.

### Cold Water Shock Symptoms

The reactions of the body may be muscle spasms and hyperventilation. Other symptoms may be an increase of

the pulse and blood pressure. Sudden immersion into cold water may cause cardiac arrest, even for a healthy person. The shock of the cold water can also cause an involuntary gasp reflex that can cause victims to swallow water and drown, even for a good swimmer. Cold water can paralyze the muscles instantly.

### Cold water shock treatments

If you are wearing a lifejacket before falling into cold water, it will keep you afloat while you gain control of your breathing and prevent drowning from loss

of muscle control. Trying to grab a lifejacket while in the water, let alone putting one on, will be very hard because of the changes your body will be experiencing. People in cold-water shock should try not to panic and try to control their breathing. ■

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# CFD in Air Conditioning

Computational Fluid Dynamics (CFD) techniques are mathematical tools to solve fluid flow equations. Air conditioning involves air flows and heat transfer, so, CFD is useful. Also, HVAC is an energy intensive process. Improvements based on CFD can save cost...



Picture Source: commons.wikimedia

**M**alls, airport terminals, hotels etc require comfortable air conditioned spaces. Warehouses storing perishable goods need controlled cooling system. Electronic manufacturing processes require controlled humidity and airborne particle counts. ICUs require quick and effective removal of microbial contaminants. Pharmaceutical laboratories have to adhere to stricter norms for facility

in drug preparation. High load density data-centres can perform at full capacity if requisite dry bulb temperature and humidity are maintained. Industrial air conditioned spaces could be enormous in size and precise conditions have to be maintained. In both, comfort or precision cooling, standards based empirical correlations are not very reliable. It could lead to over design or under design of

HVAC systems. A better method would be validating cooling parameters with help of computational fluid dynamics (CFD). CFD techniques are mathematical tools to solve fluid flow equations. Air conditioning involves air flows and heat transfer, so, CFD is useful. Also, HVAC is an energy intensive process. Improvements based on CFD can save cost.

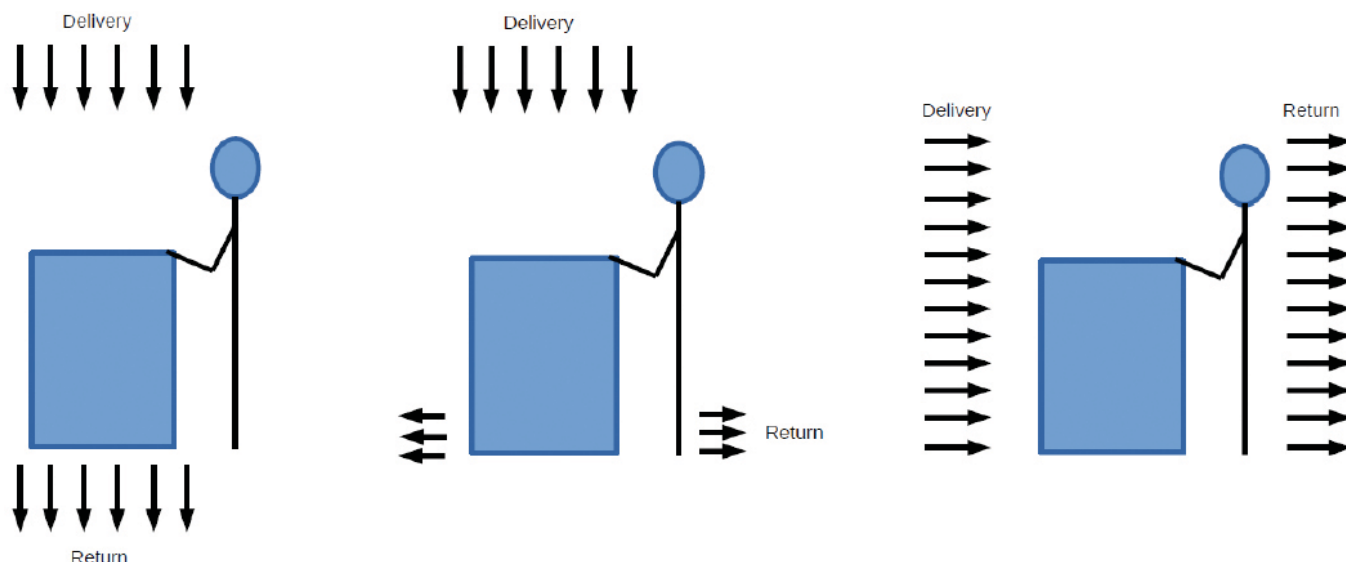


Figure 1: Air flow in clean rooms

## Stages in CFD

CFD involves three stages in sequence: Pre-processing, Processing, Post-processing. Pre-processing, involves preparation of a 3D model of the air domain of conditioned space. So, a CFD domain, as an example in a clean room, will be room volume from which the workstations, machines, humans etc. all solid object will be cut out. Those solid object walls are going to affect fluid motion inside the room. Hence, no slip boundary conditions are provided to first layer of fluid near the wall. Afterwards, it has to be divided into smaller volumes. These small volumes are control volumes of fluid and are called cells. The cells represent fluid, where properties of flow/ fluid can be assumed to be not varying. This assumption known as continuum is necessary for solving fluid flow equations. A single equation of fluid motion cannot solve entire domain under consideration. This is for the reason, pressure, velocity; concentration, temperature etc. vary inside a flow. Conservation laws cannot predict properties at different locations inside a flow domain, unless domain is split into several control volumes. The splitted volume of fluid is called a 'mesh'. It can be said, a computational mesh consists of a number of cells. The mesh is the outcome of a pre-processing stage.

Second stage is processing. The processing stage is where equations of

fluid flows are solved. Fluid equations are based on conservation laws. The fluid flow equations are partial differential equations, which require boundary conditions to get solved. Boundary conditions are provided for inlets, outlets, walls, contamination and energy sources. Third stage is the post-processing stage. This corresponds to generating plots so that quality of air flow, temperature patterns, and concentration level of particles can be visualized.

## Paradigms in CFD

Fluid flow equations change with physics involved in a problem. A steady, laminar, incompressible, in viscous flow is one of the simplest analysis that can be obtained using CFD. Each simplification eliminates variables from governing equations of fluid flows. An unsteady

problem includes time. So, a flow that varies in time is solved. Similarly, a turbulent flow needs to evaluate the turbulent quantities; those are responsible in generating fluctuations in flows. In a compressible flow, density is treated to be a variable. Finally, viscous flow is realistic. An inviscid assumption will not predict flows in a real life scenario. Apart from this basic variation in flows, there can be additional complexities, like multiple phases in a fluid flow. In precision air conditioning, to find the humidity in air, moisture can be treated as a dispersed phase in air. In a clean room application, particle clouds are to be introduced to track, how the concentration of particles can vary with time. In comfort air conditioning, dry bulb temperature,

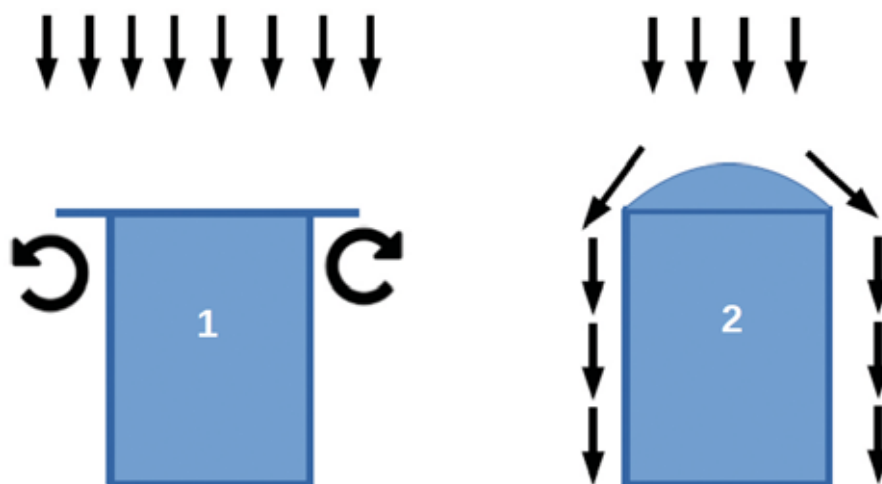


Figure 2: Flow around workstation

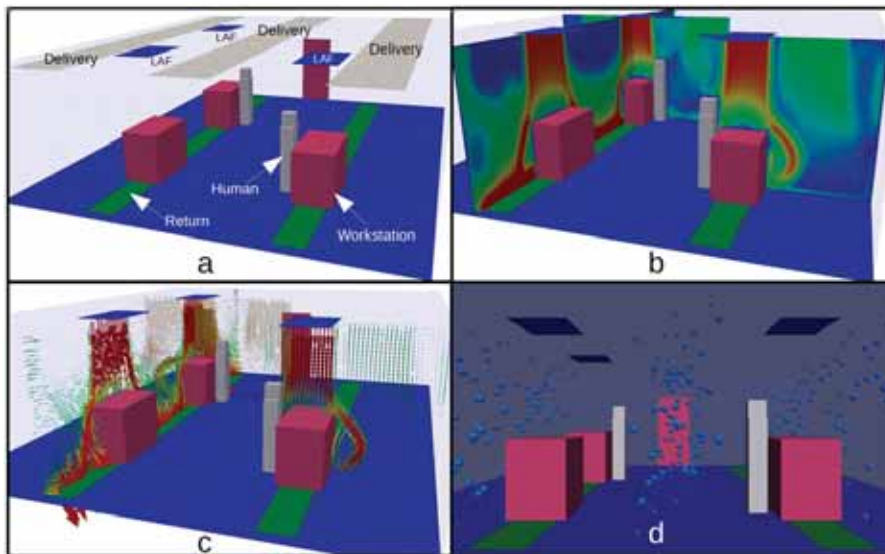


Figure 3: CFD in a clean room

unidirectional air flows, avoidance of recirculation zones, protecting human from process generated contaminants, pressure difference between different classified zones and maintaining desired air changes per hour are key criteria. All of those criteria can be established in a computational environment during layout stage. The computational techniques, mimic real life circumstances are in terms of equations and boundary conditions. The equations, derived from various conservation principles (mass, momentum and energy), are solved using computational techniques. Computational fluid dynamics (CFD) are the techniques, those are utilized to simplify and solve governing equations of phenomena related to the fluid flows. CFD increases the flaw predictions of any new design and suitable remedies can be taken care of.

## Contamination due to Airborne Particles

In a biological test lab, collected samples should not be affected by presence of virus or bacteria present in surrounding. Similarly, dust particles can affect manufacturing of electronic

duration for which air particles stay inside a room can be figured out. There are possibilities of fire in an air-conditioned space. The fire generation and propagations can be modelled mathematically using CFD. In a fire scenario, effectiveness of smoke extraction system, variation of smoke concentration can be modelled.

The governing fluid flow equations are formulated with mathematical approximations. Average behaviour of fluid flow is captured using Reynolds's averaging techniques (RANS). Several other approaches like, Large Eddy Simulations (LES) and Direct Numerical Simulations (DNS) can capture fluid flows much accurately. Due to high time and cost, LES and DNS techniques are more relevant in research context.

After formulation of fluid flow equations, those have to be solved. The flow equations are non-linear partial differential equations. So analytically solving those equations are not possible, till now. Approximate solutions are obtained by employing numerical techniques. Finite difference methods (FDM), finite volume methods (FVM) and finite element methods (FEM) are some of the popular numerical techniques in use. Proceeding from here, we will apply CFD techniques in biological laboratories and in a data-centre.

## Clean Room Applications

Clean spaces are mostly required for

pharmaceutical laboratories, biological test labs, ICUs of hospitals, electronic as well as high precision equipment manufacturers and research laboratories. Those are designed so that contaminations can be avoided, where contamination refers to undesirable mass or energy. The clean rooms are classified based on number of particles present per unit volume of the conditioned space. Among various design aspects of a clean room,

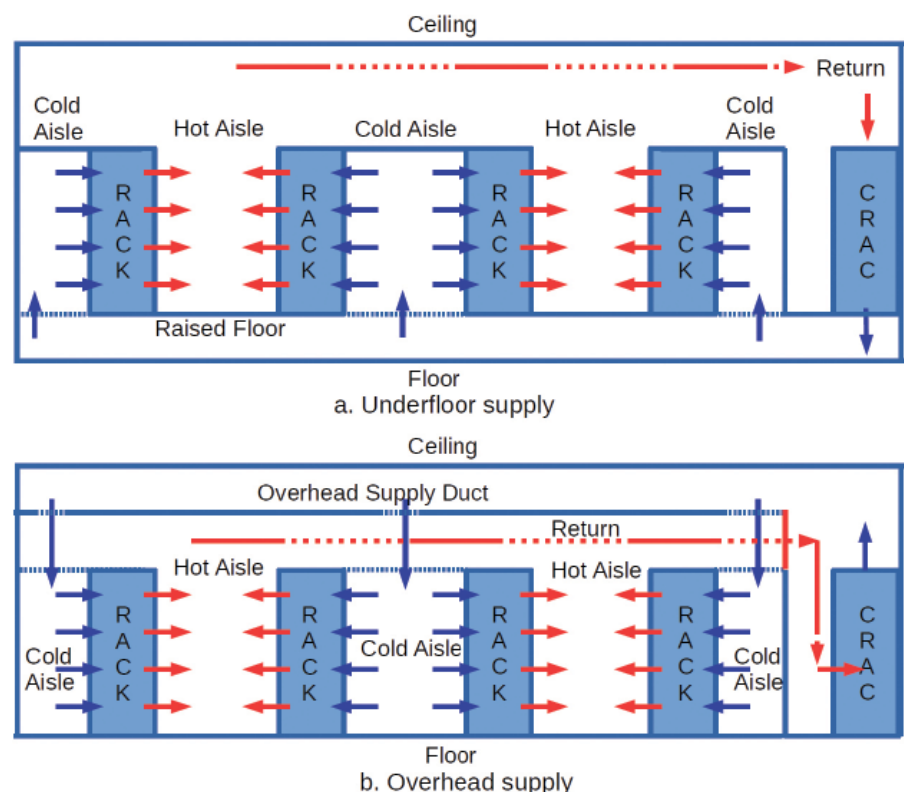


Figure 4: Under floor and overhead supplies in data centre



components. Light, heat and vibration sources may also affect manufacturing process and test conditions. So, all those undesirable elements are contaminations. Dust and microbial contaminations, those are airborne can be avoided by different filtration techniques such as, HEPA (High efficiency particulate absorber) and ULPA (Ultra low penetration air). The false ceiling can have 100 percent HEPA coverage as and when higher class of cleanliness is required. A computational fluid dynamics study can inject particle clouds and it can predict the path traced by particle over time. Those studies are helpful in deciding directions of delivery.

### Air Flow Patterns Clean Room

Clean rooms are designed to have air flow patterns, so that the substance under preparation is not contaminated. Three different types of air flow pattern are shown in figure 1.

The workstations in a clean room can be specially designed to avoid circulation. Presence of circulation zones in a flow

affects air changes in room. A portion of air remains for a longer duration. In workstation-1 in figure-2, probability of microbial growth and deposition of particles under the table top is high.

A computational study of clean room can reveal all such flows, which are not a good design indicator and can be modified. The second workstation is better in flow perspective.

### CFD study of a Biological Laboratory

A 1000 ft<sup>2</sup> is considered for illustration as shown in figure-3. Three workstations are present and two workstations are functional at an instance. Two humans are working at two different stations. Over the entire workspaces laminar air-flow unit with 100 percent HEPA filtration is considered. The workstations are provided air at a rate of 750 cfm. At this rate a total of 2250 cfm is supplied to all three workspaces. Workspaces are ISO class 5 clean zones. Background of workspaces is ISO class 6 clean zones. Class 6 zones are

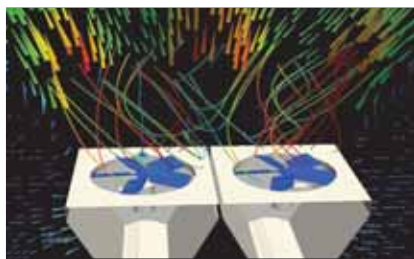
having HEPA coverage of 30%. The total of 8250 cfm is provided to the ISO class 6 zone based on ASHRAE recommendations.

The sub-figure a is layout of the clean room, with 3 workstations, 3 laminar-air-flow units and 2 humans working. Sub-figure b shows the velocity variation and flow pattern near workstations. The sub-figure c, shows direction of velocities and sub-figure d shows vertical downward particle flows. Additionally, from b and c, air circulation zones near the workstations are prominently visible. Flow from class 6 zone is not entering class 5 zone. Hence, the clean room layout is working fine.

### Data Centre Applications

CFD has vast applications to estimate the thermal energy distribution inside a data centre. Data centres are high density load applications with less negligible down time. ASHRAE has recommendations related to temperature and humidity in data centres. Single rack is normally has a 30 kW load. Temperature and humidity are both critical in those applications. Dry bulb

## HVAC System Design and Analysis



### CFD Analysis

Fluid Flow &  
Heat Transfer Analysis  
Chiller Unit Analysis  
Precision Air Conditioning  
System Optimization

### HVAC

Clean Room Applications  
Data Center  
Industrial HVAC Systems  
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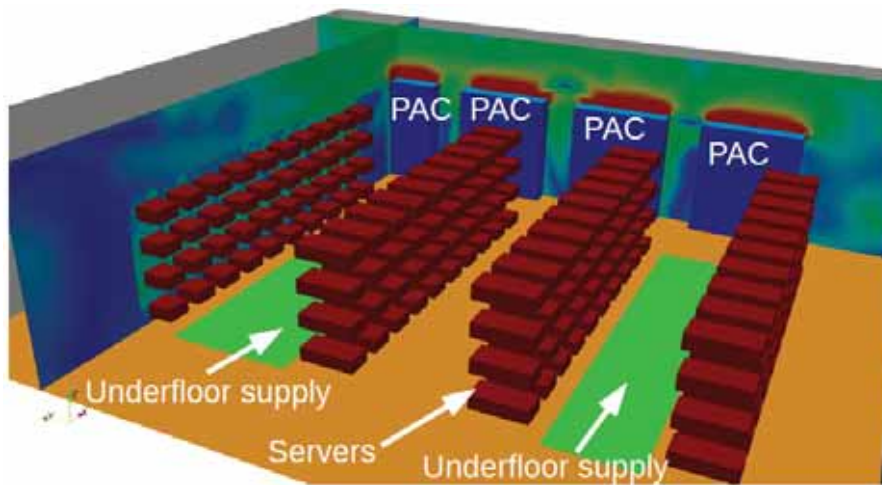


Figure 5: Velocity contours in a data centre

temperature should be below 27°C and relative humidity levels should be below 55%. Similarly, lower level dry bulb temperature limit is 18°C and relative humidity is 45%. Prediction of non-dimensional quantities such as Rack Cooling Index (RCI), Return Heat Index (RHI) and Supply Heat Index (SHI) can be done with CFD. Results from CFD analysis are helpful in deciding about supplementary cooling requirements, analyzing effectiveness of selected fans.

### Air Flow Patterns in a Data Centre

Hot and cold aisle principle is applied for proper air distribution, refer figure-4. Air flow in racks can be in front-to-rear and front-to-top configuration. Suitable racks result in better energy efficiency. Front to

rear is the common arrangement in racks, as it makes the layout ready for hot and cold aisle principles. Several other arrangements allow sideways path for air flow. Fan present in racks can enhance the convection heat transfer, resulting in better cooling. Both under floor and overhead supply are used. Two different arrangements are mostly followed. One is a under floor supply from precision air conditioning unit, so supply will be from a raised floor, as shown in figure-4a. Second is an overhead supply. Overhead supply requires additional ducting work. The return air is taken back to PAC with the help of a return air plenum. Humidity control in data-centres is based on dew-point. Humidification and dehumidification can be operated separately by taking advantage of a central dehumidification.

### CFD Study of a Data-Centre

A server room of area 1300 sq ft is taken for the study as shown in figure-5. Layout is an alternate hot and cold aisle arrangement. Each server rack is 5kW per rack. There are four rows of server racks. Four precision air conditioning (PAC) units each of cooling capacity of 53 kW. The PACs are operating in down-flow configuration. The raised floor is fitted with activated tiles. At steady state observed velocity and temperature patterns can be seen in following images.

Figure-5 shows the velocity contours at two different planes. Red colour corresponds to higher and blue to lower velocities. Return flow over the precision air conditioning units have high velocities. Figure 6, shows the vector, scaled to their magnitudes. Sub figure 6a clearly showing the hot and cold aisle flows. Sub figure 6b shows, the return flow velocity is increasing near the PAC.

### Conclusions

User industries of HVAC globally are immensely benefited with the evolving CFD methods. Green building ratings can be better with an accurate CFD analysis. Food processing, hospitals and pharmaceutical industries can achieve cleanliness with prior knowledge of design flaws. Data centre can have a better energy star. CFD is not limited to the applications in present article. Equipment manufacturers can use CFD for better performance of their products. Innovative products and services, taking care of environmental needs will lead the HVAC industry. ■

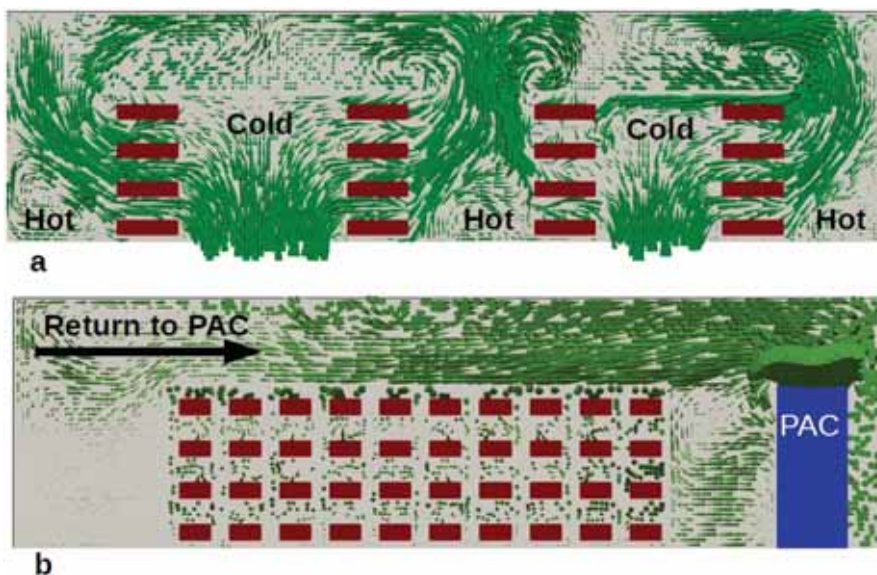


Figure 6: Velocity vectors: a) Hot and Cold Aisle. b) Return flow to PAC

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# Danfoss JV Targets Supermarket Control

Supermarket operators can use the integrated solution developed by the planned joint venture to sustainably reduce their operating expenditure and optimize their carbon footprint. Becoming a key component of the flexible energy system of the future can generate new sources of revenue for the supermarket. The first pilot project will begin shortly.

The future of the energy system depends on whether we develop solutions that provide flexibility to efficiently integrate renewable energy sources. Intelligent building technology is the key to success. The joint venture planned by SMA and Danfoss aims to provide supermarket operators with an integrated solution that interconnects cooling and refrigeration technology, photovoltaics, energy storage technology and e-mobility. Intelligently managing loads and integrating the overall system into the energy market allows supermarket operators to reduce their operating expenditure, optimize their carbon footprint and considerably improve their long-term competitiveness. In addition, they will become a key component of the energy system of the future. "Our expertise in photovoltaics, battery-storage systems and energy management is a complementary fit with Danfoss' long-standing experience in cooling and refrigeration technology and its access to customers in the food retail segment," said Dr.-Ing. Jürgen Reinert, Board Member for Operations and Technology

of SMA Solar Technology AG. "I am delighted that this planned joint venture will allow us to further expand our strategic partnership with Danfoss."

"The food retail segment is both of strategic importance and a playing field for innovation," said Jürgen Fischer, President of Danfoss Cooling. "Innovative products from cooling and heating technology combined with photovoltaics, energy storage and charging stations will be used in the supermarket of the future. Supermarkets will not only provide fresh goods, but also transform the utility grid, which will become more reliable, greener and more flexible. Danfoss and SMA are very well positioned to tap into this new market. As part of this planned joint venture, headquartered in Hamburg, Germany, we will work together to develop our tried-and-tested technology and secure ourselves a leading market position in this segment."

SMA's newly founded subsidiary, Coneva GmbH, will cooperate with Danfoss' Cooling Segment to design a service offering tailored to the individual requirements of the food retail segment. "The SMA energy management platform ennexOS is an ideal tool for optimizing the energy consumption of retailers using parameters like the current electricity prices, outside temperature, solar irradiation and temporary grid requirements," explained Jochen Schneider, general manager of Coneva GmbH. ■

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# CO<sub>2</sub> Monitoring

More recent studies have shown that the costs for remedying problems arising from an unfavourable indoor climate are often higher for the employer, the building owner and society than the energy costs of the affected (sick) building. It has also been proven that a suitable indoor climate quality can improve total performance at work and study, while lowering absentee rates...

## CO<sub>2</sub> Formation and Effect on Human Health

Carbon dioxide is a colourless and odourless gas. It is a natural component of ambient air, at a concentration of around 400 ppm (parts per million). At concentrations higher than 1000 ppm, significant negative effects on the general well-being can occur (headaches, fatigue, lack of concentration). Increased CO<sub>2</sub> concentrations in inhaled air increase the breathing frequency and the tidal volume. During this process, CO<sub>2</sub> has a dilatory effect on the bronchia, which causes an increase in the dead space volume.

Effect of Different CO<sub>2</sub> Concentrations

Concentration	Effect
350 to 450 ppm	Typical atmospheric concentration
600 to 800 ppm	Reliable indoor air quality
1000 ppm	Upper range of reliable indoor air quality
5000 ppm	Maximum workplace concentration over 8 hours
6000 to 30 000 ppm	Critical, only short-term exposure
3 to 8 %	Increased breathing frequency, headaches

> 10 %	Nausea, vomiting, loss of consciousness
> 20 %	Rapid loss of consciousness, death

## CO<sub>2</sub> in Indoor Air

- **Case 1:** A rapid increase of CO<sub>2</sub> concentration in the indoor air is the typical consequence of the presence of many persons in relatively small spaces (e.g. assembly, conference or schoolrooms) with a low air exchange rate. Critical CO<sub>2</sub> concentrations generally occur together with other air contamination factors, particularly, odorous substances from sweat or cosmetics, as well as microorganisms.
- **Case 2:** In airtight constructions with their very low air exchange rates, the CO<sub>2</sub> concentration can increase even in the presence of only a few people (e.g. in apartments or offices).

In both cases, the CO<sub>2</sub> has a direct influence on how comfortable people feel in a room. As per the model calculation by European Collaborative Action (ECA), the levels of dissatisfaction can be stated as; From 1000 ppm, around 20% of room users can already be expected to be dissatisfied, rising to approximately 36 % at 2000 ppm.

## Other Parameters Related to Indoor Air Quality

- **External air volume flow:** The outer air volume flow or ventilation rate describes the volume of the flow (in l/s or m<sup>3</sup>/h) of external air into a room or a building, either through the ventilation system or by infiltration through the building shell. For rooms, which are intended for human presence, the required external air volume flows are stated with reference to people, i.e. l/s per person or m<sup>3</sup>/h per person. The air exchange rate (n in 1/h) is the quotient from the air input volume flow in m<sup>3</sup>/h and the room volume in m<sup>3</sup>.
- **Ventilation rate:** An indoor climate is perceived to be comfortable when the temperature is between 20 and 23 °C and the air humidity between 30 and 70 % RH. However, a maximum of 50 % RH is recommended for those allergic to house dust mites. Occasional



Testo-440 - CO level measurement with Bluetooth probe





Testo-160-IAQ - Classroom



Testo-160-IAQ - Meeting Room

checks using an officially calibrated hygrometer are to be recommended in this case. Air flows in rooms should not exceed values of 0.16 m/s (in winter) and 0.25 m/s (in summer), depending on the season.

- **Hygienic Evaluation:** The hygienic levels depend entirely on CO<sub>2</sub> level in indoor air.
  - Concentrations of CO<sub>2</sub> under 1000 ppm – Hygienically uncritical
  - Concentrations of CO<sub>2</sub> for 1000 to 2000 ppm – Hygienically critical
  - Concentrations of CO<sub>2</sub> over 2000 ppm – Hygienically unacceptable

An interesting consequence that has developed due to this Indoor air quality is referred to as Sick Building Syndrome (SBS). It can be read in two ways; On the one hand, it refers to buildings which make their inhabitants sick as they work, and on the other hand, the buildings themselves are described as “sick”. The cause of sick building syndrome is usually air conditioning or insufficient air hygiene in buildings. There is a broad spectrum of symptoms, including the following: Irritations of the eyes, nose and throat; a perception that the mucus membranes and the skin are drying out; mental fatigue; frequent respiratory infections and coughing; hoarseness, shortness of breath, itching and non-specific hypersensitivity.

### Guidelines for CO<sub>2</sub> Content in Indoor Air

Globally, in several countries there are no comprehensive legally binding regulations for quality requirements regarding indoor air. Instead, many evaluation values do exist that define and limit the CO<sub>2</sub> amount in the indoor air. Many countries have even published guidelines and recommendations for the ventilation of buildings, including schools, which include stipulations for the limitation of CO<sub>2</sub> concentrations in indoor air.

### CO<sub>2</sub> Measurement Technology – A Testo Touch

There are three possibilities available for the measurement and monitoring of carbon dioxide in indoor rooms:

1. CO<sub>2</sub> measuring instruments (e.g. testo 535):  
Portable and suitable for long term measurements, they

measure the CO<sub>2</sub> content quickly and precisely. It comes with a permanently attached sensor and is designed specifically for measurement of CO<sub>2</sub> and optimising the ambient air.

#### 2. CO<sub>2</sub> data loggers (testo 160 IAQ)

If there are a lot of people in a room, the air quality deteriorates. Reliable monitoring is particularly important, because indoor air quality is linked to our well-being. The WiFi data logger testo 160 IAQ is ideal for monitoring indoor air quality in facility management. It measures temperature and humidity without interruption, in addition to CO<sub>2</sub>. Measurement values are transmitted by wireless LAN to testo Cloud, allowing alarm notifications of limit value violations by e-mail or SMS. The easily visible air quality traffic light also ensures that the responsible people see the indoor air quality status at a glance. It comes with optional, customizable deco-cover that blends in perfectly with the surroundings.

#### 3. Air velocity and IAQ measuring instruments (e.g. testo 440)

These indoor air quality measuring instruments allows you to carry out all the measurements that are necessary to check and adjust ventilation and air-conditioning systems and assess the indoor air quality. In addition to CO<sub>2</sub>, they measure all other ventilation and air conditioning parameters such as air flow velocity, temperature, humidity, turbulence level, CO or lux. these air velocity and IAQ measuring instrument can be expanded with a large portfolio of digital probes.

The best feature for testo 440 is that it is cable free and Bluetooth enabled.

### Recommendations

More recent studies have shown that the costs for remedying problems arising from an unfavourable indoor climate are often higher for the employer, the building owner and society than the energy costs of the affected (Sick) building. It has also been proven that a suitable indoor climate quality can improve total performance at work and study, while lowering absentee rates. Testo provides you with the best solutions and products that measure the necessary parameters and also ensure health and productivity. ■

(Courtesy: Testo India Pvt. Ltd. For more info: write to [info@testo.in](mailto:info@testo.in) or visit [www.testo.com](http://www.testo.com))

# Cooling Mechanism in Solar Inverter

Inverter modules generate heat and usually require a cooling mechanism. For low power solar inverters, providing a cooling air flow around heat-producing elements of the inverter module is sufficient. Higher power solar inverters require more sophisticated cooling. One known solution is liquid cooling...



**I**nverters are the devices usually solid state, which change the array DC output to AC of suitable voltage, frequency, and phase to feed photovoltaically generated power into the power grid or local load. These functional blocks are sometimes referred to as power conditioning. The current can be used in

two modes: (1) as an inverter changing DC to AC or (2) as a rectifier changing AC to DC, thus, charging the battery. Solar power inverters have special functions adapted for use with photovoltaic arrays, including maximum power point tracking and anti-islanding protection.

Solar inverters may be classified into

three broad types:

1. Stand-alone inverters: These are used in isolated systems, where the inverter draws its DC energy from batteries charged by photovoltaic arrays.
2. Grid-tie inverters: These are designed to shut down automatically upon loss of utility supply, for safety reasons.



3. **Battery backup inverter:** These are special inverters which are designed to draw energy from a battery, manage the battery charge via an onboard charger, and export excess energy to the utility grid.

Solar micro-inverter is an inverter designed to operate with a single PV module. Its design allows parallel connection of multiple, independent units in a modular way. Micro-inverter advantages include single panel power optimization, independent operation of each panel, plug-and-play installation, improved installation and fire safety, minimized costs with system design and stock minimization.

Few industries has introduced central solar inverters in sizes 1MW, 1.5MW and 2.0 MW with advanced water-cooled technology and high performance even with temperatures exceeding 50 plus degrees. This product is especially designed to suit harsh, humid and dusty conditions that prevail in the Indian subcontinent.

### Water Cooled System is Better

- The IGBT stacks can operate up to 50+ °C ambient temperature without de-rating at full power.
- A very unique mechanism i.e. the water part and electrical part are physically separated, which keeps the area neat and tidy.
- The water cooled system requires zero maintenance and the water doesn't need replacing, therefore, a supply of

water at site is not required.

- The water cooled system creates uniform cooling of the IGBTs, which improves the life of the IGBTs and in turn the life of the solar inverter.
- No addition air conditioning required.

The standard elements are: a DC (input) module, an inverter module and an AC (output) module. The DC module includes a number of photovoltaic cells that provide a direct current (DC) input to the inverter. The inverter module uses a number of electronic switches, typically, insulated gate bipolar transistors (IGBTs), to convert the DC input into an alternating current (AC) output. For inverters, providing electric power to an electricity grid, the AC module provides the AC output in a format suitable for the electricity grid. Inverter modules generate heat and usually require a cooling mechanism. For low power solar inverters, providing a cooling air flow around heat-producing elements of the inverter module is sufficient. Higher power solar inverters require more sophisticated cooling. One known solution is liquid cooling.

Liquid cooled solar inverters provide a cooling liquid to a liquid inlet of the solar inverter. The cooling liquid is directed around heat producing parts of the inverter and the liquid is heated, thereby, extracting heat from the inverter circuitry. A liquid outlet of the solar inverter is used to remove the heated liquid from the solar inverter. Typically, the cooling liquid provided to solar inverters is part of a

larger cooling system used for many purposes. For high power solar inverters, such a mechanism is inadequate to remove the heat generated. Moreover, the integration of such a solar inverter into a cooling system on-site is a skilled task and makes the installation and maintenance of such solar inverters expensive.

### Recently Developed Inverters

The recently introduced PVS980 1500 VDC outdoor central inverter by ABB is optimized for large multi-megawatt solar power plants. With the simplicity of air cooling and with the power density of a liquid cooled inverter, ABB's inverter has very high total efficiency and low maintenance. There are no fillable liquids, pumps, valves, inhibitors and thus, no leaks. All this makes the PVS980 suitable for any outdoor utility-scale PV plant.

GE Power Conversion is introducing Silicon Carbide (SiC) technology into its next-generation 1500V PV inverter product line, bringing increased power conversion efficiency to the PV industry. The LV5+ Solar Inverter is the first multi-MW, utility scale inverter based completely on SiC technology and has an efficiency rating of 99% weighted EU and is being showcased at Solar Power International 2016.

Floating solar systems are gaining rapid interest across the globe and recent projects that have been in the 20MW and 40MW range are moving to the 150MW size in China, according to major PV inverter manufacturer, Sungrow in 2017. The new Samsung S-Inverter Air Conditioner series is engineered to consume less power and produce exceptional cooling comfort in 2017. The digital inverter compressor optimizes usage by minimal wear-and-tear and extends the life of a refrigerator by over ten years. With low noise level, the smart direct cool refrigerator can withstand voltage fluctuations ranging from 100 volts to 300 volts. ■

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# HMX's Eco-Friendly Solution for A.T.E.'s LEED Rated Gold Office

A.T.E. wanted to create an environmentally-conscious office to showcase some of their own 'green' ideas and products. One of the important steps taken to create a sustainable workspace was the incorporation of HMX's Indirect Direct Evaporative Cooling (IDEC) as the primary cooling technology instead of a conventional central air-conditioning system...

A.T.E. is a multi-faceted engineering group providing sustainable technological solutions for a wide range of industry verticals. A.T.E. has been in business for more than 75 years, and believes it has grown due to its adherence to its core values. Care for nature and care for the A.T.E. team are some of the values A.T.E. lives by.

Hence, while planning their new workspace in Pune, India, A.T.E.'s aspiration was to create an environment that enhanced people's comfort and effectiveness at work. The idea was to have an office that was functional, easy to be in, and user-friendly. At the same time, A.T.E. wanted to create an environmentally-conscious office to showcase some of their own 'green' ideas and products. One of the important steps taken to create a sustainable workspace was the incorporation of HMX's Indirect Direct Evaporative Cooling (IDEC) as the primary cooling technology instead of a conventional central air-conditioning system. IDEC technology is environment friendly and does not require the use of any refrigerants whatsoever. Moreover, IDEC systems run on less than

half the power required, compared to air-conditioners.

The company's efforts were rewarded when its team collectively and uniformly appreciated their new environment. Further, this integrated facility at Pune was awarded the Leadership in Energy and Environmental Design (LEED) Gold certification from the Indian Green Building Council (IGBC).

## Area Cooled

A.T.E.'s office area has a ground and mezzanine level and an approximate total open area of 5,000 sq. ft.

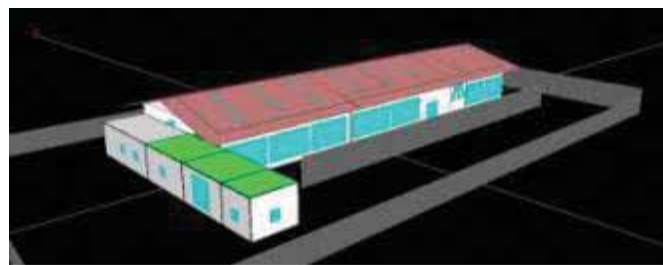
## About Technology

IDEC or Two Stage Evaporative Cooling cools the air by combining indirect and direct evaporative cooling of water in series, as shown in the figure 1.

The primary air stream is cooled first with indirect evaporative cooling and then cooled further with direct evaporative cooling. The combination of these two stages results in improved cooling,



IGBC Gold certificate awarded to A.T.E. Group's Pune facility



A 3D model of the facility

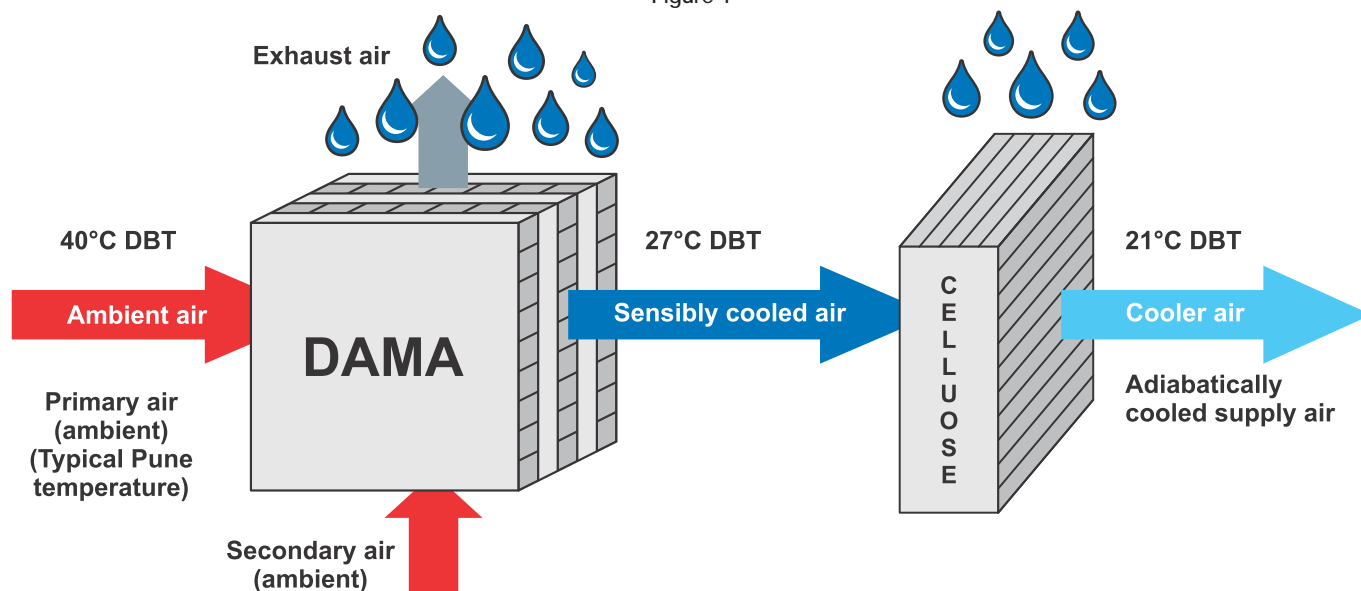


Office exterior

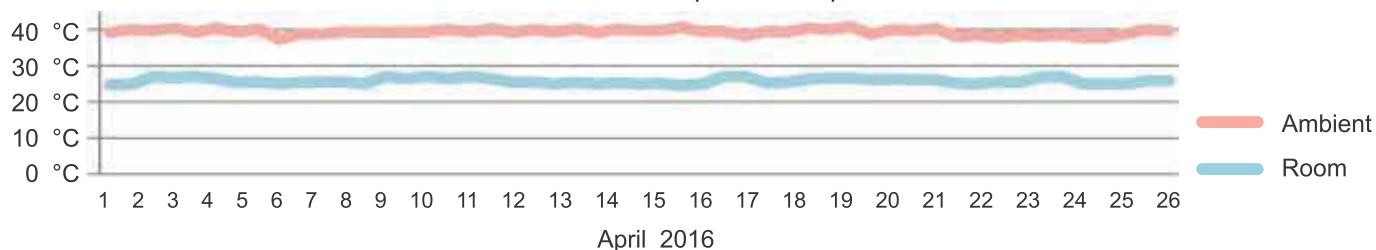


Office interior

Figure 1



Ambient vs. Room Temperature for April 2016



taking the primary air temperature well below the concurrent ambient Wet Bulb Temperature.

Compared to direct evaporative cooling (DEC), the supply air with IDEC not only contains less moisture but is 4-5°C cooler as well. This technology also uses less than 60% of the power consumed by conventional air-conditioners.

In order to meet the desired comfort conditions inside the office space, internal and external heat factors were taken into account and the required air flow was derived. Two IDEC (Indirect Direct Evaporative Cooling) units of 16,000 CFM capacity each have been installed for the main office area. These units supply 100% fresh air economically.

Each machine has a Variable Frequency Drive (VFD) that modulates the speed of the blower according to the conditions to be maintained inside the room. This helps reduce the energy consumption even further.

The facility also uses three propeller fans (4500 CFM each) in order to cool the building during the night through the introduction of cooler night air.

The structural mass of the building absorbs this cooling and helps reduce load on the HMX- Ambiators during the first few hours of the day, thus helping reduce the overall energy consumption.

## Result

A.T.E.'s facility is in operation since January 2014. Apart from maintaining a healthy indoor air quality (IAQ), the HMX- Ambiator also helps in diluting viral density in the air, reducing infections. The improved IAQ not only increases employee productivity but also makes them more energetic throughout the day. Apart from energy efficiency and sustainability, all the employees and visitors vouch for the excellent cooling and indoor environmental quality. ■

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

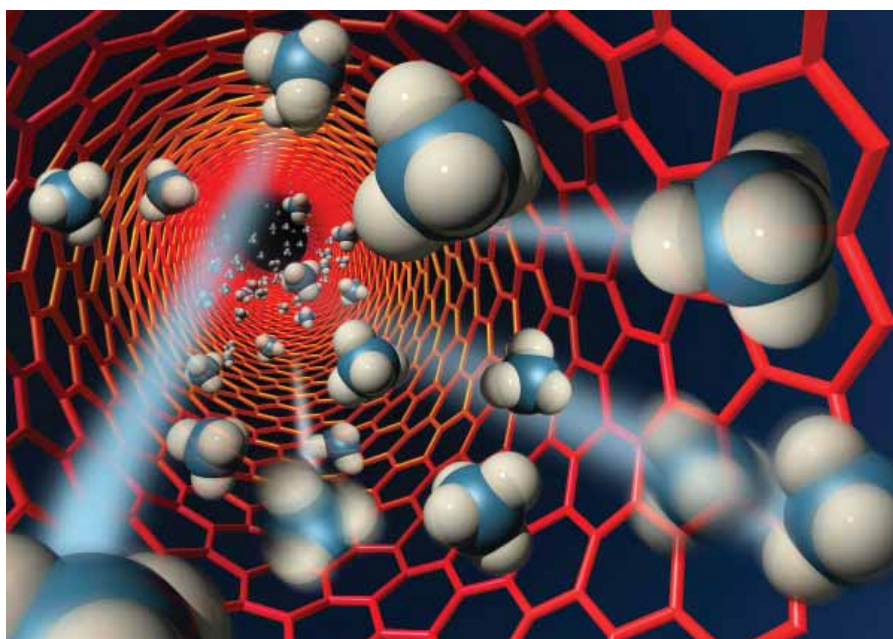
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# Smart Coating for HVAC Industry

What can make a coating smart and why it is needed? Yes, this is an intelligent coating and material that will have significant impact on the occupant in a commercial building in many aspects like comfort, hygiene and treated air related illness. In this article, we will discuss about the Nanotechnology based insulation and anti-microbial materials for HVAC industry...



In the context of global climate control policies, improving the energy efficiency of existing buildings presents a major challenge worldwide. The application of nanotechnology-based thermal insulation systems and materials is gaining popularity largely driven by environmental concerns. Significant heat losses through inadequate or poorly performing building insulation systems are responsible for 40% of total energy consumption and CO<sub>2</sub> emissions. Reducing energy consumption by

improving the performance of thermal insulation systems during the whole life-cycle of the building is, therefore, a worthwhile action in the fight against climate change.

Here, in our discussion, we will talk about nanoparticles based coating technology that can contribute towards a major change in present HVAC industry.

There's a big future in small things. Nanotechnology is the new frontier of engineering, imagining new possibilities in manufacturing, fluid mechanics, robotics,

combustion, biomedicine, measurements, heat transfer, and more. The nano particle based coating is one of the areas than can change the HVAC industry. Coatings are being invented that have the ability to provide attributes such as heat resistance, rust prevention, resistance to contagions and a variety of other surface protection qualities. But the nanotechnology based coating will have multiple capabilities as compared to today's technologies available.

In future more research is required in nanotechnology based areas with the following objectives.

- Safe, high insulating HVAC-ducts enabling minimization of heat/cool losses: cost-effective, safe and extremely thin insulating duct layers that can be applied both to circular ducts and to square ducts. Insulation will be obtained using sprayable aeroclay-based insulating foams that can be automatically applied during manufacturing of ducts, avoiding manual operation needed for conventional materials. Such technologies, coupled with advanced maintenance systems will guarantee a 50% saving in energy losses compared with conventional ducts.
- Cost-effective pathogen and allergenic removal during operation and maintenance to reduce microbial growth: (a) development of anti-microbial, sprayable and self-adhesive photocatalytic coating, based on titanium oxide nanoparticles, for HVAC filters. (b) Development of an injectable liquid polymer matrix containing antimicrobial nanoparticles for air ducts in situ maintenance activities. The liquid polymer will polymerize in situ creating



a thin coating which will cover the surface trapping dirt, debris and microorganisms, thus “regenerating” the duct inner layer. The procedure may be repeated over time without affecting HVAC energy performance.

## What is Nano-Technology?

Nano technology is simply the manipulation of materials at a smaller scale than was previously available. By manipulating matter at the nano scale, materials have the ability to be built from the atomic level up with much less waste. Science has also found that materials can take on different attributes when you manipulate them at this scale such as silver taking on anti-microbial properties.

## Application

The insulation and air quality efficiency of HVAC systems has not changed much in the past 50 plus years. However, new advancements in nanotechnology-based insulation and anti-microbial materials offer advantages that provide the ability to insulate in less space, increase longevity of performance, improve weathering and moisture resistance and increase air quality – all with an objective of affordability and cost-effectiveness.

## Improving HVAC Insulation Using Nanocoatings

Insulating HVAC systems is paramount to reducing building energy consumption and related greenhouse gas emissions. For years we have been trained to think that we need thickness in order to insulate.

The newest form of insulation incorporates a nanomaterial with very low thermal conductivity into clear, water-based acrylic latex to provide a thin film coating that can be painted onto a variety

of substrates, such as ductwork, piping and boilers, to insulate effectively and consistently.

One benefit that a thin film thermal barrier provides is the ability to resist infiltration from moisture, dirt, dust and other contaminants that typically causes degradation of fibrous insulations like fiberglass or rock wool.

By using a nanotechnology-based coating for the insulation of critical HVAC system parts, overall replacement and maintenance costs can be reduced and the ability to insulate outdoor and rooftop equipment without the issues that come with rain, snow and other weather exposure is provided.

Thermal insulation and protective nanocoatings have been shown to reduce energy costs by between 10 and 40 percent, depending upon the application, with a consistent insulation value throughout the five- to 10-year lifespan.

## Reducing Contagions Using Nanocoatings

Indoor air quality is another area where nanotechnology can assist in reducing contagions that may infiltrate an HVAC system. Building health is an increasingly important topic as it directly relates to the health of the workers inside any facility. Some of the advances in nanocoatings address issues with mould and fungi growth and corrosion prevention, as well as provide anti-microbial properties. Infiltrations of mould or fungi into an HVAC system contribute to an unhealthy building. When traditional fibrous insulation becomes moist, it can become a breeding ground for these types of contagions. Other contagions can come from infiltration of outdoor air due to rusting ductwork or

piping, which leaves unwanted openings into the system.

Nanocoatings are able to provide resistance to mould and fungi growth, prevent corrosion, and some are anti-microbial and can be used internally on ductwork to reduce unwanted contagions. One anti-microbial coating incorporating nano silicon dioxide was shown in hospital trials to reduce bacteria by up to 50 percent on surfaces treated with the coating.

## Challenges

As with any new and advanced technology, there are challenges to adoption.

- One of these is that often measurement standards put in place and written into building codes were made to measure an older technology and do not always have the ability to measure new technological advancements. Standards tend to be behind industry innovations.
- A challenge concerning the use of nanocoatings for insulation is that the make-up of the material used allows the reduction of heat conduction in a thin layer and standards used, such as the R-value (R standing for resistance to heat flow), weigh thickness heavily into their equation of effectiveness, meaning they can't be used to accurately reflect the energy saving ability of new thin film insulators. To overcome this challenge, other building standard tests that measure direct heat conduction in energy units, such as watts or btus (British Thermal Units), that show the reduction in thermal transmission without skewing the result by thickness need to be used.
- Another challenge is the fear factor any



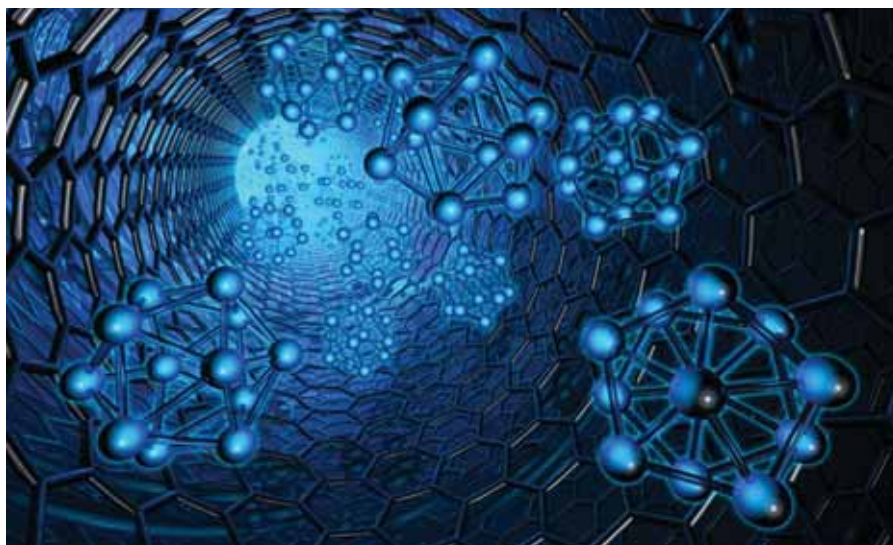
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type of new technology brings, and nanotechnology is no stranger to this. People fear that nano-sized particles may infiltrate their skin or otherwise be a danger. However, nanoscale particles are not used, but rather nanotechnology is incorporated in another way into materials, so there should be no fear of any infiltration of tiny particles. In addition, companies in the field offer health and safety testing to allay fears.

## Advantages

While you should do your homework before deciding on adopting any new technology for HVAC efficiency, it definitely can pay off to see what innovations are available from nanotechnology-based materials. Nanotechnology has now come out of the lab and has been making a difference in industry for at least a decade. It can enable huge improvements in energy efficiency, reduced greenhouse gas emissions, and overall increased longevity,

health and air quality of a heating and cooling system. The earlier adopters of these advanced technologies are already experiencing the benefits of their willingness to change old ways of thinking. As with all new technology, this eventually promotes the needed change in standards – and in the not too distant future, we should see nano-materials being incorporated into standards and specifications, and being increasingly used as a mainstream choice for efficient HVAC processes

While you should do your homework before deciding on adopting any new technology for HVAC efficiency, it definitely can pay off to see what innovations are available from nanotechnology-based materials. Nanotechnology has now come out of the lab and has been making a difference in industry for at least a decade. It can enable huge improvements in energy efficiency, reduced greenhouse gas emissions, and overall increased longevity,

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## Conclusion




In this article, an evaluation of the application of nano insulating products in the building HVAC ducting system is discussed and compared to traditional insulation materials. The analysis shows that their use in buildings is an effective solution to improve the building and occupant performance, allowing to resolve the objectives of energy consumption reduction without compromising the occupant comfort.

Apart from coating it will be used in the heat exchangers to enhance its capacity. In near future, nano technology will eliminate the use of present refrigerant that will cut its carbon footprint by over 50%. This will also make the HVAC units smaller, take up less space, require less material to be built and leave a much smaller footprint. ■

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Johnson Controls (I)  
Pune, Maharashtra



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## Freezing in the Tropics: Asean's Air-con Conundrum

**S**outheast Asia is facing a growing cooling crisis, but its people remain unaware of the threat that inefficient cooling technologies can pose to national development and the environment, finds a new whitepaper published recently.

Freezing in the tropics: Asean's air-con conundrum, commissioned by the Kigali Cooling Efficiency Program (K-CEP) and produced by Eco-Business, explores the attitudes and awareness surrounding air-conditioning and its implications for sustainable development in Southeast Asia.

It reports that cooling technologies such as refrigeration and air-conditioning could account for 40 per cent of Southeast Asia's electricity demand by 2040. This would generate significant amount of climate-change causing carbon emissions if left unchecked, particularly, in Southeast Asia where coal is a major source of energy. If Asean countries switched to energy efficient products for cooling, they can reduce electricity consumption by 100 TWH at a saving of US\$12 billion annually. This is the equivalent to the annual production of 50 coal power plants.

Yet respondents in the region who took part in a survey for the whitepaper showed limited understanding of the impact of air-conditioning on the environment. Almost half of the respondents voted for "increasing the development of solar plants" as the most important way to reduce greenhouse gas emissions in the region,

rather than increasing the efficiency of air-conditioning units. The paper also revealed that the general public has low awareness of the refrigerants used in air-conditioners and the impact it has on the environment. Over 45 per cent of respondents disagreed or strongly disagreed with the statement 'People in my country are aware of the harm that air-conditioning refrigerants do to the environment'.

The paper also includes a case study on Indonesia, which has the third highest use of air-conditioning in Asia after China and India. Despite the high proliferation of air-conditioners in the country, there is little understanding of the benefits of energy-efficient and sustainable cooling among the public, and the government also takes a relatively hands-off approach to campaigns promoting energy-efficient products.

Tim Hill, Research Director for Eco-Business, who led the research behind the whitepaper, commented: "The survey found that Asean citizens are largely unaware of the hazards of increasing demands for air-conditioning, which is only set to grow in tandem with economic development."

"However, the comments among Asean citizens surveyed exposed common areas where governments could better legislate, such as reducing excessive cooling of public buildings and ensuring energy efficient appliances are sold in retail spaces." ■

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# Drying at Atmospheric Temperature & Pressure

This article is about preservation by dehydration of food and other heat sensitive materials, its storage and transport without refrigeration or cold chain, resulting in major saving in energy and cost. A unique process called APVAC is an affordable alternative to cold chain ...



**T**here are two main ways of preserving heat sensitive and perishable materials :

- Refrigeration, whereby the material is cooled by mechanical means to low enough temperature when bacterial activity responsible for spoilage reduces to a level that will keep it useful for a specified period. The

process also requires a Cold Chain "from farm to fork".

- Dehydration, involves removing enough moisture from the material that causes the bacteria go into hibernation, thus, arresting spoilage.

This article is about preservation by dehydration of food and other heat sensitive materials, its storage and

transport without refrigeration or cold chain, resulting in major saving in energy and cost.

There are many drying methods in current use:

- By heating ambient air and passing it through the material
- By creating a high vacuum in a drying chamber

- By Microwave energy
- By Solar Energy
- And many more

Most of these methods are energy hungry and pollute the environment. They also cause varying degrees of degradation in the taste, colour, texture, aroma, volatile components, nutrients etc. of the products, making them less desirable as compared to the original product. Many products also get oxidized and thus, spoil when exposed to air.

A new innovative process, called **Atmospheric Pressure Vacuum Drying** is now available.

This seems like an oxymoron having two words with opposite meaning in the same sentence. How does one produce vacuum at atmospheric pressure?

If we chill the air to a low enough temperature, almost all its moisture will condense out.

The partial pressure of saturated water vapour in air at 30 Deg C is about 4,200 pascals while the total pressure of the air at that temperature is about 100,000 pascals.

When the air is cooled to minus 6 deg. C, then the vapour pressure drops to about 420 pascals only. This is low enough to be called "Vapour Vacuum". Hence, the name Atmospheric Pressure Vacuum Drying.

The **APVAC Machine** is a low temperature heat pump, designed to take in moist air, dehumidify it by cooling to sub-zero temperature and re-heating it to 30 Deg. C by compressor heat. At this point the vapour pressure within the liquid water in the product being dried is about 4200 pascals, while that in the dried air is 420 pascals. When this air contacts any wet or moist material, the water in the material migrates out in the form of vapour. The rate at which this migration takes place depends on the diffusivity of water vapour through the material being dried.

Therefore, the time taken for drying will also depend on the density of the material and the depth of the bed. This process continues till the desired moisture reduction is achieved in the product. Some materials will retain a minimum percentage of moisture permanently due to strong

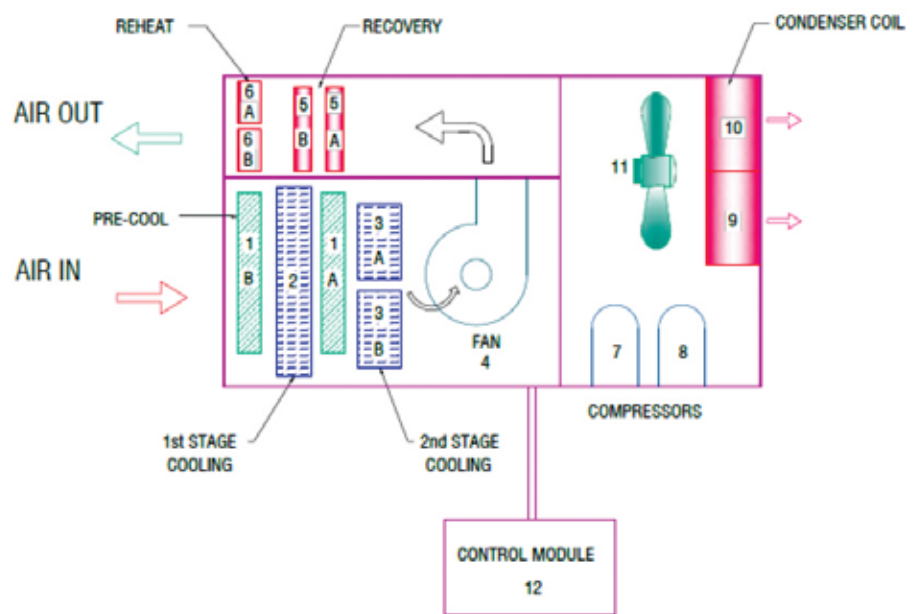


Figure 1: Atmospheric Pressure Vacuum Drying System

bonding forces. The following is a description of an innovative machine that performs the above functions very efficiently.

## Features of the System

This is a stand-alone system, using only refrigeration compressors for dehumidifying and reheating. There is no need for external heating source, full vacuum system, desiccants or freeze-drying process. It can be produced in laboratory size or full-size models to suit the output goals. A truncated version would be only an air supply unit for feeding a tray dryer, a fluidized bed dryer or a spray dryer or any other type of dryer. Both open and closed loop designs are possible, but the closed loop system is more energy efficient since it re-cycles the energy of the moisture given out by the product.

## Description of the Two Stage Energy Efficient Dryer

In Fig. 1, 1B and 2 form the first stage of cooling, where the air cooled to 4 Deg. C, thus removing as much moisture as is possible without freezing. The air then goes to the second stage cooling coils 1A, 3A and 3B, where it is cooled to sub-zero temperature. A unique process keeps them frost-free without requiring time out for defrosting. Compressors 9 & 10 and

coils 6A & 6B complete the refrigeration circuit. Recovery coils 5A & 5B constitute reflux boiling loops that save energy by allowing sensible heat of the incoming air to bypass the cooling section, thus, reducing its load and then provide free re-heat to further save energy. The control module provides automatic control of supply dew point continuously at around minus 6-7 Deg. C.

It is also possible to replace air with Nitrogen to prevent oxidation of the product.

## How it Works

- The main feature of the process is that it removes only the water and nothing much else, from the material being dried.
- The drying process occurs at room temperature and pressure. (Less than 40 Deg. C). This prevents degradation of the product quality by both biological and thermal factors.
- The product is stored, transported and distributed without requirement of cold chain.
- Thus, on rehydration, the recovered quality is as near to the original as to be indistinguishable.
- No preservatives, emulsifiers, colours, flavour enhancers or any such additives are necessary.
- In the closed loop version, most of the



Some Items that have been dried in lab sized machine

- Saving money by bypassing the cold chain.
- Long shelf life. Less space.
- Less volume and weight. So, saving in packaging and transport cost.

### Conclusions

1. There are many products that are not viable for Cold Chain due to either their low value or their short shelf life. A lot of them could be covered by ATVAC.
2. Even some products currently in the cold chain could benefit from ATVAC by lowering the high financial, logistic, and environmental costs.
3. Many markets that are not even being considered as viable could open up. For example, off season fruits and veggies for the Army, tour operators to share with tourists, caterers etc.
4. Medium or low value products that cannot stand solar or heat drying could now be dried affordably without deterioration in quality. Widespread use of this technology would preserve them economically. One example is green fodder in the summer. ■

water is recovered uncontaminated.

- Product weight and volume are greatly reduced. So, are transport and storage cost.
- Allows drying of many products that

go to waste because of high energy cost of drying them by conventional means.

- Possible to dry many products that are sensitive to heat.

**Surendra H Shah**  
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**Gaurav Bali, Manager-Refrigeration & Retail, CAREL ACR Systems India Pvt Ltd** sheds light on the company's journey in India, products, technology and much more in an interaction with **Cooling India...**

### Please take us through your company's journey in India.

Carel ACR systems India Pvt Ltd is a 100% subsidiary of Carel Group. We started direct operations in India in the year 2008 but our presence was in the Indian market from 1998 through our channel partners. We have been steadily growing over the years and providing high efficiency solutions to the HVAC&R market.

### What are the products and services offered by the company catering to HVACR sector?

Carel has three key areas of operation i.e. air-conditioning, refrigeration & humidification and we have the largest product portfolio of almost 6000+ part codes. We also specialize in offering tailor made solution to our customers after understanding their requirement. We have the flexibility of making customized programs for our customers suiting their requirement after understanding the logics from them.

### How technology for air conditioning and refrigeration market has evolved over the last decade?

We see a lot of changes happening in HVACR and as Carel we are prepared for it. We invest considerable amount of our revenues on R&D. 10 years ago the customers were not understanding the advantages of using advanced controllers, Electronic Expansion Valves and Central Monitoring systems but now these features are standards across the industry. With power bill going up and corporates focusing on turning green, a lot of emphasis is given to save energy.

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

With per capita income of the population rising, people are focusing more on high quality life. We see lot of demand for processed food and rising number of QSR, retail and logistics in

India. In all these areas, we offer advance range of automation and thus, we see demand coming from these areas.

### What kind of technological innovations would you like to incorporate in your products, considering rising global temperature? Do you have R&D hub in India?

Due to rising level of global warming, industry globally is looking for eco-friendly refrigerants and we as Carel have developed advance controllers which can work with refrigerants like CO<sub>2</sub>, Propane and Ammonia. Although this technology is at a very nascent stage in India, it is getting popular in Europe & American markets. We are also investing a lot in promoting BLDC technology which can give over 15% power saving as compared to inverter technology available in the market at the moment.

### What is the penetration level of temperature controlled cold storage in India?

In India, we are having majority of cold storages conventionally running on ammonia and most of these systems are very old and running manually. Due to manual operation, these cold storages are not able to work efficiently and are not able to maintain a very precise temperature & RH which is required by the product. Now, we see lot of logistics companies setting up huge cold storages with advanced controllers and automation. Also the new Ammonia cold storages are coming with automation which makes it very easy to handle even the most complex plants.

### What role can organized retailers play in building cold chains in India?

Organized retail can play key role in developing back end infrastructure i.e. food processing plants, cold storages and reefer trucks. With per capita income increasing and thinking of people towards good quality food increasing we see retail will develop and thus, developing the cold chain along the way. ■



## Showcasing Innovation in Efficiency at ACREX

High-performance and affordable solutions will be presented by Embraco, one of the largest global cooling specialists...

**E**mbraco presents innovative solutions for commercial, household and aftermarket segments, especially, for merchandisers and food services, at ACREX 2018 (February 22-24), in its own booth, at BIEC, Bengaluru.

One of many is the FMFT Bivolt, an intelligent and fast-cooling solution for light commercial applications. It's able to operate at different speeds and helps reduce energy consumption by upto 30 percent, when compared to fixed speed technology models. The solution uses the natural refrigerant R290, which is the most environment-friendly fluid in the market. Together with the bivolt compressor, Embraco is increasing its R290 portfolio in India with EM2X3135U and EMX3134U to a total of 72 models. Embraco also showcases the FFUS solution, the bestselling compressor in the company's portfolio with globally recognized quality.

**FMFT413U:** Embraco presents an intelligent and fast cooling solution for light commercial applications, such as medium and low temperature reach-ins, as well as self-contained refrigerated islands. This solution improves the temperature control, has much lower noise and vibration compared to the current solutions, and is one of the most efficient compressors available for users in its capacity range. It also works with R-290 (natural refrigerant), making it a great low GWP solution. The FMFT Bivoltage compressor employs Variable Speed Technology, which enables the refrigerator to reach the target (set point) temperature much faster. A traditional single-speed compressor always operates at maximum speed, which can waste energy if only a low-cooling capacity is needed most of the time. The FMFT is able to operate at a broader range of speeds, allowing it to reach target temperatures more efficiently. This can help reduce energy consumption by up to 30 percent, compared to the traditional solutions available in the market.

**EMC3125U:** the EMC Compressor, as part of our EM family of compressors, is one of the world's most efficient single-speed compressors and uses natural refrigerant R290, which has zero Ozone

Depletion Potential (ODP) and negligible Global Warming Potential (GWP). The EMC Compressor is designed for beverage coolers, vending machines, under-counters and reach-ins. It features a smaller platform, with an extended cooling capacity that can replace larger compressors, releasing more internal space for refrigerators.

**FMX:** Latest generation of compressors with Fullmotion Inverter technology (variable speed) for wine coolers with an extremely high built-in energy efficiency. Provides better food preservation, low noise and wide voltage range.

Furthermore, it's a compact product, which brings advantages when developing applications with limited internal space. It's designed to use natural refrigerant R600a (isobutane).

**FFUS:** Latest generation of compressors Embraco "F" family, this model is the best seller of portfolio with recognitions of all regions because of quality and due to is 22% more efficient comparing to competitors. It works in severe conditions due to the possibility of using start capacitor, with less noise and vibration.

**NJX:** Extension of NJ family in a compact design, NJX is the right solution for all commercial refrigeration applications upto 1770 WLBP (refrigerated islands, milk coolers, coolers, glass door Merchandiser, upright cabinets, reach-ins, icecream makers and cabinets, walk-in coolers). Its new 38 cc displacement (equivalent to 50cc on the market) can stretch the cooling capacity up to 2HP for LBP, with an improvement upto 30% in comparison to the current NJ Embraco solutions on the market. NJX stands out for its robustness, high reliability and improved performances. Available with natural refrigerant R290,



it is an intelligent solution for the upcoming EU F-gas ban regulation, ensuring high eco-sustainability and zero effect on the ozone layer. NJX is lighter (15kg less in comparison to the current 2 cylinder solution on the market (R404A) and has lower noise emission.

**PLUG N' COOL:** It's a complete solution for the food retail chain and designed as a drop-in solution for reach-in refrigerators. Embraco achieved a simplified installation process with the Plug N' Cool modular concept. Its innovative design improves the experience for customers and OEMs, food retail chains and even consumers, by increasing the flexibility of the store's architecture. The hallmark of this particular cooling solution is that it provides



a "plug and play" refrigeration option that simplifies the installation process, and eliminates the need for a machine room. The Plug N' Cool uses R290 (natural refrigerant) and also delivers significant positive effects on the environment, while contributing to a reduction in energy usage - a win-win scenario for all the refrigeration chain.

### Natural Refrigerants

For more than 20 years, Embraco has used natural refrigerants in its compressor portfolio for commercial and household use as an alternative to reduce the negative effects on the ozone layer, greenhouse effects and to improve the equipment's efficiency index. The company believes that using natural refrigerants – especially hydrocarbons – is the ideal solution for the future of refrigeration by sustainably aligning economic and environmental needs. ■

Embraco can be found at booth B-31 in the show's Hall 4.

## Top 10 States for LEED Green Building Per Capita

Today, the US Green Building Council (USGBC) released the annual list of the Top 10 States for LEED (Leadership in Energy and Environmental Design), the world's most widely used green building rating system. The list ranks states in terms of certified square feet per resident in 2017. The list draws attention to states throughout America that are making significant strides in sustainable design, construction and transformation at the building level and opens up conversations around community and city-level accomplishments in sustainable development. LEED-certified spaces use less energy and water, save money for families, businesses and taxpayers, reduce carbon emissions and create a healthier environment for occupants and the community at large. "As the US Green Building Council celebrates 25 years of market leadership and growth, we know how important green building practices and certifications are to ensuring a more sustainable future for all," said Mahesh Ramanujam, President and CEO, USGBC. "These states showcase exceptional leadership and by using LEED, businesses, property owners and policy makers in these states are strategically addressing some of the most critical social and environmental concerns of our time." Now in its eighth year, the list is based on 2010 US Census data and includes commercial and institutional green building projects that were certified throughout 2017. Massachusetts retained its top position for the second year in a row with 130 LEED certifications representing 4.48 square feet of LEED-certified space per resident, the highest since 2010.

The mid-Atlantic continues to show strong regional leadership, with both Maryland and Virginia returning to the list for the seventh year running. Also notable, Washington, DC, which is not included in the official list of top states due to its status as a federal territory, tops the nation with 39.83 square feet of space per resident certified in 2017.

With Georgia, Hawaii and Minnesota all returning to the list for the first time since 2014, it is clear that market uptake for LEED is strong nationwide and not limited to any particular region or corridor. Illinois and Colorado are the only states to have made the list every year since the inception of the ranking in 2010. This year, Illinois comes in third with 3.38 square feet per capita and Colorado places 10th with 2.27 square feet per capita. The 2017 list has the highest average square footage per resident per state since 2010 (2.9). The full ranking is as follows:

2017 Top 10 States for LEED				
Rank	State	Certified Gross Square Footage (GSF)	GSF Per Capita	Number of Projects Certified
1	MA*	29,338,378	4.48	130
2	NY*	65,749,387	3.39	192
3	IL*	43,363,065	3.38	135
4	HI	4,519,757	3.32	16
5	MD*	15,854,679	2.75	105
6	MN	13,018,056	2.45	47
7	GA	23,638,051	2.44	71
8	CA*	89,258,519	2.4	475
9	VA*	18,589,482	2.32	152
10	CO*	11,397,964	2.27	76
**	DC	23,966,817	39.83	139

\*Included in 2016 Top 10 States for LEED list

\*\*Washington, D.C. is not ranked as it is a federal district, not a state

USGBC calculates the list using per capita figures to allow for a fair comparison of the level of green building taking place among states with significant differences in population and number of overall buildings. In 2017, LEED for Building Operations and Maintenance (LEED O+M) was once again the most popular rating system within the Top 10 States, representing more than 50 percent of the total square footage certified. ■

# Automatic Vs Manual Balancing of HVAC Hydronic Systems

Automatic balancing has numerous advantages over manual balancing, especially, in variable speed pumping systems....

**H** VAC hydronic systems use chilled water or hot water as the medium of heat transfer. Proper operation of the hydronic system depends upon the proper distribution (balance) of this water to all parts of the system under design load, as well as all part load conditions. Automatic balancing has numerous advantages over manual balancing, especially, in variable speed pumping systems.

## Fewer Valves Required

Systems utilizing automatic flow control valves require far fewer balancing valves than systems that are manually balanced. Figure 1 shows a schematic of a system serving 18 heat transfer (heating or cooling) coils.

The manual system, shown on the left, requires a total of 27 valves whereas the automatic system, on the right, requires only 18 because it does not require the "partner balancing valves" (shown in red) on the risers and the branches.

As each terminal unit's automatic flow control valve is self-balancing over a wide differential pressure control range, the flow through the risers and the branches is also automatically controlled (balanced) without the use of additional valves. The elimination of the manual partner balancing valves on the mains, risers and branches in turn eliminates the head loss through them. Hence, the system head loss is reduced which lowers the pump BHP.

## Better Flow Balance Accuracy under All Load & Flow Conditions

Properly designed and manufactured automatic flow control valves will control flow to within  $\pm 5\%$  of the design values.

Unlike manual balancing valves:

- Automatic flow control valves have a spring-loaded cartridge that dynamically absorbs pressure fluctuations, resulting from changing flow conditions due to varying heating/cooling loads.
- A change in differential pressure ( $\Delta P$ ) across the automatic flow control valve does not change the flow through it.
- Flow through any given automatic flow control valve will not change when the

flow through an adjacent valve is increased or decreased.

In a manually balanced system, the flow accuracy is dependent not only on the quality of the valves but also on the expertise of, and the effort dispensed by, the person conducting the balancing procedure. Even then, flow balance is conducted at design load only and the manual balance valves are set accordingly. After the initial balancing effort, the flow through any given manual balance valve in the system will still vary as the  $\Delta P$  across that valve changes with system conditions. On an average, do not expect manually balanced systems to be more accurate than  $\pm 15\%$ .

NOTE: The Automatic Flow Control Valves are shown on the coil return side. Flow control accuracy of both types of valves is the same in closed-loop systems.

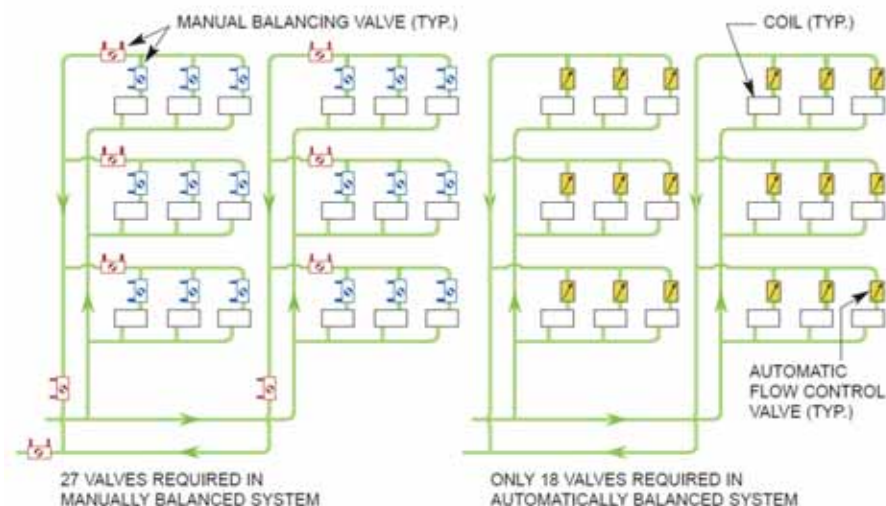


Figure 1: Comparison of the Number of Valves Required in Manual vs. Automatic Balancing



For a typical 100-ton chilled water system with automatic balancing, the flow will be within  $\pm 12$  gpm as compared to  $\pm 36$  gpm for a manual system. If the flow is much lower than design, one or more coils may not get enough chilled water. If the flow is much greater than design, then be ready for higher utility bills due to higher pump BHP.

## No Plumbing Restrictions

An automatic flow control valve can be plumbed anywhere in the line. Proximity to pipe bends, fittings, etc., upstream or downstream location, horizontal or vertical orientation, does not affect its performance. To retain the calibrated accuracy of manual balancing valves, there must be a minimum length of unrestricted straight pipe, upstream and downstream. The actual recommended minimum length varies by manufacturer, 3 to 10 pipe diameters upstream and 1 to 2 pipe diameters downstream are typical.

## No Labour for Balancing, Minimal Labour for Verification

The procedure to manually balance a system is very labour intensive. Each time a valve is adjusted, the flow through the other valves will change including those that were set previously. Hence, the previously set valves must be reset, which in turn affects the flow through the other valves and so on. In a large system, a minimum of 3 resets per valve is generally required. Also, the actual labour that will be required is difficult to estimate.

On the other hand, each automatic flow control valve is self-balancing as soon as the pump is turned on. Therefore, the entire hydronic system with many such valves self-balances. The only labour required is for flow verification. The pressure drop across each valve is measured by using the ports provided on the valve body. As long as  $\Delta P$  is within control range listed on the valve tag, the flow, which is also listed on the tag, will be within  $\pm 5\%$ .

The total labour required for flow verification of an automatic system should be no more than 15% to 25% of that required to balance a manual system.

## Building Renovation Does Not Require Hydronic System Rebalance

Very often, space renovation in an existing building also changes the heating/cooling requirements of that space. For example, an open office area that is converted into a large conference room will require more cooling due to the additional sensible and latent heat from the people. This may result in an additional fan-coil unit for the conference room. Figure 2 illustrates this scenario for a Manual vs Automatic system.

If this is a manually balanced building, as shown in Figure 2 on the left side, valve MBV#5 would have to be added and manually set. However, doing this would change the flows through existing valves MBV#1 through MBV#4 and they would also have to be reset. Similarly, upstream branch/riser balancing valves (not shown) may also have to be reset. The resulting labour cost can be significant.

If this is a building with automatic flow control valves, as shown in Figure 2 on the right side, you would only have to add valve AFCV#4. Because these valves have wide control ranges, they would all automatically self-balance to provide the required flows. No labour would be required to set the new valve or to reset any of the existing valves.

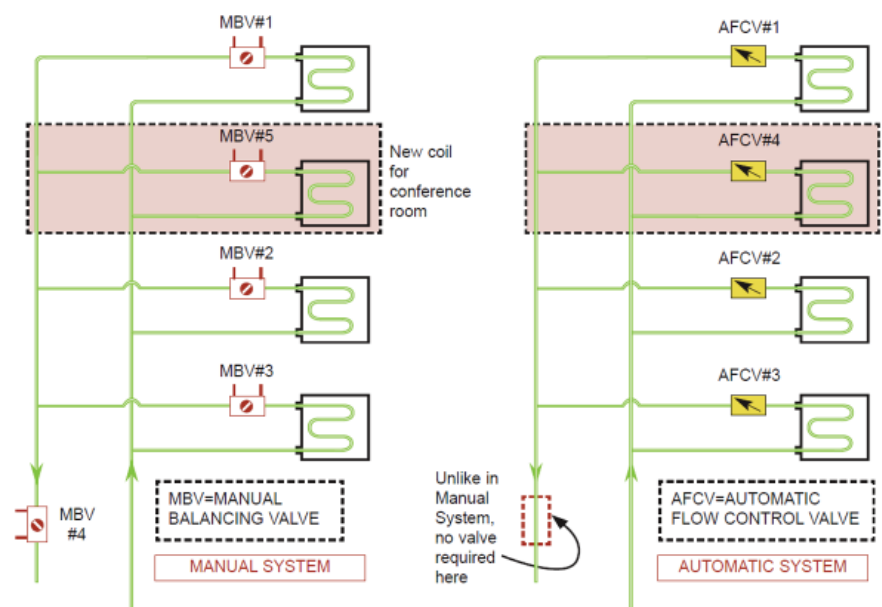


Figure 2: Space Renovation Comparison

## No Coil Will Starve When Saving Money by Variable Speed Pumping

Chilled water systems with variable speed pumping save a lot of energy. As the building cooling load decreases, you can reduce the total amount of chilled water being circulated by slowing down the pump. Since the pump power is proportional to the cube of the speed, reducing the speed by only 33% (which is very common), reduces the power by about 70%! However, reducing the total chilled water flow does not mean that all the coils in the building individually need the same reduction in flow. For example, on a typical spring day at 1:00 p.m., the total chilled water requirements of an 8-story office building will generally be much less than on a hot summer (design) day. However, the air-handling unit (AHU) serving the filled-to-capacity cafeteria, on the first floor, will require almost 100% (of design) chilled water. A building with automatic flow control valves will give you this diversity whereas one with manual balancing valves cannot. Let's take a look at the three hydronic system schematics in Figure 3 to understand why. The schematic at the top shows the design load condition. The system operation point, at design load, is at (say) 125 feet of pump head. The head loss across the

various elements (which adds up to 125 feet) for the cafeteria circuit, is as shown. Since the cafeteria is on the first floor, the head loss through the risers is negligible and ignored. Please note, for design flow at design head, the head loss through the manual balancing valve is the same as that through an automatic flow control valve (86 feet).

The schematic in the middle shows what happens when system flow is reduced (by lowering the pump speed to 67%), if the system is manually balanced. At the lower speed, the pump head will be smaller. Let's assume it is decreased to 65 feet. Since nothing else has changed in the cafeteria coil circuit, the head loss through the various elements will decrease

proportionately and now add up to 65 feet instead of 125. Since the head loss through the manual flow control valve is reduced to 44.7 feet and since flow is proportional to the square root of the head loss, the flow through the manual balancing valve (and the coil) is reduced to 72% (square root of 44.7/86). There is a flow deficit of 28%.

The schematic at the bottom shows what happens when system flow is reduced by the same amount (pump speed again lowered to 67%), if the system has automatic flow control valves. Again, the pump head decreases to 65 feet. However, the head loss distribution is not proportional. Instead, the cartridge inside the automatic flow control valve moves by a precise amount, to absorb only 26 feet of head and keeps the flow at the required 100%.

With the automatic flow control valve, there is no flow deficit at reduced system flow and reduced pump head.

(Note: In all three schematics of Figure 3, all losses in the pump room are ignored for clarity of discussion.)

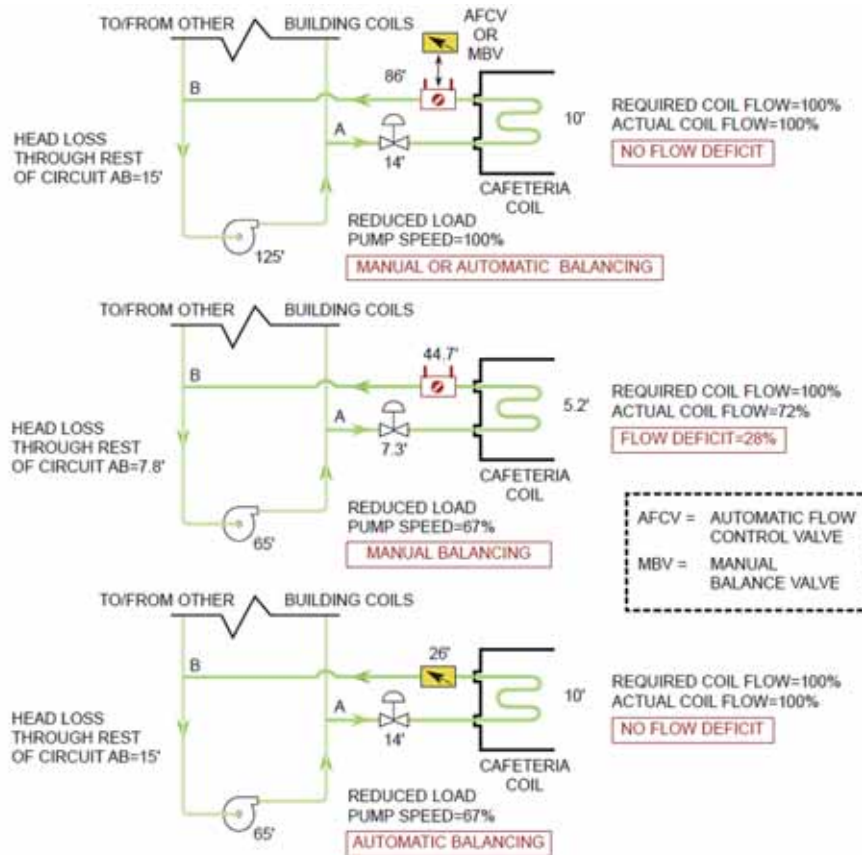


Figure 3: Variable Speed Pumping



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# BITZER ECOLINE+ is Refrigeration Product of the Year

Compressor specialist BITZER receives prestigious award from the British ACR News industry magazine for its innovative ECOLINE+ reciprocating compressors...



Great excitement at the ACR News Refrigeration Product of the Year Award 2018. From left: Miles Jupp (ACR News Awards, celebrity host), Gianni Parlanti (BITZER Chief Sales and Marketing Officer), Kevin Glass (Managing Director at BITZER UK), John Smith (British Refrigeration Association)

One of the leading British magazines serving the refrigeration and air conditioning industry has honoured the reciprocating compressors of the traditional German company BITZER. The Refrigeration Product of the Year is the ECOLINE+ series for transcritical CO<sub>2</sub> applications.

With the ECOLINE+ reciprocating compressor series, BITZER has achieved a milestone by using low-GWP refrigerants for energy-efficient supermarket applications. By awarding the prestigious prize in London on 24 January, the ACR News magazine honoured the ECOLINE+ compressors as the most innovative refrigeration technology product of the year. A crucial factor in the decision of the six-member jury was the energy efficiency of the compressors as well as the low global warming potential of the used refrigerant CO<sub>2</sub> (GWP 1), among other things. The ACR News awards have been given out since 1997 and recognise companies that demonstrate excellence in the way they operate or in what they produce. After being honoured in 2014, BITZER received the Refrigeration Product of the Year Award this year for the second time.

'ECOLINE+ is the most efficient CO<sub>2</sub> compressor available in the market today. It is the result of over 20 years of commitment that BITZER has always had for solutions that protect the environment. The combination of natural refrigerants and maximum energy efficiency is a constant challenge for BITZER. Today this prestigious recognition allows us to say that we are winning this challenge', says Gianni Parlanti, Chief Sales and Marketing Officer.

## ECOLINE+: efficient, environmentally friendly, innovative

The ECOLINE+ series is available as four- and six-cylinder compressors and offers optimal efficiency both for full- and part-load. BITZER improved the whole series in three ways: the ECOLINE+ series has an enhanced line start permanent magnet motor which makes direct connection to 50 or 60 Hz electrical supplies possible, offers a completely new level of efficiency and increases annual performance figures by more than 10 per cent. The new feature is the mechanical capacity control VARISTEP for transcritical CO<sub>2</sub> applications which enables system efficiency that is otherwise only possible today when using frequency inverters. BITZER has also developed a new operating concept with intelligent (IQ) modules so that users can fully exploit the potential of this technology. The IQ MODULE allows for the new ECOLINE+ reciprocating compressors to be easily, quickly and cost-effectively integrated into a variety of system configurations. In addition, the IQ MODULE improves the protective measures as well as the monitoring options for the compressors, allowing them to be used in a wider range of applications. Users, thus, benefit from more flexibility; it is also easier, for instance, to compensate for the differences between summer and winter operation.

Thanks to the intuitive BITZER Electronics Service Tool (BEST) as well as the sensors and actuators, which are factory-wired and preconfigured, the compressors are very easy to install, configure and service. ■



The ECOLINE+ reciprocating compressors offer optimal efficiency both for full- and part-load





## “Getting skilled manpower is a major challenge in the industry”

**GAPS Engineering & Consultancy** deals in HVAC products and services. The company has knowledge in the areas of simulations -fire and life safety, fire evacuation, green building, HVAC, ventilation and software. The company offers all type of ventilation products e.g. demand control ventilation, smoke and heat extractions. Our energy efficient products can be installed in all type of projects where we can save upto 30-40% of working cost, states **Gaurav Vasudev, Managing Director, GAPS Engineering** in an interaction with **Cooling India...**

### **Please take us through your company's journey.**

GAPS (Global Air conditioning/Acoustics Products Services) Engineering & consultancy has started in year 2015, initially for providing product support to acoustics and ventilation market. Gradually, we have decided to extend our services in waterside products, IEQ products and products for energy efficiency. We are an engineering company and work to provide the best optimized solutions for new projects as well as retrofit applications. The products associated with GAPS are from across the globe & have expertise in their respective fields.

### **What are the trends in HVACR segment?**

World is moving towards energy efficient products and systems, so, is HVAC market. Earlier, designs were focusing towards reducing the air conditioning load. Now-a-days, designs are not only working in that direction but they are moving towards to reduce the operating cost of a project. From designer to

manufacturer, all are working to reduce the carbon footprint for supporting sustainable environment.

### **What are the products and services offered by the company? Do you offer energy efficient services?**

GAPS has a big basket of products. We deal with ventilation products, pumps (HVAC, Fire, Plumbing & Sewage), cooling towers, demand control ventilation systems, external sun shadings, ESP units for improving IEQ, energy efficient industrial filtration systems, innovative solar thermal technology, acoustic designing and products & ASET / RSET simulations on human evacuation for fire & smoke management. All products are energy efficient. But we would like to highlight Innovative Solar Thermal Technology. This product is not only suitable for new installations but also suitable for retrofit applications. This product gives upto 30-40% saving on the working capital and it comes with zero upfront cost. Our demand control ventilation & industrial filtrations

systems use energy efficient motors which can operate at minimum and maximum working points based on the requirement in the system for having low energy consumption.

**What kind of opportunities would you envisage for your company with the government's emphasis on upgrading infrastructure like roll out of 100 smart cities project, metro projects, etc?**

We have expertise to work on metro ventilation, tunnel ventilation, hospitals, commercial offices & residences. Our energy efficient products can be installed in all type of projects where we can save upto 30-40% of working cost.

**What are the stumbling blocks faced by Indian HVACR industry in India? What solution would you suggest to overcome these hindrances?**

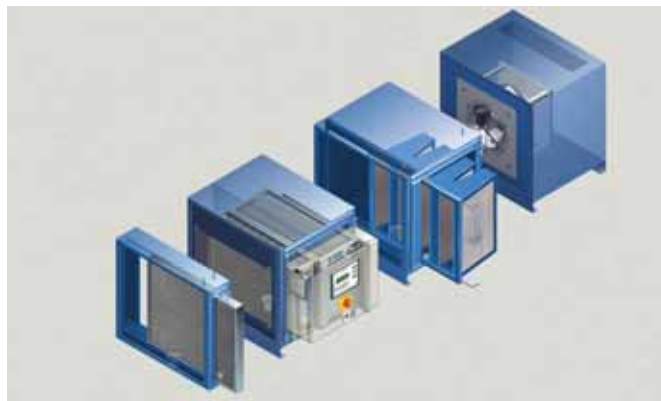
The major challenge is getting skilled manpower in the industry. We have good engineers but we don't have good technicians. Due to this lack of knowledge, new innovative products with better technologies do not perform till the time technicians install it properly. We are not able to recover the cost of equipment if the systems do not operate to its optimum level. According to me, we have to work on the grassroots level & train people at all levels. To overcome this problem, ISHRAE as society is playing a vital role. Every year ISHRAE organizes more than 400 programs for training workforce.

**The Government of India launched 'Make in India' campaign in order to make the country manufacturing hub. So, what are the products that the company manufacturing in the country? Do you have any expansion plans?**

This is a good initiative of the Government of India in order to become the country a manufacturing hub. India, being the biggest consumer of products, has rolled out congenial policies for attracting MNCs to set up manufacturing plants. At present, we are associated with an assembly plant for assembly of our ventilation products. We have expansion plans that depend on business growth in forthcoming fiscal.

**What are the technological innovative products/services that you would like to bring in your company to make the services more efficient?**

To be innovative, first we need to understand the challenges around. Having an engineering base & solution oriented approach leads us towards the solution for every challenge we get during the initial discussions with our customers be it an end user, designer or operator. Since beginning we have been known for the solutions in smoke & fire simulations. We are not only working as extended arms to designers in India, but we are doing a lot of projects outside India. We have developed an expertise for ASET/RSET simulation based on NFPA 101 for HUMAN Evacuation analysis. These results are widely accepted by authorities around the world & our goal is to make it workable for Indian projects by using the service in connection with our



National Building Code. These simulations help in optimising the building designs from fire point of view when project is in conception stage. Other innovative product, we have commercial (e.g. Electrostatic Precipitators) & industrial filtration (e.g. oil mist filtration) systems. The controller used along with these systems have capability to monitor the system at all point of time to reduce the downtime / maintenance time. The ability to control the fan speed based on the requirement helps in saving energy during its operations. A centralised ventilation system (Health Box) for high end villas is another product we have in our range. Health Box have one EC fan connected with 6/8 outlets. Unit have VOC sensors with a digital wireless speed controller to operate fan all the times at different speed keeping the indoor air cleaner & helps in saving energies. The most recent addition we have innovative solar thermal technology. The specially designed panels are suitable for new applications as well as for retrofit applications. The principle is to optimise the power consumed by compressors and provide upto 30-40% power saving in the system & "0" upfront cost for retrofit projects. These all products and services offered by GAPS will take us on an interesting journey in HVAC segment. We are sure these innovations not only will help us to grow but to have a better impact in Indian HVAC industry.

**What will be the impact of GST on the company's business in India?**

GST has a positive impact on our business leading to smoother transactions as compared to the earlier ones.

**What is your outlook for the sector for the fiscal 2017-18?**

HVAC sector has been growing and in near future will witness fast growth rate. The FY 2017-18 has been slow as the real estate industry has been witnessing slow growth momentum. But, we expect it to perform better and stable in forthcoming period.

**What are your expectations for the sector in order to bring the sector on growth trajectory?**

In a developing nation like India, air conditioning is no more a luxury. According to various reports & studies, the consumption of air conditioning will be three times by 2030. We are working to match the pace of demand & supply. ■



# Gearing up for 19<sup>th</sup> Edition of ACREX India

Organized by Indian Society of Heating, Refrigerating and Air Conditioning Engineers (ISHRAE), this edition of ACREX India promises to venture into exciting themes like sustainability, green buildings, eco-friendly innovations and carbon neutrality while expecting more than 600 exhibitors and participation from major global players across 30 countries...



After the resounding success of ACREX India 2017 organized by the The Indian Society of Heating, Refrigerating and Air Conditioning Engineers (ISHRAE), the society is steadily gearing up for the 19<sup>th</sup> edition of the exhibition that is slated to happen from 22<sup>nd</sup> to 24<sup>th</sup> of February, 2018 at BIEC, Bangalore. Last year, people from across the globe attended the symposium and witnessed one of the largest displays of HVAC products offered by national and international exhibitors. This edition of ACREX India promises to venture into exciting themes like sustainability, green buildings, eco-friendly innovations and carbon neutrality while expecting more than 600 exhibitors and participation from

major global players across 30 countries. One of the highlights for the annual exhibition this year will be ISHRAE's collaboration with United Nations Environmental Programme (UNEP) to discuss the technological developments in zero-ODS and low-GWP RAC technologies as well as the regulatory and policy measures needed to scale up their adoption, thereby, maximizing ozone, climate and energy efficiency benefits.

At ACREX 2018, UNEP will be hosting an exclusive 'Ozone Pavilion' which will serve as a platform for organizations to come and showcase their respective Ozone 2, climate friendly technologies and products. The 'Ozone Pavilion' will serve as a testimony to efforts shown towards

building ozone and climate friendly refrigerant technologies or systems. Additionally, in line with the ACREX India vision of becoming the largest network and the most dynamic platform for the HVAC&R and the building construction industry, ISHRAE has advocated the importance of natural resources, recycling and reusing materials alongside employing energy efficient equipment is the key to organic sustenance. Laying importance on efficient use of resources such as energy, water among other, will aid in protecting occupant's health and improving quality of life.

Sharing his views, Nirmal Ram, Chairman – ACREX India 2018 & ISHRAE Presidential Member, said: "ISHRAE is committed to address contemporary issues and deliver innovative solutions through ACREX India every year and this year, we are excited about the unique product offerings that we will be introducing. The 2018 edition of ACREX will be all the more memorable because of ISHRAE's collaboration United Nations Environment Programme (UNEP), one of the leading organizations globally for environmental activities. ACREX India is a flagship event of ISHRAE and has always played an essential role in bringing the industry together while working closely with key brands and partners. We at ACREX believe in organic development and sustainable living which runs parallel with the world we live in and this year, we will continue to strengthen our mission."

ACREX India's main focus revolves around the fact that the Indian consumer market is ever growing and so is its infrastructure. With the HVAC&R industry





benefiting from this growth, thereby, making India a consumer market to be reckoned with and a destination that attracts many international companies to come and sell their products.

"UN Environment is pleased to co-organize the Ozone to Climate Technology Roadshow and Industry Dialogue at ACREX India 2018. This is the result of a decade-long successful partnership between ASHRAE and UN Environment", said Shamila Nair-Bedouelle, Head of OzonAction - Montreal Protocol. "This can be easily demonstrated by many similar events as well as other products jointly developed and offered to best serve the needs of developing economies in complying with the Montreal Protocol and advancing alternative refrigeration and air-conditioning technologies and practices. The joint work plan for 2017-2018 of our two organizations is structured around the

theme "Working beyond High-GWP Refrigerants" to reflect international movement to reduce dependency on high-GWP technologies especially in light of the adoption of the Kigali Amendment to the Montreal Protocol. Cooperation with ISHRAE is an example of how the ASHRAE-UN Environment cooperation is shaping to actively engage with regional and national associations, ensuring the global messages and programmes respond to the specific needs of developing economies," she added.

The exhibition, held over three days, witnesses a host of both national and international visitors and is known to be the largest platform for networking for the construction industry. ACREX India is also responsible for offering its key stakeholders an opportunity to acquaint themselves with the latest technologies in the field. Last year, the theme of "Rising India: Enterprising and Cool" was linked both to

the rapidly growing economy of India as well as the welcoming nature of its citizens. This year commits to garner even more attention and positively impact the society that we live in with dedicated pavilions on Refrigeration & Cold Chain, Building Automation (BMS).

"We're pleased to partner with ACREX India again this year. This partnership is an important part of AHRI's continued commitment to supporting the HVACR and water heating industry around the globe. As we work toward standards harmonization and certification as a path to regulatory compliance, ACREX is a critical partner that attracts thousands of industry leaders each year," said Stephen Yurek, President and CEO, AHRI.

As ACREX India 2018 gears up to be a truly international show, ISHRAE, as an industry body, continues to protect the environment, facilitate energy conservation and improve the impact of HVAC&R on the marine, food & refrigeration, indoor & outdoor air quality management, medical and the cold chain industry. This is in line with the larger goal of promoting energy efficiency, sustainability and achieving advanced functional and aesthetical value in the HVAC&R industry, that is going to be addressed through ACREX 2018. ■



## FLIR DM285 – Industrial Imaging Multimeter with IGM

**F**LIR DM285 is industrial, all-in-one True RMS digital multimeters and thermal imagers that can show you exactly where a hot spot or temperature anomaly is for faster troubleshooting. Featuring Infrared Guided Measurement (IGM™) powered by a built-in 160 x 120 FLIR thermal imager, the meters visually guide you to the precise location of a problem. You'll pinpoint issues faster, more safely, and efficiently. Both multimeters are ideal for inspecting industrial-electrical, mechanical, HVAC/R, and electronic systems, and can be used for both benchtop electronics or in the field.

The DM285 uniquely features Bluetooth® which enables wireless data transfer by connecting to the FLIR Tools Mobile app on compatible mobile devices. The DM285 is also compatible



with the new FLIR InSite™ workflow management tool that allows you to prepare efficient survey routes, maintain accurate documentation, share information with clients, and file instant reports.

- Identify energized and faulty equipment from a safe distance with non-contact

temperature measurement

- Save electrical parameter data and thermal images with onboard data storage
- Solve challenging problems with the 18-function DMM including VFD mode, True RMS, LoZ, NCV, a built-in worklight, and laser pointer
- Measure voltage, current, frequency, resistance, continuity, diode, capacitance, and temperature
- Operate easily with an intuitive menu system
- Rely on the meters' drop-tested durability in any working condition
- Change the battery quickly and easily with the 'no tool' battery compartment
- See readings clearly on the TFT display with a wide viewing angle.

Website: [www.flir.in](http://www.flir.in)

## Ice Make - Evaporator Unit (Temperature Range upto -40°C)

**I**ce Make has gained continuous appreciation as the prime organization offering evaporator unit. This appreciation encouraged us to develop the evaporator unit with ultra-low temperature range up to -40°C.

This unit can be used in multi-purpose cold rooms especially used for



blast freezing and storing frozen food items like ice-cream, frozen meat, frozen seafood, frozen vegetables and ready to

cook & ready to eat frozen items.

### Features

- Highly durable
- Defrosting heaters for ultra-low temperature units
- Inner grooved copper coil for high efficiency
- Built to operate in highly varying Indian ambient temperature ■

Website: [www.icemakeindia.com](http://www.icemakeindia.com)

## Pressure Gauge Cocks

**T**he range of Gauge Cocks offered by us is used to isolate the pressure gauge from the pressure media to enable inspection of the same where the pressure is continuously pulsating. This array of products is suitable for various pressure applications till 30 BAR.

Pressure gauge cocks provide the



opportunity to either vent the connected pressure gauge according to the position of the handle (venting position), i.e. put it into a pressure-free state, or to vent the pressure measuring instrument

under pressure (operating position) or to let the medium escape (blow position). Our products need low maintenance.

### Applications of the Pressure Gauge Cock

Shut-off device for pressure gauges, for measurement of liquids, gases and vapours.

### Industries Used

- HVAC Connections
- Petroleum Industries,
- Steam Boilers,
- Steam Taps,
- Chemical Process Industries, etc ■

Website: [www.mminternational.net.in](http://www.mminternational.net.in)



[www.foodlogisticsindia.com](http://www.foodlogisticsindia.com)



## International Exhibition on Logistics, Transportation and Warehousing for Food & Drink Industry

September 27-29, 2018

Bombay Convention & Exhibition Centre,  
Goregaon (E), Mumbai



### Concurrent Events:



Tel: +91-22-28715200  
Fax: +91 22 28715222  
[info@koelnmesse-india.com](mailto:info@koelnmesse-india.com)



Koelnmesse YA Tradefair Pvt. Ltd.



# RefComp Italy Technical Seminar in India

The new series of refrigeration screw SW5 series (with green efficiency design) are also introduced to cold chain OEM & new series of Compact Screw Compressors (built-in oil separator) suitable for R-134, SS5 is introduced to Indian HVAC Industry experts..

**R**efComp Italy Technical seminars in India were organized in Delhi, Ahmedabad, Bangalore and Mumbai. The stakeholders from HVAC & refrigeration fraternity like OEM, system integrators, contractors, consultants and end-users were present actively. Enrico Faccio (GM RefComp Italy), Nilesh Naik (BDM), & Shiv Kumar Gupta (CMM) were present in the seminar along with distributors HRS (M.P. Singh at Delhi), ACS (Anurag Begwani at Ahmedabad & Mumbai) & Sub-dealer Alpine Refrigeration Co (P. C. Pillai at Bangalore).

Enrico Faccio (GM-RefComp Italy) held the technical seminar comprising of following topics:

1. The new series of Compact Screw Compressors (built-in oil separator) suitable for R-134, SS5 is introduced to Indian HVAC industry experts. The out-of-the-box, new generation design with highly efficient and, advance cyclone based



vertical oil separation system, lower noise level, completely made in Lonigo factory, Italy.

- Higher efficiency
- Modern design
- Suitable for low GWP refrigerants
- Acti flow system\* (Patent pending)
- Auto Vi system\* (patent pending)

Higher efficiency oil separator, Oil flow switch, oil cooling connections, discharge temperature sensors, Oil level sensors, integrated and inspectable oil filter cartridge.

2. The new series of refrigeration Screw SW5 series (with Green



Enrico Faccio, GM, RefComp, Italy



Shiv Kumar Gupta, CMM

Efficiency design) are also introduced to Cold chain OEM, System builder, contractors and end-user. In SS5 series the oil separator is external.

- Efficient at Variable load% Reliable ( Extended bearing life)
- Compact
- Modern
- Design (with SRM "I" profile rotors)
- Easy to install (Valves repositioning)
- Easy to maintain (without disassembling the compressor)

Higher motor efficiency on the version with permanent magnet motors (PM Motor) integrated oil filter, oil flow switch, oil shut off valve and oil filter differential pressure switch completely made in Lonigo factory, Italy. ■

Website: [www.snowkey.com/en](http://www.snowkey.com/en); Email: [shiv@snowman.cn](mailto:shiv@snowman.cn)

# Forthcoming Events At A Glance

## ACREX 2018

**Venue:** BIEC, Bengaluru

**Date:** 22<sup>nd</sup> to 24<sup>th</sup> February 2018

**Website:** www.acrex.in

## Climate World

**Venue:** IEC Crocus Expo, Moscow

**Date:** 27<sup>th</sup> February to 2<sup>nd</sup> March 2018

**Website:** climatexpo.ru/eng/

## China Refrigeration

**Venue:** New China International Exhibition, Beijing

**Date:** 9<sup>th</sup> to 11<sup>th</sup> April 2018

**Website:** www.cr-expo.com

## Worldbuild India 2018

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

**Date:** 19<sup>th</sup> to 21<sup>st</sup> April 2018

**Website:** www.Buildingshows.Com

Company Name	Page No.
Aggreko Energy Rental India Pvt. Ltd.	55
Air Master Fire Safety Equipments	11
ALM Engineering & Instrumentation Pvt. Ltd.	IFC
Amul Refrigeration Spares	113
A.T.E. Enterprises Pvt. Ltd.	29
Belimo Actuators India Pvt. Ltd.	13
Bharat Bijlee Ltd.	15
Bitzer India Pvt. Ltd.	47
CAREL ACR Systems India Pvt. Ltd.	31
Desiccant Rotors International Pvt. Ltd.	61, 73
ebm-papst India Pvt. Ltd.	7
Embraco	FC
Emerson Electric Co. (India) Pvt. Ltd.	41
Ensavior Technologies Pvt. Ltd.	BC
FLIR Systems India Pvt. Ltd.	51
Food Logistics India	111
Fu Sheng Industrial Co. Ltd	19
Fujian Snowman Co. Ltd.	25
GAPS Engineering & Consultancy	IBC
Hira Technologies Pvt. Ltd.	53
Hitachi Air Conditioning India Limited	21
Ice Make Refrigeration Ltd.	69
LG Electronics India Pvt. Ltd.	27
Lamilux Composites GmbH	9
Lubi Industries LLP	3
M M International	75
Mist Ressonance Engineering Pvt. Ltd.	5
Russair Technologies	91
Safe Refrigeration Pvt. Ltd.	83
Sam Products Pvt. Ltd.	71
Sekisui Foam International	33
Technical Solutions & Engineers	17
Technovalue Solutions Pvt. Ltd.	93
Testo India Pvt. Ltd.	37
Trane - Ingersoll - Rand International (India) Ltd.	65
Udvavisk Technologies Pvt. Ltd.	79

## REFRIGERATION SPARES

Condenser ■ Motor ■ Fan Blade ■ Water Cooler Fitting  
Copper Pipe & Other parts



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Refrigeration Spares

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Astodia, Ahmedabad 380001, Gujarat, India.  
Ph.: 079 - 22161643 • Mob.: 09825286684  
Email: mediwalam@gmail.com

## Hospital Wins World's Top Award for Green Building

**J**iahui International Hospital in Xuhui district was awarded LEED (Leadership in Energy and Environmental Design) Gold Certification for healthcare construction, making it the first and only healthcare institute in China to receive such an award. Built and promoted by USGBC (US Green Building Council), LEED is so far the most influential evaluation standard in the world regarding the assessment of architectural surroundings, environmental friendliness, and sustainability.

The council's President and CEO, Mahesh Ramanujam, visited the hospital late last week to present the award. "LEED is an award for architecture, but ultimately it is all for humans," said Ramanujam. "They share the same goal as the architectural design of the hospital: helping make patients feel more



comfortable." The designer of the hospital, NBBJ, incorporated various environmentally friendly facilities, many of which were used for the first time in China. A variable air volume (VAV) box was used for air filtering and ventilation, to guarantee that air is safe and the air temperature is comfortable for patients.

Another design aspect that helped the hospital achieve LEED certification is a garden that brings patients closer to nature and helps relieve their stress. Jiahui International Hospital, approved by the National Health and Family Planning Commission and co-branded with Massachusetts General Hospital, is the first tertiary international hospital in Shanghai. Phase one in operations launched in 2017, when 246 of its 500 beds were put into use. ■

## First LEED Gold Logistics Hub in Italy

**T**he sustainability of the new Decathlon logistics hub has been proven by the LEED Gold certification. The new hub located in Brandizzo, serves 25 stores and guarantees that products are delivered to clients in the shortest possible time, with the lowest CO2 emissions.

This warehouse has a gross surface area of roughly 23,000 m<sup>2</sup>, and is divided into two units; one unit is mainly dedicated to picking while the other one only stocks bulky material. It is the first logistics hub certified in Italy, in accordance with LEED NC 2009 register.

The HVAC system is based on 15 WSM high efficiency



reversible air cooled roof top units by Climaveneta. 10 of them are dedicated to the open spaces, 4 to the automated mezzanine floors and the last one to the laboratories, for a total air flow of about 340.000 m<sup>3</sup>/h. Going into detail, they have installed 7 WSM/CE 402 with free-cooling and 8 WSM/HR with thermodynamic heat recovery to maximize the energy efficiency under all

weather conditions. High COP index, higher than 5, allows not only for respecting the LEED certification prerequisites, but also for the system to outperform the output required by the regional legislation at -7°C and +33°C. ■

## Rogers Place Going Environment-Friendly

**R**ogers Place, home of the Edmonton Oilers in the heart of downtown Edmonton's ICE District, has reached a new milestone: LEED Silver. It's the first NHL facility in Canada that is built to LEED® Silver standards, and DIALOG is proud to have a role in making that happen.

As the lead sustainability consultants on the project, we led the client, construction, and design teams through the sustainability strategy. We held early stage workshops with visioning, provided direction throughout the project, and administered the LEED® application.

As part of the LEED New Construction certification, a major consideration is the process and materials used for construction.



PCL did an excellent job of managing sustainable efforts throughout the construction by committing to green building products and waste management, and managing air quality throughout the build. Rogers Place continues to reduce their environmental impact by committing to green operations including cleaning,

education, and food waste handling. "Oilers Entertainment Group is a strong advocate for environmental design and operation. We also want to acknowledge the many committed staff at OEG who contributed to this milestone. We are all so very proud of the accomplishment," Susan Darrington, Executive Vice President, Roger. ■





## Engineering Solutions



FLOW-TECH AIR (P) LTD.

Cooling Towers



CTI Certified Cooling Towers  
(FTA Series)



Custom Cooling Towers  
(RE Series)



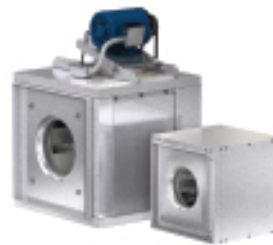
Low Sound Cooling Towers  
(CF Series)



Ventilation Fans



Axial Series Fans



Square In-Line Fans



Fire/Smoke Dampers  
(UL555S)



Filtration Systems



Compact Filter Units



Dust Collector



Oil Mist Filter



Creating healthy spaces



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## GAPS Engineering & Consultancy

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

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Let's Solve Water

**Pumps & Package Pumping System on Variable & Constant Speed**

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



# FlowCon international

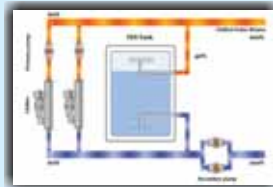
**PICV & Automatic Balancing Valves**

**Key Features**

- Continuous Display of Flow Rate
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- Optional Fail-Safe Power Storage Feature
- Communication with BMS thru RS-485
- BACnet Compatible
- 51 Different Maximum Flow Rate Settings
- 100% Valve Authority
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- ◆ Externally Adjustable Automatic Balancing Valves
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# FT EnE, Inc.



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Utilizes only the sensible heat of water for cooling energy storage in a chilled water storage tank and discharges the stored coldness for air-conditioning.

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

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- Energy Savings
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**Electrostatic Precipitation System**



**Key Features**

- Removal of grease and smoke from commercial kitchens
- Removal of smoke, fumes and oil/coolant mist from industrial processes
- Higher efficiency, upward of 90-95% in single stage, more than 99% in multi stage
- Very low pressure drop in comparison to media and cartridge filters

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