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# Publisher's Letter



## Publisher's Letter

### *Inducing efforts in energy storage development*

Climate change and increasing energy cost are inducing efforts in energy storage development. A Thermal storage system is an innovative way to store thermal energy, either cold or hot, in order to utilize it at a later time. An article that describes 'Design of Pumpless Ice Thermal Storage System' is an innovative idea, applied for patent, to eliminate the Pump from the system and make it more energy efficient and thus make the compressor and blower as the only power consuming devices. It carries information about other dynamic Ice Production systems also.

For improvements in energy efficiency, building management system provides great opportunities. A proper designing and management system of any building is an important concern for the present environmental and energy issue, well narrated in an article 'Building Management System'. And while talking about green buildings, among other write-ups, an interesting coverage, on world's greenest hotel in Copenhagen, speaks about its being one of the first hotels to meet the standards in the EU Green Building Programme, designed with sustainability at top of mind.

Indian Green Building movement is one of the fastest growing in the world, with over two billion sq ft of space delivered or registered for the various types of green building certifications -designed to have optimal air quality, so that the impact on the occupants is minimized. Modern air conditioned spaces have limited ingress of fresh air to reduce the air conditioning load which has a negative impact on the IAQ. The write up 'Managing IAQ in Green Building' explains how the green buildings are designed to have better IAQ.

Further, this issue has other interesting articles such as on refrigerants, technology, case study, etc, in a new layout and would appreciate your feedback.

Please send your comments at [pravita@charypublications.in](mailto:pravita@charypublications.in)



**Pravita Iyer**  
Publisher & Director







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# Editorial

## Integrate Cold Supply Chain with Transit Centers



**T**erminology & technology wise, we frequently resonate with integration and sustainability in all aspects including building management system that implies centralization, to control movement across specific functions. Integration is a challenge for tracking vehicles during transit, monitoring temperature with GPRS, for instance, if the temperature before loading and after loading.

Conservation of electricity and reducing wastage is main focus of those engaged in reefer transport requiring cold chain technology, refrigeration technique and refrigerants. Data logger keep check over live temperature and its display initiates decision-making thus prompting situation control since perishable stuff wastage will increase during transit of goods. Cold chain handling is a good investment in preventing perishable food losses since some transports skip temperature control despite high surrounding air temperatures enroute and unforeseen delays during movement.

In cold supply chain technology, just-in-time delivery combined with ambient temperature strategy is the business ethics. Hence, supply chain delivery and storage space involves managing improvement of inside-vehicle shelf customizing to products at variant temperatures. This requires an automated & integrated concept to manage and control. Also, the drivers of reefer trucks should have the knowledge of basic corrective measures such as awareness of water drop formation and humidity principles.

Further, irradiation, an effective tool for food safety and preservation technology, prolongs wastage period. However, cold storage capacities need be increased. The efforts for replacement and increasing the capacity while on the highways can be a better option on lines of Reefer Motels. For this, a body consisting of all India association of cold storages, supply chain and refrigeration businesses may together share load, unload pricing during transit, concerns and challenges in cold supply chain; to support infrastructure with designated access points across length and breadth of country and also be in sync and line with global movement of refrigerated products.

  
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**Editor: Gopal Krishna Anand**





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## Honeywell: opens Sixth Manufacturing Facility in Vadodara, Gujarat



**H**oneywell added its sixth manufacturing facility in India with inauguration of a plant that will manufacture solar water heating systems for its Environmental & Combustion Controls (ECC) business, adding to other manufacturing facilities the business has in Chennai and Dehradun. This business is part of Honeywell Automation India Limited (HAIL), a \$300 million company. The 50,000 sq ft Vadodara facility will manufacture solar water heating (SWH) systems for residential, commercial and industrial applications for the domestic market in India as well as for export to Southeast Asia and North Africa. Honeywell's Vadodara facility will manufacture 10 solar water heater variants of stainless steel (SS) and galvanized iron (GI) material ranging from 100 to 300 liters per day. "Honeywell is a technology leader in energy efficiency & clean energy generation, with more than 50% of the company's portfolio linked to energy efficiency," said Beth Wozniak, president, Honeywell Environmental and Combustion Controls, who was at Vadodara to officially launch the facility. "Solar water heating technology is evolving as one of the most energy-efficient methods of heating water. The opening of this facility marks Honeywell's entry into the renewable energy product manufacturing, & adds to our already broad portfolio of energy focused products & technologies for customers worldwide." Honeywell ECC is global industry leader in integrated products and solutions in heating, ventilation and air conditioning (HVAC), building management systems, and industrial burners and combustion controls. Honeywell's solar water heating system works on the thermo-siphon principle that allows heat exchange without the need for a pump. The system uses an advanced triple layer evacuated tube technology with high absorption & low emission characteristics. To ensure that water stays hot for longer, Honeywell provides specially insulated storage tanks that are robust resistant to corrosion & available in various sizes. ■

## Seminars to showcase leading Pumping Solutions for Commercial Buildings

**G**rundfos Pumps India Pvt Ltd (Grundfos India) will be hosting seminars to showcase its leading pumping solutions for the commercial buildings segment across multiple cities. Grundfos has a wide range of pumping products to suit the various commercial building application needs.



These seminars will be most relevant for builders, developers, consulting engineers, architects, project managers, facility managers, hoteliers, contractors and service providers in building services industry. Some of the key Grundfos products that will be displayed and demonstrated during the seminar include: MAGNA 3, the most energy efficient circulator pump in the air-conditioning market. The new Magna 3 circulator pump gives the user & integrated solution combining a pump, balancing valve & a BTU meter. Magna3 is a perfect fit for radiant heating and cooling application where it eliminates most of the field instrumentation. Hydro MPC - Grundfos Hydro Booster System provides dependability, supreme technology & ease of operation for a range of purposes. These seminars will be held in Trivandrum, Raipur, Bhubaneswar and Lucknow. ■

## Haier pioneers in '1HiT' Refrigerators in India

**H**aier, global leaders in Home Appliances & Consumer Electronics and the Number 1 Global Major Appliances Brand for the 5th Consecutive



Year, has introduced yet another path breaking innovation for their flagship category- refrigerators. The new range of 5 star TM and DC refrigerators come with the 1HiT or the '1 Hour Icing Technology' that freezes water in the least time in its category. The technology brings down the water temperature to the icing point in precisely 60 minutes. The 1HiT has been achieved by combining several features to obtain best results. The high efficiency compression, the turbo cooling eva, the optimism condensation and the cellular foaming put together provides the fastest cooling in the industry. The technology also facilitates best freshness results helping maintain high standards in retaining the nutrition value for perishable food items. The superior designing of the HiT range of refrigerators also gives it an edge over competition. The refrigerators come with larger cooling pads for better cooling retention, a chiller room for better space management, larger LEDs for better lighting and concealed air duct with 360 degree air flow for more freshness. The refrigerators also consume minimum energy by the industry standards despite its speedy cooling process\*. The refrigerators come with a 5 star rating. Yet another noteworthy innovation is the table-top finish which has been done keeping in mind the Indian household psyche and the paucity of space in Indian households. The top of refrigerators can even hold bulky articles such as microwave ovens. Eric Braganza, President, Haier India commented, "Innovation has always been at the heart of Haier. We have always consciously made efforts to bring out revolutionary products with relevant innovations to suit the needs of the growing middle and upper middle class. Our latest range of TM and DC refrigerators with the 1HiT technology is yet another path breaking success for the team and we hope to continue our good work." ■

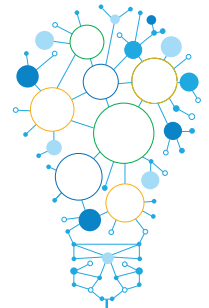
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## Trane enhances EarthWise Air-Cooled Chiller Plant



Trane, a leading global provider of indoor comfort solutions & services and a brand of Ingersoll Rand, has added a new chiller to its EarthWise™ Ice-Enhanced Air-Cooled Chiller Plant portfolio. The ice-enhanced air-cooled chiller plant is now compatible with the Trane Stealth™ air-cooled chiller, which has the lowest published sound levels in the industry. The ice-enhanced air cooled chiller plant provides an energy efficient, cooling solution and is ideal for K-12 and commercial buildings. Like all EarthWise systems, the energy costs of the ice-enhanced air-cooled chiller plant are typically 20 to 30 percent lower than competitive solutions. According to the United States Department of Agriculture Forest Service, many building owners or rate payers can attribute about half of their monthly electrical bill to peak electricity use. Switching a portion of cooling energy consumption to off-peak hours, can help building owners reduce both energy costs and overall operating expenditures. Thermal energy storage tanks are a proven way to store cooling produced at night when electricity costs are lower. Melting ice that is stored inside storage tanks provides cooling during periods of peak electrical costs or temporary power outages. The Trane EarthWise ice-enhanced air-cooled chiller plants are paired with CALMAC IceBank® tanks. These modular, non-corrodible tanks circulate glycol through tubes to freeze water held in the tanks. “The strategic relationship with CALMAC and standardized layouts with controls allow Trane to provide customers exactly what they want — a one-source solution provider for equipment, controls and services,” said Susanna Hanson, principal applications engineer, Trane “Because Trane can provide the entire chiller plant as a prepackaged solution — including the controls, energy storage tanks and a hydronic completion module — it is easy for customers to install and maintain. We make it easy to design systems that run efficiently and as intended throughout the system’s life.” In addition to saving on energy bills, ice-enhanced air-cooled chiller plants have a lower environmental impact than non-ice systems. Shifting energy demands to off-peak hours puts less burden on the local power infrastructure and allows companies to draw on cleaner sources, like wind energy, which are predominantly generated at night. ■

## Godrej Eon Green Balance ACs win India Design Mark Award

Godrej Appliances, a leader in consumer durables manufacturing vertical and pioneers in the sector has been awarded with the “Indian Design Mark- Good Design Award” for their Godrej Eon Green Balance AC. The Revolutionary Green Balance Air Conditioners was awarded by the GoI through the India Design Council. The award was conferred on the company for designing and manufacturing India’s first commercially manufactured Green AC- the Godrej Eon Green Balance AC. The Air Conditioners stands tall as the only one being recognized for this award in the entire Indian Air Conditioning Industry. Godrej Eon Green Balance AC: The stylish range of Green Balance Air Conditioners use eco-friendly R290 refrigerant ensuring ‘Zero Ozone Depletion Potential’ and a minimum global warming potential of just 3 (against competition’s over 1600). These ACs use highly advanced technology that helps them perform and achieve efficiency much beyond the set Indian standards by the BEE and consume even lesser power than a hair dryer. With up to 10% more energy efficiency of 5 star ACs- Godrej Eon Green Balance has achieved a six-star performance. ■



## 100th integrally geared compressor for air separation plant ordered

MAN Diesel & Turbo has established 100th integrally geared centrifugal compressor as a key component in air separation trains and continues to develop it further. With the latest order the company has broken the century mark. MAN Diesel & Turbo’s AIRTRAIN and AIRMAX air separation trains cover a broad spectrum. With oxygen production volumes of 500 to over 7000 tpd (tons per day), they are particularly in demand for the production of liquid hydrocarbons (XtL = X-to-Liquid). With the latest order for three AIRMAX machine trains, exactly 102 integrally geared centrifugal compressors for air separation trains have been ordered since 2001. “China, in particular, is a booming market for air separation plants,” states Tamer Bayri, Vice President Sales & Contracts at MAN Diesel & Turbo in Berlin. “They are installed there to produce large volumes of oxygen and are required primarily for the processes of coal liquefaction and gasification.” These industrially produced liquid hydrocarbons from coal (known as CtL – Coal-to-Liquid) are helping the country to become more independent. They can be used to manufacture commodity chemicals and fuels, thus reducing reliance on expensive oil imports. Each train consists of three MAN turbomachinery units – a main air compressor, a centrally located steam turbine drive unit and a downstream air compressor. An integrally geared centrifugal compressor (RG) always serves as the downstream air compressor. It increases the pressure of the pre-pressurized air with the help of up to six compressor stages that are arranged around a single casing with integral gear unit. The compressed air is then fed to the rectification process. Rectification is a thermal separation process that separates the air into its main components (oxygen, nitrogen and various noble gases). “The industrial plants for this process are getting bigger and bigger,” states Bayri. “This means for one thing that the size of our machinery is growing. And secondly that more trains are needed.” ■







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## Lineage Logistics to acquire Millard Refrigerated Services

Lineage Logistics (Lineage), a warehousing and logistics portfolio company of Bay Grove, signed agreement to purchase Millard Refrigerated Services (Millard), a national third-party warehousing & logistics company headquartered in Omaha, NE. With the acquisition, Lineage will expand its network by 30 strategic locations & increase its footprint to more than 21 million sq ft and more than 518 million cubic ft of cold storage capacity. The combination of Lineage & Millard will immediately double the size of Lineage's business & create the second largest refrigerated warehouse network globally, based on data from the International Association of Refrigerated Warehouses. The deal is expected to close within the next 30 days. "Bringing Millard into the Lineage family will give us additional scale to support our growth and increase our investment in innovative technology, logistics offerings and our facilities, while adding talented management to our team. As a result, our customers will have unparalleled geographic and service capabilities in major logistics centers throughout the country with individually-designed solutions to fit their needs," said Lineage CEO Bill Hendricksen. "Millard's highly reputable operations and dedicated focus on service makes the company a great fit for Lineage." Millard's CEO and owner, Lance Larsen, will become a Board member of and investor in Lineage. "Lineage's leadership team is highly experienced and the ideal partner to continue growing Millard's legacy," said Larsen. "This is a terrific opportunity for all employees and customers to work with an exceptional company." "By acquiring Millard, we are executing on our long-term strategy to grow Lineage by adding a great family-owned company with deep entrepreneurial roots, values & culture," said Kevin Marchetti, MD, Bay Grove. "The Lineage vision started with the acquisition of one warehouse in 2008 and has now resulted in the combination of two acknowledged leaders in the industry. We are proud of the fact that every former owner supports our vision and has chosen to remain an active investor in Lineage. The Larsen family has built a world class company and we are honored to be the stewards of the business for the future." Larry Larsen founded Millard in 1963 to serve the American food industry in the Midwest. Since then, the family-owned & operated company has grown its network to 30 facilities across the United States totaling 228 million cubic ft of capacity. ■

## UNIDO project to green Chinese air-conditioning production

Global use of air-conditioning is rocketing. In India, sales of air-conditioning units are growing by 20% each year. With last year's report by the Intergovernmental Panel on Climate Change stating, intensity of hot days and heatwaves are increasing, and World Bank warning of a global temperature increase of four degrees Celsius by end of century, demand for AC is likely to increase. In this context, a UNIDO demonstration project that has helped convert a production line for residential air conditioners to ozone- and climate-friendly technology has clear relevance. The production line conversion took place at Midea, a manufacturing company that has one of the largest air-conditioner production set-ups in China. Midea's main products include residential air conditioners, refrigerators, washing machines and compressors. The air conditioner production line converted by UNIDO has a production output of 200,000 units per year. The production line was converted from HCFC-22 to propane (R-290). ■



## Klima-Therm wins two national awards for innovations in cooling and renewable energy

Klima-Therm won two national awards for pioneering developments in air conditioning and renewable energy systems.



The company's Virtual Power Plant initiative won the award for Best Commercial Project 2014 at the National ACR Awards, while its high efficiency EXP system was highly commended in the Air Conditioning Product of the Year category. Virtual Power Plants use high efficiency heat pumps, running on virtually frictionless magnetic bearings, to generate and store reservoirs of thermal energy and "coolth", which can be used to supply heating and cooling. The collaborating partners, Klima-Therm, Next Controls, thEnergy and Imperial College, believe that a network of community-based Virtual Power Plants across UK could provide a national renewable energy infrastructure to run and support the increasingly vulnerable National Grid. Advanced heat pumps powered by Turbomiser chillers, or Rhoss EXP Polyvalent heat pump and heat recovery systems, can achieve a Total Efficiency Ratio (TER) of up to 20. This means they can deliver up to twenty times more thermal energy than they use in the form of electricity. This compares to typical stand-alone systems delivering efficiencies of between 3 & 5 TER. With a capacity of up to 10MW each, the plants can generate high efficiency, low carbon energy to augment conventional electricity supplies. Roberto Mallozzi, MD, Klima-Therm, says, "Around a third of the UK's conventional power generating capacity is due to become obsolete over the next few years. This presents a serious vulnerability and is a major strategic issue that has yet to be addressed. "We believe that with their outstanding efficiency, a UK-wide network of Virtual Power Plants could provide the answer, while adding resilience and a vital energy safety net for the nation." Tim Mitchell, director, said, It is the ability to generate and store "comfort" energy – in the form of both heat and coolth – that is the virtual power aspect. This enables to effectively load shift demand from the grid to the Virtual Power Plants. ■



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## New oil-injected screw compressors for Marine



Atlas Copco Marine presents two new ranges of water-cooled, oil-injected screw compressors designed, tested and certified for on-board as well as off-shore applications. The MAS GA 55-90PP offers record-breaking performance from 55 to 90 kW. The MAS G 180-315 is a single screw oil-injected compressor from 180-315 KW. Both compressors are open units with a small footprint and high energy efficiency. Both units will be revealed on SMM Hamburg, from 4-7 of September. Both ranges offer reliability and efficiency of Atlas Copco's in-house designed oil-injected rotary screw technology. They have straightforward design, small footprint and equipped with the latest Elektronikon® Mk5 controller and Delayed Second stop, which minimizes the run time of the drive motor. Both ranges are water-cooled, with either fresh water (of up to 40°C at inlet) or seawater and they are delivered fully IMO certified for integration on-board. They are outfitted with all features the marine industry requires. MAS GA and G are ideal for all air demands: as general working air, booster air for nitrogen, ballast water treatment and bulk handling. MAS GA 55-90 Power Pack – Energy efficiency and performance Based on Atlas Copco's record-breaking GA 30-90 (VSD), the MAS GA 55-90 Power Pack oil-injected screw compressor brings outstanding efficiency to the marine industry. ■

## Conference: The Future of HVAC

The Future of HVAC conference, to be held at the Australian National Maritime Museum, Sydney, from July 16-17, 2014, will explore the changes, ideas & innovations driving the industry's future. "The idea behind The Future of HVAC 2013 is to discuss not just the new HVAC technologies and materials that are impacting on our profession, but also all the other things that affect what we do," AIRAH CEO Phil Wilkinson, M.AIRAH, says. "These can include changes to the way building are designed and constructed; indoor environmental issues; BIM and the digitisation of the built environment; the take-up of large-scale off-site prefabrication; life-cycle environmental considerations; legislative & regulatory changes; and the people issues, which are always complex and multifaceted." ■

## DOE's first step in updating National Reference Standard for Commercial Buildings to 90.1-2013

Preliminary analysis from the U.S. Department of Energy (DOE) shows that the ASHRAE/IES's 2013 energy efficiency standard contains energy savings over the 2010 standard of 8.5 percent source energy & 7.6 site energy. In an announcement in the May 13 edition of "The Federal Register," DOE attributes the greater energy savings to improvements in ANSI/ASHRAE/IES Standard 90.1-2013, Energy Standard for Buildings except Low-rise residential buildings, related to better lighting, fans, commercial refrigeration, boilers & controls. The DOE is now receiving comments on the preliminary determination. If the preliminary determination is finalized, then states would be required to update their codes to meet or exceed the 2013 standard. Currently, states must meet or exceed the 2010 standard, which serves as the commercial building reference standard for state building energy codes under the federal Energy Conservation and Production Act. The DOE noted that the 2013 standard contains 52 positive impacts on energy efficiency that were incorporated into the analysis. ■



## Ingersoll Rand CEO joins President Obama for Energy Efficiency announcement

Ingersoll Rand Chairman and CEO Mike Lamach joined President Obama as he announced executive actions



to advance energy efficiency, boost solar deployment and reduce carbon pollution, through his membership on the Executive Committee of the National Association of Manufacturers (NAM). Both Ingersoll Rand and NAM are active supporters of several public energy efficiency initiatives. Lamach said, "Energy efficiency is the smartest approach to the looming global energy crisis, and Ingersoll Rand is in a powerful position to help. We develop reliable, energy efficient and sustainable solutions to help our customers address energy consumption and improve productivity every day." The President announced the expansion of the Better Buildings Challenge (BBC) through commitments of several new partners. The BBC is the public-private challenge component of the Better Buildings Initiative (BBI) launched in February 2011, which set a national target for improving energy efficiency in commercial and industrial buildings by 20 percent by 2020. Ingersoll Rand supports both these efforts, and is active in two other energy efficiency programs under the BBI umbrella: the Better Buildings Better Plants (BBBP) program and the Better Buildings Performance Contracting Accelerator, designed to expand the use of performance contracting by federal, state and local governments. Through the BBBP, Ingersoll Rand has helped the Department of Energy develop energy-savings tools and standards for assessing building performance, and we have taken advantage of the program's benchmarking data and best practice guides at many of our U.S. facilities. Ingersoll Rand serves on a program review committee for the Performance Contracting Accelerator program, through which we share best practices and gain insights on requirements for government performance contracts. "Ingersoll Rand's Trane brand has been a recognized federal Energy Services Company since 2001," said Lamach. ■

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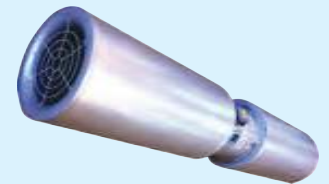
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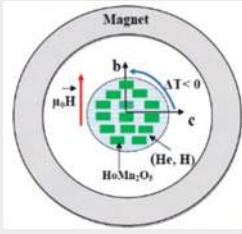
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## Magnetic cooling enables efficient, 'green' refrigeration



Magnetic cooling is a new refrigeration technology with several advantages - ranging from lower energy consumption to eliminating the use of hazardous fluids - that

combine to make it an environmentally friendly option than today's standard fluid-compression form of refrigeration. One novel magnetic cooling approach, developed by a team of Canadian-Bulgarian researchers, relies on solid magnetic substances called magnetocaloric materials to act as the refrigerant in miniaturized magnetic refrigerators. As the team describes in the journal *Applied Physics Letters*, these materials are the key to the development of a "green" cooling technology whose efficiency is able to scale directly with generated magnetocaloric effect. The magnetocaloric effect is "the thermal response of a magnetic material to the change of an external magnetic field, which manifests as a change in its temperature," explained Mohamed Balli, a researcher in physics department at the Université de Sherbrooke in Quebec, Canada. Ferromagnetic materials, for example, are known to heat up when magnetized and to cool down when the magnetic field is removed. "The presence of a magnetic field makes ferromagnetic materials become more ordered. This is accompanied by disorder within the atomic lattice, which causes an increase in the material's temperature," Balli said. "Inversely, the absence of a magnetic field means that the atomic lattice is more ordered and results in a temperature decrease. Magnetic refrigeration essentially works by recapturing produced cooling energy via a heat transfer fluid, such as water." The researchers originally set out to measure the standard magnetocaloric effect in the multiferroic compound  $\text{HoMn}_2\text{O}_5$ . This material possesses an insulating behavior that prevents energy losses associated with electric currents passing through it when altering its magnetic field. But, they discovered that a giant magnetocaloric effect can be obtained by simply rotating a crystal of  $\text{HoMn}_2\text{O}_5$  within a constant magnetic field - without requiring moving it in and out of the magnetic field zone). This discovery is an important step toward the development of magnetic cooling technology, and will likely lead to efficient, "green" cooling systems for both domestic and industrial applications. ■

## ARBS 2014: Melbourne Convention & Exhibition Centre

Melbourne Convention & Exhibition Centre buzzed with the show activity during May 20-22. Visitor numbers were steady across the three days, totalling 7,774 – around 5% higher than the 2012 show, which eclipsed previous records. This year's technical seminar series had attendees across a range of industries and organisations getting the latest on legislative & technology changes and hearing case studies from national and international speakers. Seminar registrations were higher than the previous show, aided by sessions on highly topical subjects including HFC phase down, the repeal of the carbon tax and sessions for tradies including working with R32. The theme for ARBS 2014 was "connecting your industry", a focus that encapsulated the benefits of the event for attendees, and ARBS was again applauded for offering the right combination of information and networking opportunities. Exhibitors reported that visitor numbers was up, and quality of leads was high. One exhibitor had signed up two new distributors by the end of the first day of the show. And, ARBS 2014 Industry Award winners were announced & five nominees were inducted into ARBS Hall of Fame. ■

## Carrier and SolarCity offer Innovative, Cost-effective and Efficient Energy Solutions to Homeowners

Carrier, the world's leader in high-technology heating, air-conditioning & refrigeration solutions, has teamed up with SolarCity, America's largest full-service solar



power provider, to offer a unique solution that can significantly reduce a homeowner's energy costs. Effective immediately, Carrier-trained technicians and comfort consultants will be able to offer SolarCity services to Carrier customers. Those who purchase a new Carrier product and elect to install SolarCity solar panels will receive a \$1,000 rebate, while reaping the benefits of leveraging a sustainable energy source to help power their home. Carrier is a part of UTC Building & Industrial Systems, a unit of United Technologies Corp. Recognizing that a home's heating, ventilation and air conditioning (HVAC) system is one of the largest household consumers of energy, Carrier and SolarCity's new initiative offers a clean, energy-efficient solution that further enhances the benefits of Carrier's already efficient products. As a result of the companies' combined vision, this collaboration will benefit customers of both businesses and also serve as the first step toward providing offerings that can truly optimize home energy performance. "Carrier's collaboration with SolarCity is a natural fit as we look to expand energy efficiency beyond the HVAC system to the whole home," said Matthew Pine, director of marketing, Carrier. "Our collective offerings allow us to create solutions that enable homeowners to gain more control of their home energy consumption and help create a more robust home energy ecosystem." The \$1,000 rebate can be applied to furnaces, air conditioners, heat pumps, packed units, ductless systems or entire system upgrades, upon operation of the homeowner's SolarCity system. Carrier is a part of UTC Building & Industrial Systems, a unit of United Technologies Corp, a leading provider to the aerospace and building systems industries worldwide. ■

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## Senator h. c. Peter Schaufler receives Gründerpreis for his life's work



(From L to R) District Head Roland Bernhard, Sparkassen President Peter Schneider, Senator h. c. Peter Schaufler, Christiane Schaufler-Münch, Minister of Finance and Economics Dr. Nils Schmid, Michael Tillmann (member of the Kreissparkasse Böblingen board).

Images: BITZER

Senator h. c. Peter Schaufler, CEO of BITZER SE, received the 2014 Baden-Württemberg Gründerpreis (founder's award) in the category "life's work" in Stuttgart. The award was presented by Dr. Nils Schmid, patron and Minister of Finance and Economics.

Sparkassen-Finanzgruppe Baden-Württemberg has been presenting the Gründerpreis in a variety of categories for 17 years. The category "life's work" was added eleven years ago. The award presented to Senator h. c. Peter Schaufler honors a lifetime of achievements, with a focus on entrepreneurial thinking and a high level of dedication to social issues. For instance, BITZER regularly supports the work of communities, organizations and social institutions. With the Schaufler Foundation, which he founded in 2005, Senator h. c. Peter Schaufler plays a key role in uniting entrepreneurship, vocational training and work placements

with research, science and art in the refrigeration segment.

### Schaufler Foundation

The Foundation will continue the successful life's work of the entrepreneur, which began when he joined his father's company back in 1963. Peter Schaufler has been Managing Director of the BITZER Group since 1979. Since then, the number of employees has increased from 250 people to more than 3,200. "I live for the company and would like to be a role model for my employees in every respect," explains Peter Schaufler. He recognized the importance of globalization very early on, positioning the Group on all continents by establishing new companies and acquiring other ones. BITZER SE is currently represented with 90 locations around the world and, following a study carried out by WirtschaftsWoche magazine, took 15th

place last year among Germany's 1,500 most economically powerful medium-sized companies.

Despite this global success, the world's largest independent manufacturer of refrigeration compressors and pressure vessels has remained true to its roots and its country of origin, Germany. Senator h. c. Peter Schaufler can take credit for this, too. In addition to commercial success, the well-being of its employees is also important to the BITZER Group.

The 2014 Baden-Württemberg Gründerpreis in the category "life's work" honors Senator h. c. Peter Schaufler, a person who has made countless contributions to the community in Baden-Württemberg as well as in Germany. "For me, the award is a great honor and confirmation of my entrepreneurial philosophy," Schaufler explains following the award ceremony. "I'd like to further pursue these ideals." ■



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# Building Management System



**A** proper designing and management system of any building is an important topic of present Environmental and Energy issue. The system adopted for designing and management protocol is called Building Management System (BMS). It provides great opportunities for improvements in energy efficiency by:

- Enabling building managers to provide an optimal working environment consistent with maintaining a building's energy efficiency rating
- Early identification of equipment failure
- Identification of unusual patterns of energy usage, such as equipment being left on out of office hours
- Monitoring effectiveness of Energy Management Plans.

It is very important to learn how these mission-critical facilities can be optimized using an integrated Building Management System and an energy efficient approach.

## What Is BMS?

Effective well utilised Building

Management Systems (BMS) provide the core management tool required by building managers to ensure compliance with, and achievement of, Green Lease requirements, such as the target energy efficiency rating, monitoring of the Energy management Plan (EMP), and reports for the Building Management Committee (BMC). It enables Building Managers to provide the optimal working environment consistent with maintaining the required energy efficiency rating while minimising the costs to both I and building owners and premises users. Effective BMS utilisation allows for optimal building performance by extending the operational life of equipment and systems through reducing loads and operating hours. Maintenance and capital costs are therefore reduced and less embedded energy is consumed through equipment replacement and upgrades.

When a building has been completed the impact of its structure on its energy consumption performance is normally fixed until refurbishment occurs. Base Building and Premises user Light and Power energy consumption can however



**Dr OmPrakash G Kulkarni**, recognized as Scientist at Global level in the field of Renewable Energy and as Inventor of World's first Solar Thermal/ Renewable Energy based Air Conditioning / Refrigeration system. He is Expert Advisor, member of Governing body of more than 13 Engineering Educational Institutions. He established three industries having footprint at Global level; was President and All India Head to Enercon India Ltd. and many other Govt./ Private organizations.



be increased or decreased by the performance of both building systems and premises users. A BMS will show increases in energy use due to equipment failure or adjustments to operating parameters. viz. - heating valves opening when the building requires cooling or whole floors of lights being left on for extended periods of time due to cleaning activity.

A BMS may also indicate that air-conditioning is starting up hours before the building is fully occupied due to activities of security staff. With this information in hand, the building manager may be able to rectify such issues through consultation or engineering solutions. In the absence of a BMS, the impact of such events can be disguised by seasonal variations, changes in occupancy levels or technology upgrades. A correctly configured BMS with an adequate number of correctly located monitoring points is the only way a building manager can be quickly alerted to problems which could otherwise remain undetected until annual inspections or external audits are undertaken. A BMS is

also a primary tool for identifying energy intensity improvement opportunities, for example refining the size and number of lighting time blocks, providing meaningful reports to the Building Management Committee on issues and opportunities, and enabling identification of faults, maintenance planning, and energy saving upgrades.

### Importance of Data in BMS

As the data centre market expands, power and cooling have become the primary focus for data centre managers and senior executives. The volume of online video, commerce, gaming and regulatory compliance requirements continues to rise, increasing the need for more data storage. The high demand for data centers identifies them as a critical asset for any business, whether the enterprise operates its own data center or uses calculation facilities.

For a BMS to function effectively, it needs to reside on a computer that has adequate capacity and speed to support BMS function. BMS related data storage of one year is required for all active control points. Computers and data storage hardware will normally require replacement at least once during an average tenancy. The BMS data collection network should have capacity to provide data to the BMS at required frequency, via an industry open protocol such as a fully compliant BACNET. Energy Efficiency and performance issues relating to BMS.

### Energy Intensity Enhancement opportunities through BMS

BMS energy intensity enhancement opportunities require free access of all parties to BMS data and agreement to share existing BMS capacity or fund required upgrades.

BMS is the building owner's primary management tool to ensure the Base

Building performs in accordance with the Green Lease Schedule, and for the premises user to ensure energy efficiency tenancy rating is maintained. It is critical to effective management and fault finding of the primary heating, cooling, and ventilation systems. On a day-to-day basis, it will be under the responsibility of a party identified in the lease. The responsible party will be obliged under the lease to operate, repair and maintain the building, and freely provide access, data and reports to the premises user, owner and BMC.

### Responsibilities of Building Owners and Premises Users

- A fully functional BMS configured to manage systems, identify faults, and provide the required reports for the premises user, building owner and BMC.
- Adequate monitoring, zones, scheduling and so to enable the building to operate at maximum possible energy efficiency consistent with premises user lease provisions.
- Positive support to the BMC committee and the energy efficiency assessment process, including timely and regular availability of data to relevant parties.
- A commitment to a continuous improvement strategy to increase energy efficiency rating.

The premises user's responsibilities include:

- Providing accurate and detailed information on premises user equipment loads.
- Providing a detailed schedule on occupation and equipment loads of premises used areas.
- Early advice on changes to usage of premises used areas.
- Providing positive support to the BMC committee and the energy efficiency assessment process,

including timely and regular availability of data to relevant parties.

- A commitment to a continuous improvement strategy to increase energy efficiency rating of contract.
- Vetting staff requests for system adjustments to ensure energy impacts are considered.
- Identifying changes to premises user work practices which would reduce energy intensity.
- Ensuring premises user contracts take account of energy consumption impacts. The responsibilities of the responsible party, as identified in the lease, include:
  - Daily monitoring of the BMS for faults and exceptions relating plant and equipment.
  - Maintenance of the BMS.
  - Management of temporary or permanent adjustments to control parameters in accord with Green Lease provisions.
  - BMS software and hardware upgrades.
  - Providing reports to Building Management Committee.
  - Manage upgrading of BMS as required by owner and premises users to support changes in space utilisation, equipment upgrades, or energy intensity improvement projects.
  - Providing timely and accurate advice and reports to the BMC.

### Comparison of BMS Capabilities

The capability of installed BMS systems varies from the most basic being virtually a time Clock (a device which turns equipment on and off) to that of a highly sophisticated and flexible management tool.

#### A high level BMS system will include-

- Fully support Green Lease premises user requirements.
- Fully support a wide range of best practice control strategies.
- Have a detailed suite of automated reports.
- Support simple set up of ad-hoc reports for maintenance or enhancement activities.
- Have an alarm hierarchy that flags relative importance of alarms.



- Not constrain use of improved equipment or strategies.
- Have capabilities that continue to be enhanced and evolved by supplier. When the power and capabilities of a properly configured high level BMS are fully utilised by maintenance staff, operators, and premises users, the payback period of the additional cost is normally very short. It can be less than one year, and is seldom more than five years from energy savings alone. Premises user satisfaction is generally higher through better environmental control, and ease of adjusting functional usage of the building.

### Integration of BMS with other Tools

Integration between a BMS and a business management system such as SAP requires a detailed configuration study. A high level interface between such systems can be implemented if care is given to the following.

A satisfactory alternative to a high level interface given the normal batching needs of business systems is for the BMS to download its readings of hours run, energy used etc, into a spreadsheet format at agreed times. The business system can normally be easily programmed to populate its data fields by interrogating the spreadsheet at agreed times.

The manager of each system is then responsible when modifying or upgrading their system to ensure data moves as required. This is particularly relevant when systems are owned and operated by different parties.

High level interfaces between systems will seldom be cost effective in small or medium environments.

### Best Practice Building architecture and Equipment Selection

The thermal performance of building architecture and energy efficiency limits of equipment are inherent in their design. They set the maximum efficiency a building can achieve without major refurbishment.

#### Building Architecture Optimization

It is important for new builds that the building envelope has good thermal characteristics, and that glazing and shading devices are selected to minimize heat loss in winter and gain in summer. They should conform to Section J of the Building Code of Australia [at the time of publication]. Design options could include:

- Minimum glazing to reduce summer heat gain and winter heat loss.
- Minimal use of floor to ceiling glazing, standard 800 mm sill height preferable.
- Maximum use of correctly designed sun shading devices to northern, western, and eastern building architecture to optimally control solar gain and loss.
- Specifying high performance coated double glazing [Low U and low SHGC as required].
- Additional wall and ceiling insulation particularly in climatic extreme areas. Equipment and Lighting selection The efficiency and effectiveness of equipment is improving exponentially. Often designers and consultants can be very conservative and only consider equipment which has been marketed for some years. While proof of performance is required this should be balanced against the dramatic improvements in performance currently available on an annual basis.

#### Guidelines for Selection: Equipment and Systems

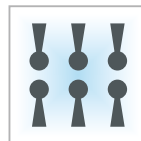
- Use of high efficiency variable speed centrifugal chillers, water cooled, with a good co-efficient of performance across the full anticipated load range.
- High efficiency gas fired condensing boilers, with Variable Speed Drive (VSD) pump sets.



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- Easiest option for water aeration to reduce BOD in waste water treatment.
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- Suggested installation drawing.

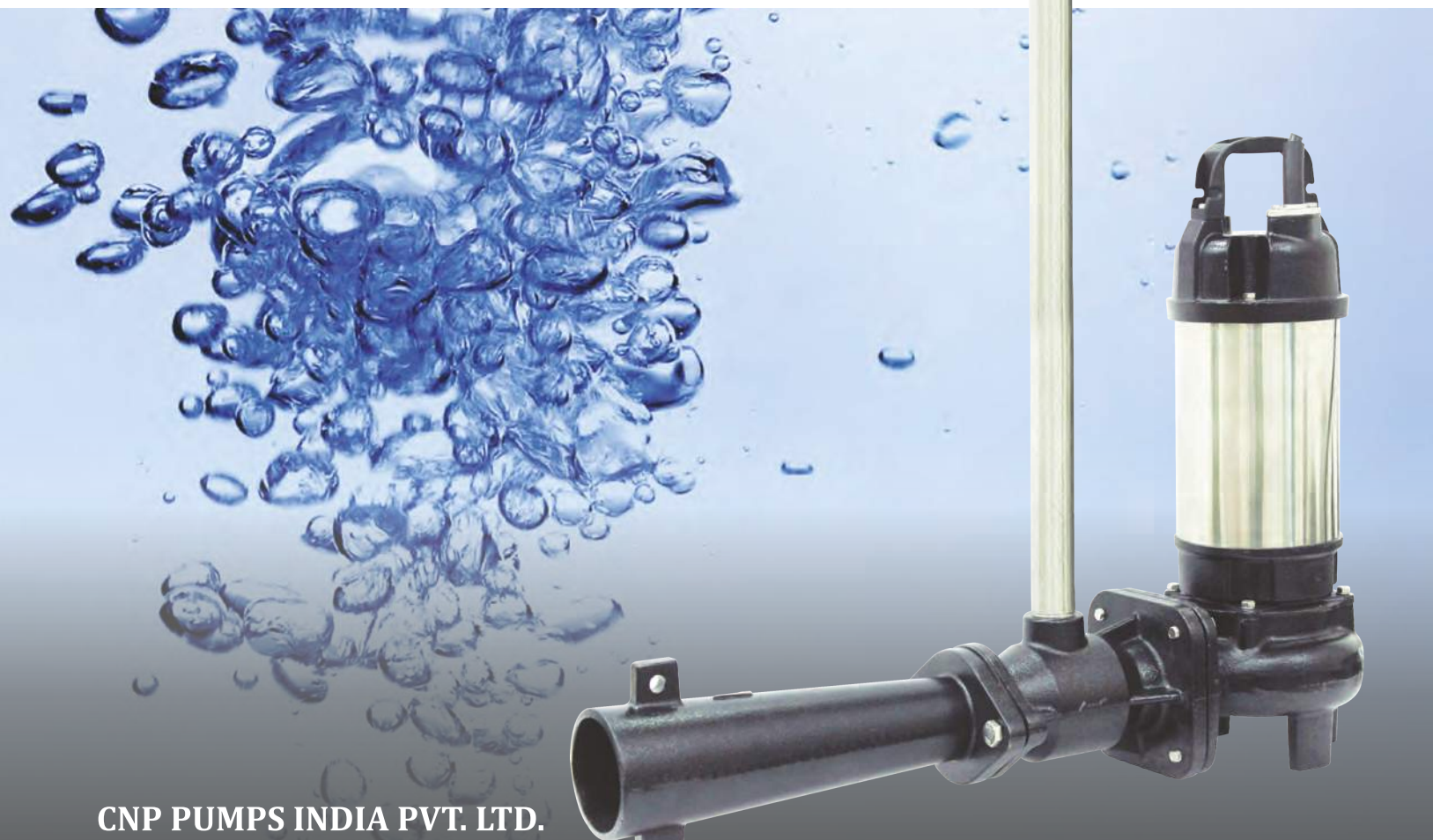
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- Use of co-generation or tri-generation where appropriate.
- Use of Variable Air Volume (VAV) or chilled beam high efficiency mechanical systems, with good zone selection (separating perimeter areas with different solar conditions, and special purpose area)] and without terminal reheats.
- Intake dampers sized for economy and night purge modes particularly in areas with cooler days and in particular nights.
- Fresh air dampers linked via the control strategy to return air CO sensors for reducing energy consumption in low occupancy periods.
- High efficiency fans, pumps and motors, maximizing use of VSD's.
- Local standalone systems if small 24 hour calls for conditioned air genuinely exist.
- Running central plant for a single small load is energy intensive, and shortens major equipment life expectancy.
- High efficiency solar or gas domestic hot water systems with water conservation devices.
- Lifts with variable voltage, variable frequency, AC drives including regenerative braking, and low use modes such as lighting which turns off.
- Metering incorporated in all key equipment with reporting capability to the BMS.
- Car parks to have VSD controlled fans and CO sensors
- Lighting to common areas (fire stairs, car parks, corridors, foyers) with two stage occupancy control where allowed.
- Lobbies and toilets on occupancy control.
- Light fittings to have high efficiency reflectors
- Lighting systems to have power consumption of 1.5W/m<sup>2</sup> or less per 100 Lux of light level.
- Lighting levels are even through zones and do not exceed specified levels.
- All ballasts and controls to DALI or equivalent standard. Best Practice control strategies and their

**An open system such as a fully compliant Building Automation and Control Network (BACNET) enables a wide range of compliant sensors controls and equipment which can flexibly plug and play without special programming.**

optimization Control strategy optimisation requires a well configured high level BMS coupled with correctly chosen and located sensing equipment.

### Mechanical Services

- An open system such as a fully compliant Building Automation and Control Network (BACNET) enables a wide range of compliant sensors controls and equipment which can flexibly plug and play without special programming having to be added or written.
- Automated seasonal temperature adjustment, lowering set point temperature at low temperatures and gradually raising through the seasons, giving immediate savings.
- Remote alarming to pager, mobile, I-phone, blackberry or fixed line as needed.
- Secure remote access as agreed for fault response, diagnosis, and premises user emergency need. For example, the premises user may need to set up a crisis response unit over a weekend or out of hours. Maintenance contractor may need to drive isolation valves to isolate a water leak, or remotely isolate equipment which has failed to the 'on' position.
- Scheduling calendar to be highly sophisticated so as to be able to check and adjust for daylight saving, Easter and other events which can be adjusted without programming skills. For example, shutting down unoccupied zones or temporarily varying working hours.
- High turndown capability utilising VSD's for reduced airflow in low occupancy periods: This generally

should go to 20 per cent or less of full flow.

- Use of CO<sub>2</sub> sensors in car parks and return air ducts to sense when air requirements are reduced. For example, in many car parks it may be sufficient for fans to run for one to two hours per day rather than 12 or 24 hours.
- Occupancy sensors, many areas have minimal occupancy at any time or highly variable loads such as conference rooms. In such cases it may be appropriate to provide minimal conditioned air during normal hours, and ramp up only when space is fully occupied. Ramp up can sometimes be most effectively provided by standalone units to avoid over sizing the central plant to respond to low frequency situation.
- Utilise enthalpy control in low humidity environments: This can improve air quality and lower energy consumption as air cools when moisture is added.
- Economy cycle to fully utilise free cooling: In many environments the outside air temperature is lower than return air temperature when cooling is required. Even when this is the case, the energy intensity of many buildings is such that during spring and autumn they may need cool air to maintain required conditions. If the fresh air intakes can provide more than minimum fresh air requirements then "free" 12 cooling is available from the atmosphere.
- Night Purge: In many hot climatic zones several hours of low overnight temperatures occur. If fans are run in this period this cold air can pre cool the internal structure reducing the day time cooling load at minimal cost during off peak tariff periods.
- Control zones to be limited in size, in the order of 100 m<sup>2</sup>, and of uniform thermal need. Do not mix perimeter and core space in a single zone or low heat generating offices with more densely populated open plan equipment intensive areas.
- Ensure sensors are correctly located. Sensors must be at the correct height, not above heat generating equipment, or hidden behind office



fit-out, within supply air flow, or where external events can effect. For example, a thermostat mounted on an external wall must be insulated from the wall cavity, or it will read cold in winter, and hot in summer. A thermostat used as a coat rack will have a delay in registering actual room temperature. A thermostat above a photo copier may consistently read four degrees higher than actual temperature when copier is at full power to correct temperature when it is in sleep mode.

- Calibrate sensors: While many modern sensors do not suffer accuracy drift over time, a base line error of up to one degree can occur. It is essential that offset to correct occurs at the zone or at the BMS so that control strategies utilise a true reading at all times.
- Calling after hours air conditioning: The ability to call must be limited to genuine operational needs in small areas, and turn off after a limited period or as soon as no occupation is detected. Many systems lack the turn down capacity to service small areas, so entire floors or wings are turned on for the comfort of one or two people. Consider providing airflow only and activate heating or cooling when two-four out of hours calls are made.
- CO<sub>2</sub> sensors for system control in low occupancy periods.
- Control strategies to have proportional control tailored to building needs, combined with adequate dead bands and predictive control algorithms. Systems must not overheat and then enter cooling mode (particularly in winter), nor over cool in summer then call for heating.
- Ideally no or minimal heating should be called by the system in summer, and similarly in winter minimum or no cooling should be required.

### Electrical Services

- Lighting controlled in zones by occupancy sensors, whose area will generally not exceed 100 m<sup>2</sup> unless special circumstances exist.
- Fire stairs on occupancy sensors with automatic override to full lighting during fire alarm events.

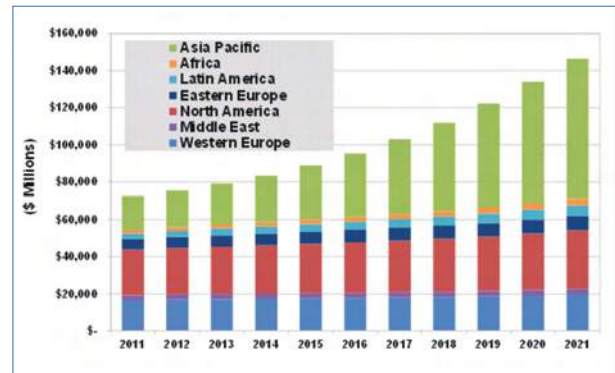
- Car park daylight adaptation lighting to be dual dimmer controlled by photoelectric (PE) cell and occupancy sensors.
- Car park lighting to have two stage occupancy sensor control covering normal and out of hours lighting levels.
- Perimeter office zones to have PE cells operating dimmer controls in addition to occupancy sensors.
- Entry lobbies to revert to occupancy sensor control outside of operating hours.
- General security lighting to minimum level required by security cameras. With modern cameras this is very low and less than human eye requires.
- Responsive security lighting to be event activated with time controlled manual override for emergency situations.
- External lighting as required by code and assessed safety need under PE control.
- Toilet lights under PE control.
- Metering of equipment and zones to be integrated through BMS to required reports.
- Lift operation to be optimised via intelligent lift controllers, with activity & consumption reports to BMS.

### Hydraulics

- Meters to report to BMS (number must enable excess consumption to system or zone).
- Temperature optimisation control of boilers, by control strategy.
- Flow meters to alarm on abnormal consumption.
- Boiler temperature reset optimisation, to match actual and predicted loads.
- Automated shut down valves in critical areas to avoid waste and damage from major failure, with BMS override function.

### BMS Configuration Active Point Control

- Must default to safe condition on



- failure and trigger alarm.
- All events to be achieved.
- Points to be actively interrogated on status to ensure they are operating and reporting.
- Point trending and graphing to be flexible and comprehensive.
- Demand limiting algorithm in place and load shedding if indicated.
- Alarms have priorities set to at least three levels, are placed in permanent archive file, with name of operator who responded to alarm. Archive can only be by a person with highest authority level, and only when record is over one year old.

### Graphics & User Interface

- To clearly present data required to check status of system or sub system without clutter and in logical visual presentation.
- Navigation from a graphic page either up to a system overview or down to sub unit or point history to be intuitive, point and click.
- Graphics available of all systems and sub systems.
- Temporary trend graphics able to be set up by all users, and not require high level skills or access.
- A full suite of reports is configured to enable effective management of system and building.
- Four level or equivalent user authorization level control. Programmer, system controller, maintenance staff, premises users.
- Simple click and point to data, graphics, and agreed control functions of each user.

The chart hereinabove shows that the demand for Building Automation Control Equipments is ever increasing. ■

Biola University  
supports the  
green energy  
movement  
by boosting  
**HVAC  
Efficiency**  
- Case Study



Biola University, La Mirada, CA, USA

*‘Optimized energy efficiency through a cost-effective solution that reduced energy waste and improved the bottom line.’*

**N**amed one of the nation’s greenest colleges, Biola University is a private Christian institution located on 95 acres in the residential neighborhood of La Mirada in Southern California. The campus offers more than one million sq ft of floor space housed in forty major buildings, many of which have been extensively renovated over the past decade to improve their energy efficiency, and decrease the university’s overall carbon footprint.

### **Reducing overhead costs to support campus expansion**

Chris Reyes, Manager, Central Plant & HVAC, is leading the charge to reduce overhead costs and operate an energy efficient campus by implementing green energy initiatives where possible. In 2011, Chris was given the task of determining if Biola University needed to make a financial investment to expand its HVAC system’s chilling capacity to accommodate a continually growing campus. New dormitories were required to continue with the expanding student population, and the university was concerned about the financial impact of having to bear the cost of both the dorm construction and expanding the current HVAC system. A possible solution was to find a way to increase the efficiency of

the existing HVAC system and delay the costly system expansion. The problem that remained was to find any possible cause for the current system not running as efficiently as it could.

Working with other facility staff members, Reyes noted there was a significant waste of energy caused by students leaving their HVAC systems on during periods when they were not occupying their rooms. As a result, the rooms were continually being air conditioned, thereby causing the university to waste energy. This waste was taxing the existing campus chillers to a point that they were nearing 100% capacity.

### **Reducing wasted energy**

The university uses chilled water as part of the cooling process for the campus buildings and Reyes needed to find a way for the HVAC system to be more efficient without increasing the current chilling capacity. He was looking for a way to eliminate the need to rely on the students to turn their systems off when leaving the premises. This would decrease the electrical and chilled water usage of the dorms, without sacrificing the occupant’s comfort. What he proposed to the university management was to implement a solution using a “smart” thermostat control system that



could detect when the dorm room was unoccupied. If the thermostat detected that there was no movement in the room then it would automatically shut off the fan coil to reduce energy consumption. By automating the process of thermostat control in the current dorms, Reyes deduced that the dorm rooms were unoccupied nearly 30% of the time. By controlling the wasted energy during the unoccupied times, the university could potentially save 100 tons of air conditioning during peak hours.

The 100 tons of saved air conditioning could then be distributed to other parts of the campus making the cooling process extremely energy efficient. This would improve Biola's bottom line through a yearly savings of more than \$11,500 on cooling costs. Using "smart" thermostats would also maximize the HVAC system's ability to cool the entire campus without an increase in energy consumption, taking the university one step closer to being a greener institution.

### Room controller advantage

The search began for components that would bring Biola's energy management solution to life; this led Reyes to Schneider Electric for their leading room controller offer.

The team at Schneider Electric recommended their SE7300 room controller with PIR motion sensor functionality as their solution for Biola. The SE7300 room controller is specifically designed to handle the advanced occupancy routines of campus dorms, while also providing automatic energy savings during occupied periods without sacrificing student comfort.

The pricing and performance of the SE7300 room controllers was what really convinced Reyes of the value of this project. The total cost of the project was less than \$200K, versus the monstrous \$1.2 million for a new chiller addition to the campus. Biola's goal of making its campus more efficient and green could be realized for a mere fraction of the price of the alternative.

### Leveraging open protocols to reduce costs

The SE7300 room controller is designed for new construction as well as

Biola University, La Mirada, CA, United States



retrofit projects. This was another great benefit for Biola as it would not only be able to retrofit its existing buildings, but also use these room controllers in the construction of a new student dormitory

*"Since it was the first project of this type for our office, and considering it was wireless, we anticipated possible cost overruns but in actuality the installation & program-ming went smoother than we thought & we actually picked up a couple extra percentage points in gross margin. Customer was happy with the job also."*

**Bob Meinking,  
Control Technologies West, Inc.**

*"At every stage the Schneider Electric team provided exceptional service. They design very good products and provide great customer support. It was such a positive experience that we have spec'd out their room controllers for all of our future dormitories."*

**Chris Reyes, Manager,  
Central Plant & HVAC**

opening in 2015. Moreover, this meant Biola could continue to delay the huge cost of expanding the university's HVAC system by leveraging the same plug-and-play room controller technology in the new building. This enabled Biola to breathe new life into his existing HVAC system without the extensive costs of additional software or drivers. The plug-

and-play room controllers from Schneider Electric easily integrated into the HVAC system meaning that the university could easily integrate them into the existing energy management system (EMS).

The SE7300 room controllers seamlessly connected to a secure wireless router and then was directed through Schneider Electric's (partner-installed) Andover Continuum building management system, which provided connectivity to the campus EMS.

Control Technologies West, Inc. completed the initial installation and integration of the room controllers in 2011. Their integrators replaced the existing Trane controls with the SE7300 fan coil controllers and third-party door switches.

The integration of the SE7300 fan coil controllers provided a quick return on investment. Biola University was able to delay the chiller plant expansion as the HVAC system no longer wasted chilled water sent to unoccupied areas.

In 2014, Biola University is set to construct its new dormitory equipped with room controllers with PIR motion sensors, door switches, and window lockouts. For Biola University, it is just another example as to why this innovative & environmentally conscious institution continues to rank as one of America's finest private Christian universities.

Biola University, named an "up and coming" national university by U.S. News & World Report three years in a row, is a private Christian university located in Southern California. ■

Courtesy: Schneider Electric India

# Managing IAQ in Green Buildings



*The Indian Green Building movement is one of the fastest growing in the world, with over 2 billion sq ft of space delivered or registered for the various types of green building certifications.*

One of the key requirements for a building to be classified as a green building is the quality of air that is available for the occupants of the space. Pollutants from the surrounding as well as contaminants generated from within the occupied space contribute to degrading the quality of air in the building. The impact on the occupant's health, as well as the equipment and systems within the space are impacted negatively due to the degradation of the air quality. Green buildings are thus designed to have optimal air quality, based on the type of usage of the building and the location, so that the impact on the occupants is minimized.

Air quality assessment is a critical aspect of understanding the kind of air that the occupants will be inhaling, and there are many sophisticated tools as well as protocols used in the industry to measure the quality of air. Along with the measurement, the means to address the air quality is another important area of study in the building design sector. Improving air quality has a reverse trade off in terms of the cost, as the higher the quality of air that is delivered, the higher is the cost that associated with the delivery systems. Designers thus have to find a trade off between air quality and cost, which is not always an easy task.

While green buildings have designs that theoretically deliver the most



**Aneesh Kadyan**, Director - Operations, is a Professional Engineer, a certified Energy Auditor and an IGBC Accredited Professional and heads the operations of a large team of professionals in the building and facility management arena. He is a post graduate in Mechanical Engineering. His areas of interest include Maintenance management, corporate governance, Strategic planning & technology interventions in Industry.



62.1.2007 – Ventilation for acceptable Indoor Air Quality and Standard 55 – 2013 – Thermal Environmental conditions for Human occupancy. Degradation in the air quality, either thermal or the presence of contaminants in the air impacts the health of the occupants leading to loss of productivity and consequential loss of revenues.

### How does air quality Degrade

The air inside a building (taking the case of air conditioned buildings that one comes across in the office environment) is mostly recirculated, with specified amounts of fresh air from the atmosphere introduced to maintain the air quality. Air Handling units (AHU) typically recirculate the air within the occupied space, with provision for controlled amount of outside air to enter. The AHU's have mechanical filters that trap contaminants, the fineness of the filter deciding the size of the contaminants that are trapped. The key sources of pollutants within an office are shown in Figure 1. The air quality is impacted by either the thermal

degradation or the air degradation, or a combination of both. Figure 2 lists the key contributors to each of these factors.

Air quality is designed to meet the ASHRAE or applicable standards. However, during the operational phase of a building, the air quality deviates from the design parameters, primarily due to poor maintenance or improper use of the ventilation system by the building operations team. Other factors, such as degradation of the external environment (dust storms, factory emissions etc.), variations in thermal conditions also impact the air quality of a building. Dampness in buildings, especially near the washrooms and wet pantry areas is another source of air quality degradation as it leads to growth of fungi, microbes etc. which in turn impact the IAQ.

### Green Building IAQ requirements

Various Green buildings standards exist, such as the United States Green Building Council (USGBC) LEED

optimal air quality, the key aspect that is worrying buildings owners as well as occupants is how much of the theory is put into practice – does a three year old green building still have the same air quality that it was designed for. Deterioration in air quality, either due to natural wear and tear of systems, or by changes in the design or poor maintenance can all impact the air quality.

This article presents an overview of the air quality requirements of a green building, and how the building maintenance team can ensure that the air quality is maintained as per original design intent during the life of the asset

### What is Indoor Air Quality?

Modern offices are characterized by air conditioned spaces that are sealed from the outside environment. The two key parameters that building designers and managers lay emphasis on with regards to the internal environment are the air quality and the thermal comfort of the occupants. The most commonly adopted standard used in the industry for ventilation is the ASHRAE standard

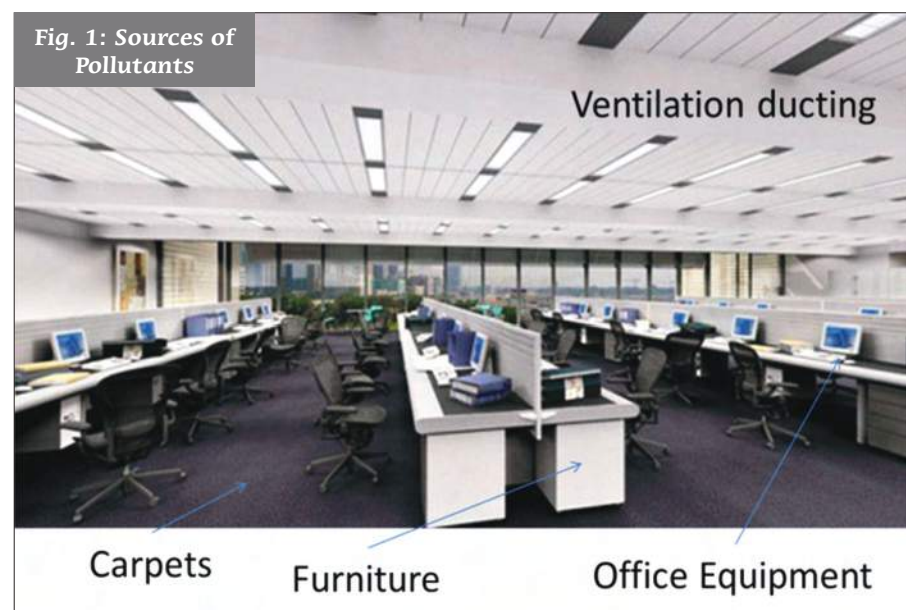


Fig. 1: Sources of Pollutants

Thermal
<ul style="list-style-type: none"> <li>• Temperature</li> <li>• Humidity</li> <li>• Air movement</li> </ul>
Air Pollution
<ul style="list-style-type: none"> <li>• Suspended particles (Microbial, Animal/Plant, Mineral and Radioactive)</li> <li>• Tobacco Smoke</li> <li>• Volatile Organic Compounds (VOC) - (From carpets, paints, photocopiers, from outside, etc)</li> <li>• Human respiratory products/Odour</li> <li>• Ozone-from photocopiers, laser printers</li> </ul>
<b>Fig. 2: IAQ components</b>

levels of pollutants and hence is a more useful standard to refer to when aiming to enhance the IAQ of a occupied space. The salient features of the EB rating systems with respect to IAQ are:

- ETS: Provision of smoking room and also demonstration of policies that emphasizes no smoking in occupied spaces

(Leadership in Environment and Energy Design), Indian Green Building Council (IGBC) rating systems, GRIHA etc. The key features of these rating systems, with respect to the air quality are shown in Figure 3.

While most of the standards are focused on the new buildings and lay emphasis on the design aspects that will address IAW requirements, the Existing Building (EB) rating system focuses on the health of the thermal and ventilation systems as well as actual

- Measurement of ventilation rates and benchmarking with standard – for office spaces, 5 cfm per person/0.06 cfm per sq ft.
- Carbon Dioxide monitoring systems (a differential level of 530 ppm)
- Isolation of potential pollutant zones (store rooms etc.), provision of exhaust in such spaces
- Use of ecofriendly (green) chemicals
- Thermal comfort: Maintaining humidity levels of 30 – 70 and air conditioning temp at 26 degrees

### IAQ management Plan

The quality of air inside a building is dependent on a number of factors, both internal as well as external. Location, type of use of building, hours of operation, use of hazardous substances, etc. All effect the air quality. Thus, to be able to achieve the optimal level of air quality, an asset specific IAQ plan needs to be implemented rather than putting in place a generic program for air quality improvement. The key aspects that a building or office manager needs to consider when putting together an IAQ management plan are as follows:

- **Top Management involvement:** No IAQ plan can succeed if there is no buy in from the senior leadership, who need to understand the importance of a healthy work place and its link to employee productivity.
- **Review of work procedures:** Analyzing the way existing work is undertaken can bring to light potential sources of pollutants. Storage of hazardous chemicals and their use can be regulated or



### Enviornental Tobacco Smoke (ETS) control

- prohibit smoking totally, or no smoking within 8 m from rnares
- Designated smoking rooms, with a specified negative pressure



When the AQI is in this range:	Air quality conditions are:	Air symbolized by this color:
0 to 50	Good	Green
51 to 100	Moderate	Yellow
101 to 150	Unhealthy for Sensitive	Orange

### Air Quality

- Indoor and Outdoor air quality ( CO2, CO NO etc) monitoring
- Ventilation rates that surpass the ASHRAE standard by min 30%



### Constrcution air qulaity monitoring plan

- Limits to concentration of various particulates matter
- Air testing protocols



### Use of Low emitting substances

- Adhesives, Paints, sealants etc
- Flooring Systems

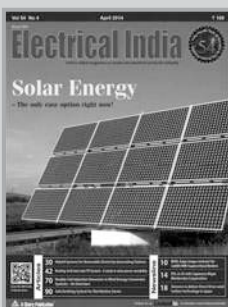
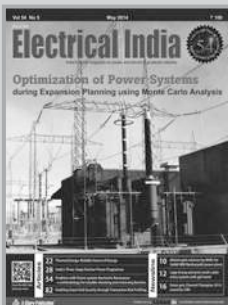
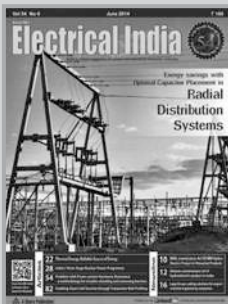


### External chemical and pollutant control

- Use of filters, isolation of entry points
- Hazmat disposal plans

**Fig. 3: IAQ requirements in Green Buildings**





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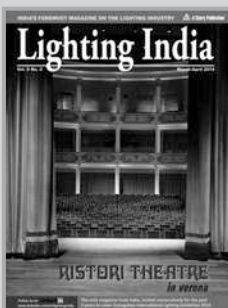
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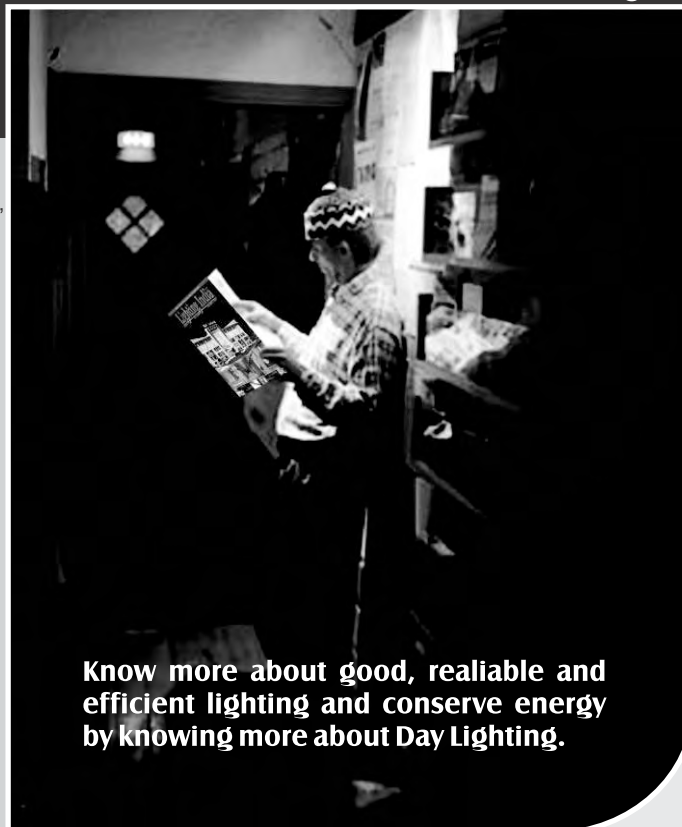


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stowage location changed to prevent harmful chemicals from getting into the air stream. Similarly, peripheral cleaning by housekeeping staff leads to dust in the area surrounding the building. If this task can be shifted to a time when the occupancy is low, the impact of dust in the air intakes will be minimal.

- Measurement:** Without knowing what your air quality is, you will not be able to quantify the level of degradation in the office air. Regular measurement of air quality is essential to monitor the impact of operations on the ambient air. Typically, IAQ measurement for at least carbon dioxide, particulate matter and microbiological matter once in six months is recommended. The measurement needs to be undertaken at as many points as possible to capture any localized IAQ problems. At a recent IAQ test at a MNC's office, the office space of the senior management floor turned out to have the poorest air quality which was on account of the limited fresh air that was being let into the air stream. The problem was resolved by changing the fresh air inlet percentage at the AHU.
- Preventive strategies:** In addition to the suggestions that arise out of the IAQ test report, a proactive approach to maintaining air quality will go a long way in keeping the workforce healthy and productive. Simple steps such as using low VOC paints whenever any spot painting is undertaken, enclosing the photocopying machines in one place that is cut off from the ventilation stream, regular vacuuming of carpets and implementing a policy of not allowing employees to bring food and beverage to their work stations to prevent growth of microbiological contents etc. are some of the ways that office managers can proactively help improve the IAQ.

## Conclusion

As the service industry grows and other segments of the economy grow, the need for more and more office space will increase, bringing with it the associated issue of having a healthy work place. Modern air conditioned spaces have limited ingress of fresh air to reduce the air conditioning load which has a negative impact on the IAQ. As managing costs are essential for business growth, the role of the building and office manager becomes even more important in maintaining the IAQ. Green buildings are designed to have better IAQ. The onus again rests with the building manager to ensure that the design intent is adhered to during the building operations so that IAQ is not impacted. While there are additional costs involved in maintaining the IAQ as per applicable standards, the cost is more than recovered through higher productivity and better employee morale. ■



# Heat exchanger for every application

## Packaged Goods



GACC GHF GDF DHF

Insensitive goods, maximum utilisation of room

## Freezer Storage Rooms



GHN

High performance required, frost formation on cooler possible, large air throw, large air quantity

## Fish, Meat Processing



GHN GBK

Sensitive goods, respect of hygiene requirements, corrosion protection available

## Fruit and Vegetable Storage



GHN DHF GACA

Sensitive goods, prevent dehumidification, select small  $\Delta t$ , large face area

## Blast Freezing



GFN GHN

High performance available, external pressure, observe frost formation on cooler

## Processing Rooms



GBK DHF

Rooms with staff – prevent air drafts

## Storage of Cheese



GDF GACC GHN DHF

Sensitive goods, corrosion protection available

## Stockage



GACC DHF GDF GHN

Various performance levels available, special coolers available, lower operating costs

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# Building Management System Market in India

## by Frost & Sullivan

*Growing industrialization and increasing usage of fossil fuels (coal) have greatly impacted the increase of CO<sub>2</sub> emission levels. It is observed that during the last decade (2000-10) the CO<sub>2</sub> emissions grew at a fast pace.*

India has set its target of reducing 20-25% CO<sub>2</sub> emissions of its GDP by 2020. As per the National Greenhouse Gas Inventory, direct CO<sub>2</sub> emissions from industrial sources accounted for nearly 31% of the total CO<sub>2</sub> emissions in the country.

The target has provoked the Ministry of Environment & Forests (MoEF) to upscale efforts to create the National Mission for Enhanced Energy Efficiency (NMEEE). As per the Energy Conservation Act of 2001, the NMEEE is part of the eight missions ("National Solar Mission; National Mission for Sustainable Habitat; National Water Mission; National Mission for Sustaining the Himalayan Ecosystem; National Mission for a Greener India; National Mission for Sustainable Agriculture and National Mission on Strategic Knowledge for Climate Change") that were created by the National Action Plan on Climate Change (NAPCC) to address inefficient energy usage in the country.

As a part of the NMEEE, the Bureau of Energy Efficiency (BEE) introduced the Energy Conservation Building Code (ECBC) in 2007 to lay out energy conservation guidelines for the building sector. The mission augments the need for Building Management System (BMS) with integrated energy-efficient (EE) products and services to be installed in end-user facilities. It is observed that increasing penetration of EE products and services in the end-user segment will have a direct positive impact on the CO<sub>2</sub> emission reduction plan. Moreover, it is expected nationwide implementation of the code will save 1.7 billion Kilo Watt Hour (kWh) of electrical units annually.

### Integrated Building Management Systems (IBMS) Market in India

The commercial building space has seen unprecedented growth in the country since 2005. The total building space, which was around 21 billion sq ft in 2005, is likely to undergo a five-fold increase and become 104 billion sq ft by 2030.

The Indian market for BMS is yet to catch up with the seamless integration (integrating several sub-systems within the IBMS architecture through open protocol) approach seen globally. It is mainly focused on the basic level of integration (Level 1 and 2) in many small, medium, and big enterprises

irrespective of retail / housing complexes, industrial houses, corporate offices, etc. due to limited awareness and funding limitations. The need for energy efficiency amid widening power shortage and surmounting pressure to reduce the operating expenses (OPEX) of the facilities / buildings is likely to boost growth of the IBMS market in India.

Other growth boosters include the need for heightened safety, security, and comfort. The IBMS market is expected to grow in sync with investments in the construction sector and market for safety systems, security systems, Heating, Ventilation and Air Conditioning systems (HVAC), lighting systems, & energy management services.

### Market Assessment

The IBMS market has been assessed by Frost & Sullivan under five major levels of integration.

Apart from end users and system integrators, OEMs play a major role in shaping the growth of the market. BMS offers a wide spectrum of opportunities to the OEMs and distributors / system integrators to be efficient by developing products and integrate effectively. In addition, the consultant / contractor needs to incorporate

BMS in the building design right from the conceptualizing stages to avoid errors, thereby raising the energy efficiency bars for fruitful payback. On the other hand, the end users (owners / occupants) enjoy the benefit of controlling, monitoring, optimizing, and reporting the operations of building facilities, thus enhancing safety and comfort levels.



Exhibit 1: IBMS Market - Levels of Integration (Source: Frost & Sullivan)



Level IV and V integration is growing at a fast rate due to the growing acceptance level that building performance can be improved by introducing seamless integration, as it can bring down energy cost, improve efficiency, & diminish energy usage.

### Competitive Scenario

The competition is highly intense at Level I as the complexity of integration is simple and is targeted at regional markets. Climbing up the ladder reduces competition as only a few prominent participants have the technical prowess and integration capabilities to handle such complex integration.

Intense competition in the market further shrinks the participants' profit margins but it encourages large and medium-sized companies to offer top-notch designs, installations, commissioning, overseeing, and training.

Acknowledging the vast opportunities in this market, many leading international and domestic participants are looking at mergers and acquisitions to expand their geographic reach, product portfolio, and to grow inorganically.

### Market Synergies with Energy Service Companies (ESCO) & Facility Management Companies

#### Operation & Maintenance (O&M)

The O&M activities of BMS may either be provided directly by the company as in-house servicing or the manager is an employee of the professional facilities management company to whom the services have been outsourced. The facility managers often face challenges of reducing operating expenses by 10-15% year-on-year. However, the challenge is aggravated due to increasing cost of electricity and cost of maintaining the facilities.

#### Energy Management

The ESCO are also increasing their focus on providing energy efficiency implementation solutions, through funding models such as guaranteed and shared savings model.

#### Market Opportunities

Some of the market opportunities for end users are listed in the exhibit 2 herein.

In corporate offices / commercial buildings, lighting controls operate separately due to proprietary protocols.

In a housing complex, home automation serves the purpose; however, integration with BMS will enhance the scope and thus provide wider capabilities.

In industrial houses / factories, industrial automation plays a key role by controlling the processing equipment and maintaining effective production processes. However, integrating building management with industrial automation will ease the efficiency level as both utilize and control electrical energy.

Many case studies have found that 13% energy saving is possible with IBMS in a platinum-rated green building. According to Confederation of Indian Industry-Godrej Green Building Centre (CII-GBC), the total power consumption was 479 kWh per day without IBMS, which was reduced to 415 Kilo Watt Hour per day when IBMS came into play. A study conducted by The Energy and Resources Institute (TERI) of 18

End-user Segments	Opportunity Areas
Retail	Largely integrates HVAC, lighting, and Closed Circuit Television (CCTV)
Hospitals	Require fully integrated BMS, customized to include patient management systems
Hotels	Require fully integrated BMS, customized to include room management or hotel automation Largely integrates HVAC, lighting, and access control for room management Energy management is an important requirement
Airports	Require fully integrated BMS; a system that is also able to integrate passenger management system is preferred
Offices (IT / ITeS / BFSI)	Require fully integrated BMS, customized to be integrated with lighting controls Mid-size enterprise integrates only HVAC & lighting Energy management is an important requirement
Residential Buildings	Require BMS, customized to meet the home automation solution to enjoy complete energy management of the home
Industrial Buildings	Require BMS to integrate with the complete industrial automation solution to meet the effective energy management needs of factories and offices

Exhibit 2: Key Opportunities for End-user Segments  
Source: Frost & Sullivan

premier hotels in India found that energy conservation measures can lower electricity bills by 15-20%.

### Conclusion

The BMS projects require significant upfront capital investment based on the size and scale of the project, which many small and medium enterprises may be hesitant to accept. The high price restricts BMS companies to target mostly large enterprises / companies that have the requirement to save energy & capabilities to fund such projects. Therefore, offering a customized low-cost system for small and medium enterprise segments and be competitive to the third-party system integrators who source quality components at lower costs.

The growing awareness among customers has catapulted the growth of proprietary protocols. However, the complexity of integration and increase in maintenance cost have enabled the BMS companies to offer systems that integrate with the products of any manufacturer, thus maintaining their market share as open systems are becoming the norm globally.

It is also observed that customers are gradually moving away from price-based to value-based products and systems. Some of the key success factors will include product differentiation in order to gain competitive advantage. Integration of BMS in data centers and evolution of smart building technologies will propel the growth of this market. This will lead to aggressive marketing on wide product offerings, low cost of ownership, and the return on investment in order to cope up with the growing needs of the future. ■

Courtesy: Environment & Building Technologies Practice, Frost & Sullivan

# Crowne Plaza Copenhagen Towers

The world's greenest hotel



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*The new Crowne Plaza Copenhagen Towers in Copenhagen, has been designed with sustainability at top of the mind. The hotel is one of the first hotels to meet the standards in the EU Green Building Programme. In terms of energy consumption and the environment, the hotel is several steps ahead of most other hotels in the world.*

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**C**rowne Plaza in Copenhagen is a luxury hotel in international class when it comes to guest comfort, service, & conference facilities etc. At the first glance, there is nothing green about the 85 m tall, black hotel, Crowne Plaza. However beyond the shiny facade there is a building that sets new standards for sustainability and low energy consumption. This hotel shows that comfort really can go hand in hand with sustainable solutions.

### **Innovative energy solutions**

In order for energy consumption and CO<sub>2</sub> emissions to be as low as possible, the hotel insisted on the most innovative energy technology throughout the building.

In the basement of Crowne Plaza one of the worlds most advanced ATES (Aquifer Thermal Energy Storage) systems are located. With this system cold groundwater is used for cooling the guest rooms during summer. The heat



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rejected from this process is reused for heating during the winter.

Combined with the building's variable airflow volume (VAV) ventilation system it is ensured that guest rooms, lobby as well as conference facilities are cooled, heated & ventilated individually and in accordance to the actual load. All in all the building's ATES and VAV systems ensure that costs for air-conditioning and heating is significantly lower than that of other hotels. The system delivers 4.1 MW of cooling and 2.4 MW heating.

The hotel was opened in 2009 but has already won recognition by winning several prizes. Latest by the organisation Skål International EcoTourism Award in October 2010 for the project "The World's Greenest Hotel."

### Aquifer Thermal Energy Storage, (ATES) for heating and cooling

To find the Copenhagen Tower's star performer in terms of reduction of energy consumption we have to go underground. Here, the ATES system Aquifer Thermal Energy Storage delivers cooling and heating for the building's

high performance HVAC system. This system represents one of Denmark's first ground-water based cooling & heating systems. The hotel's total annual energy consumption is a remarkable 51 kWh per square meter for heating, air-conditioning, domestic hot water and ventilation. And the ekstra investment in the ATES system really pays off. The ATES system has a projected payback time of only six to seven years.

This means that the Crowne Plaza Copenhagen Towers is both greener and in the long term more profitable than its competitors.

### Cooling mode during summer

Groundwater from an 8°C cold well is circulated through an exchanger that cools water in the hotel's hydronic air-conditioning system. In this process the groundwater is heated and subsequently returned to a warm well in the aquifer. The warm well and the surrounding groundwater heats up to approx. 16°C during the cooling season.

During this process no active refrigeration is required. The COP is as high as 41. The "free cooling" process covers up to 60% of the buildings total cooling need. Two ammonia chillers are standing by to cover peak loads between 60 and 100%. Heat rejected from the chiller's condenser is stored in the warm groundwater well too. By reversing the flow the warm groundwater is now available for heating during the winter season.

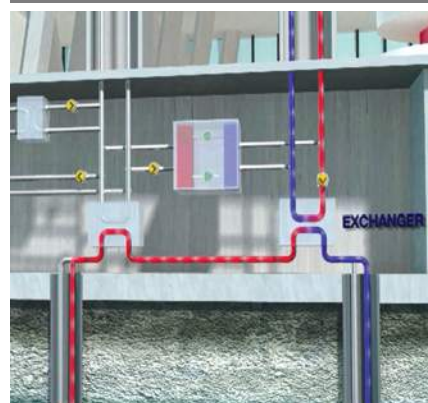
### Heating mode during winter

During the heating season the chiller is turned into a heat pump. After the cooling season the warm well is charged with warm ground water which is utilized by the heat pump during the heating season.

In this way the ground water is cooled and returned to the aquifer's cold well. The water is returned at a temperature similar to the temperature of the untouched ground water. In order to maintain a high COP on the heat

Load [%]	Capacity [kW]	Groundwater [kW]	Chiller [kW]	Pumps [kW]	Compressor [kW]	COP	ESEER [ratio]
100	4200	2474	1726	3x28	2x90	15.3	0.03
75	3150	2474	676	3x28	1x75	19.8	0.33
50	2100	2100	0	3x17	0	41.2	0.41
25	1050	1050	0	2x7	0	75	0.23

Table showing ATES system performance in accordance to the cooling load



pump, the hydronic heating system is designed as a low temperature system with a flow temperature of 60°C and a return temperature of 30°C.

The ATES system must achieve thermal balance over the course of a full cooling / heating cycle. If there is excess heat in the warm well at the end of the heating season, this is removed using a back-up cooling tower.

In peak load situations and when the aquifer's warm well temperature sinks to

Load [%]	Capacity [kW]	Temperature set [°C]	Pumps [kW]	Compressor [kW]	COP	ESEER [ratio]
100	2340	30/60	3x28	2x295	3.5	0.03
75	1750	30/55	3x28	2x216	3.4	0.33
50	1170	30/50	3x17	1x245	4.0	0.41
25	875	30/45	2x7	1x179	4.5	0.23

Table showing ATES system performance in accordance to the heating load

a temperature close to the temperature of untouched ground water, a stand-by heating source can be activated. This additional heating source is a district heating system.

### Highly compact measures

The ATES system is designed extremely compact. The entire system - without distribution equipment - occupies only 8 x 10 meters.



To maximize energy savings and high heating temperatures, ammonia is used as a refrigerant. Moreover, refrigeration machines optimized application of frequency converter and open economiser.

### Ground water wells

There are three cold water wells and three hot water wells (depth: 110 m) each supplying 80 m<sup>3</sup> of water per hour. The upper 20 m consists of sands and gravel and larger stone, followed by a layer with relatively dense lime without any significant groundwater content. At a depth of approx. 40 m the more fractured bryozokalk is found. The upper 40 meters is fitted with a closed pipe that is permanently fixed in the soil and limestone layers with concrete. From approx. 40 to 100 meter the well is made as an open well in the cracked limestone layer. The wells are located in the building's two storey basement. The wells are artesian in basement level.

### ATES system in outline

- Cooling capacity with groundwater only: 2.1 MW at 12/18°C, COP: 4.1
- Cooling capacity with groundwater and chillers: 4.1 MW at 12/18°C, COP: 14 Heating capacity: 2.4 MW at 60/30°C, COP: 4.0.
- Chillers: Ammonia (NH<sub>3</sub>) variable speed screw compressors

with plate type evaporator and condenser with oil separator and cooler.

### Frequency converters throughout

The two chillers are fitted with frequency controlled screw compressors which enable the chillers to adjust the capacity to the actual load, with the same efficiency.

Chillers rarely run at full capacity and it is important that the efficiency is high, regardless of at which duty point the chillers are running.

Ground water pumps and all other pumps both in the ATES system and in the hydronic air-con and heating systems



Grundfos TPE in-line pump, with built-in frequency converter

are provided with frequency converters in order to let the pumps adapt to variations in flow requirements. Frequency converters are both built-in and delivered separately.

All sunny facades on Copenhagen Towers are equipped with ultra-thin high technology solar cell panels. The installation constitutes Northern Europe's largest private array of solar cells, producing annually more than 200,000 kWh. This constitutes around 15% of the hotel's annual power consumption. The total solar cell capacity is 270 kW. The remaining 85% is bought as green energy produced by wind turbines. Both the energy efficient ATES system and the solar cells are part of the hotel's green profile.

### More green initiatives

Several other initiatives have been taken to reduce CO<sub>2</sub> emissions as far as possible and to ensure that the hotel achieves its aim of sustainability.

- The hotel's guests literally get to feel the green profile of the hotel. Everything from the shampoo bottle to the tooth brush is made of corn and potato starch. The revolutionary, organic material looks and feels like plastic but is both recyclable and biodegradable. And of course the products contain no parabens or allergenic substances.
- The hotel information folder and similar printed products have been done away with. All information to the hotel guests are now delivered electronically in an interactive TV



screen information system that is very similar to web pages and is therefore intuitive.

- All components in the hotel IT infrastructure – both switches, routers, access points and not least laptops- are chosen from the energy consumption and recyclability – even taking the packaging into consideration.
- The kitchen is – wherever possible – built up around the latest induction technology. Induction stands out by turning on and off instantly and heating immediately and only where it is needed. Thereby heat waste in the kitchens is minimized drastically.
- Handling of waste products from the kitchen is another substantial investment in technology and environment. All food waste in the hotel is grinded and stored in a tank in the basement. The waste is transported to a biogas plant & the remains from this process are used to fertilize farm land.

- Food is delivered only 3 times a week instead of once or twice every day. The aim is to reduce the carbon emission from transportation of goods and collection of packaging. Food deliveries are as far as possible only accepted from companies located within a radius of 300 kilometres.
- The traditional company car solution has been eliminated. Crowne Plaza has bought two electric Citroën C1's which are mainly used by the hotel's sales team. The hotel's staff is encouraged to use public transportation, as there is no employee parking at the hotel.
- All guest rooms are ventilated with VAV (Variable Air Volume). The air volume is automatically adapted according to the temperature and occupancy.

### Grundfos products

Grundfos delivered all pumps for the buildings airconditioning, heating,

water boosting. Following products were supplied specifically for the ATEs system.

- 3 pcs. NB 65 200/219 end-suction pumps with external frequency converters. Primary pumps in the buildings hydronic heating system
- 3 pcs. NB 125 315/290 end-suction pumps with external frequency converters. Primary pumps in the buildings hydronic cooling system
- 2 pcs. NBE 65 250/254 end-suction pumps with internal frequency converters. The pumps are dedicated for the chillers condenser circuits
- 2 pcs. NBE 100 200/195 end-suction pumps with internal frequency converters. The pumps are dedicated for the chillers evaporator circuits
- One TPE 80 340/4 in-line pump with internal frequency converter. Serves primary cooling tower circuit
- One TPE 80 370/4 in-line pump with internal frequency converter. Serves secondary cooling tower circuit. ■

The advertisement features a central circular graphic with the text "Our Products" and a list of items: Air Curtains, Laminar Flow Bench, Clean Rooms, Air Shower, Fan Filter Units, Air Cooling, Air Filters, and Pass Box. Surrounding this central text are images of various equipment: a white air curtain unit, a blue laminar flow bench, a white cleanroom unit, a white air shower, a white fan filter unit, a white air cooling unit, a white air filter, and a white pass box. A photograph of a cleanroom interior is also included.

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

**Sam Products Pvt Ltd**  
 B-137, Sector-6, Noida, U.P. 201301, India Email: samproducts@vsnl.com, samproducts1992@gmail.com  
 Mob.: +91 98100 65139

# Offering very high quality and cutting edge solutions



**Pathik Gopani**, Managing Director, Expedio Green Water Pvt Ltd, in an exclusive interview with **Cooling India** says, we would like to tie up with like minded companies who are involved in providing hi-technology, sustainable green solutions in the market.

## Could you share details about your company?

Gopani Products Systems and other Group Companies, Expedio Green Water etc are involved in filtration and water treatment verticals. And what we do is we filter everything that flows, be it liquid or air or gas. And most of our products are sold in refineries, petrochemicals, cooling tower industry and our systems are used by water treatment and sea water desalination industry. We export all our products throughout the world offering very high quality and cutting edge solutions.

## What according to you is the scope of the HVAC industry in India?

We have been observing, several issues in HVAC; one is whenever you are using a cooling tower, cooling tower blow down is an effluent which has to be treated. We have processes, systems and products that in a big way are

into treating the cooling water in the blow down effluent but we also have systems that take care of cooling tower in the sense that it does not allow the scale build up in the cooling tower. Expedio clear water system is one such system which converts the water into reductive form and it increases solubility of magnesium, calcium & other salts into water. In the same action it also sucks out the scale. We strongly feel that we will have a wonderful market in HVAC industry.

## What product range was displayed at the ACREX 2014 exhibition?

We found that there is lot of energy loss in cooling towers and also a lot of manpower is required. Now in cooling tower you have to have water softening systems that should take out the salt, before the water enters the cooling tower. But, this is the only a part of the solution. Our product, Expedio Clear water Machine with specific



low voltage and high-frequency electrolysis technology. It electrolyzes the water into weak micro molecule reductive water and active water, enhancing the water's solubility and ability of dissolving scale. The specific electric field changes the crystallization of  $\text{CaCO}_3$ ,  $\text{Mg(OH)}_2$  and other scale, inhibiting the formation of scale. The active micro molecule water, electrolyzed by the specific low voltage and high frequency by patented technology, gradually dissolves the scale existing in the inner walls of pipes, heat exchangers, cooling tower etc. The sucking baskets suck scale and rust onto their nets, making the process of removing scale and rust visible. Meanwhile, the active micro molecule water generates a protective membrane in those equipments, preventing the corrosion of pipes and equipments. Its sucking baskets will produce lots of  $\text{O}_3$ ,  $\text{OH}$ ,  $\text{O}_2$ ,  $\text{H}_2\text{O}_2$ ,  $\text{O}_2$  during the electrolysis process. These products have excellent sterilization efficiency, so that they can kill algae and bacteria effectively.

#### How was the experience at Exhibition?

This is our first outing on the HVAC expo and we are seeing a lot of people taking interest in our clear water machine. Everyone seeks maintenance & manpower free solution and this is the right kind of solution for them according to many but we have to wait and see since it was the first day we really didn't know what to expect. But we feel that since we are concentrating on HVAC vertical we will have a lot to take from this expo.

#### Could you detail us about maintenance of the product?

As far as the expedio product line is concern it requires very little maintenance. If you think in perspective, when you have a water softener you need to have complete solution of water softener and a team people that works around it. You have to continuously monitor the performance of the softener but incase of Expedio you just have to throw these baskets in to the cooling tower basin, no manpower is required, and the Job is done ! No scaling, no bacteria. Expedio clear water machines are thoroughly checked and we guarantee this system for performance from the period of one year from the date of supply and if anything happens we replace the whole machine there are no repairs.

#### Would you tell about the production capacity?

Well this is a new product we can produce as many or as little as one wants but we don't know exactly where this smart tech will lead us to. But we feel that there is a scope of setting 5000 of systems every year in India. We are looking forward to developing the market and take it to 5000 systems a year.

#### What are the overall growth plans for the company?

Gopani group has 3 different companies. Currently we are focusing on the cooling towers recirculation water and blow down water treatment. I think there is lot of scope in the market for this type of system.

#### Who are your main competitors?

We have not seen many competitors in our Expedio Clear Water Machine but as far as Porex Tubular Micro Filtrations System is concerned, our competitors are into conventional water treatment technologies which we feel have a lot of scope to improve but in our case our systems works very efficiently and these membrane last for 7 to 8 years. So you have an early payback period but a very long life of membranes.

#### Do you have collaboration with any company?

We are attached with global leaders in their respective fields. Porex is one such company. We also work with Grace-Taiwan which is also one of our very strong collaboration. We also work with industrial filter manufacturing company, Canada; Atlas filtri, Italy; Entegris from USA etc. Gopani, Uniexcel and Expedio with its products and products of all other partners, are a force to reckon with in various technologies.

#### Could you tell about the marketing structure, policies and strategies that you adhere to?

We would like to tie up with like minded companies who are involved in providing hi-technology, sustainable green solutions in the market and right now we are appointing distributors around the country. We have already appointed few distributors who are focusing on different regions and areas. Our team is headed by vice president Pranav Shah under leadership of Executive Director Sudeep Nigam who have immense experience in sales, marketing and technology. And we feel that by the year 2015 we should have close to 30 distributors in 30 major centres for our product. We are looking at building services industry, malls, large buildings, centrally air conditioned spaces, cold storages etc.

#### Where would you envision the company in the next two years?

We expect to be in the region of 50 to 100 crores turnover for Expedio Green Water. GOPANI and UNIEXCEL are already seasoned players in the industry but Expedio has yet to grow. An we hope to be in zone of 50 to 100 crores in the year 2016. ■

**Expedio Green Water venture deals in innovative technology which are patented and give an edge for water process and waste water treatment towards making the industry a Zero Liquid Discharge and effectively reclaiming, recycling the water. The product is based on membrane technology catering to Heavy metal recovery, internal extracts in Pharmaceuticals, F&B, Dairy & Hotel Industry, Apartments, Township & different technologies for cooling water applications. The plants are packaged in modular units to address small & medium industries.**



# Challenges of Climate Change

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*Climate is always changing, and always will. There are seasons. There are day-night (diurnal) cycles. At any one location, heat energy from the sun varies during the day. Energy from the sun is affected by local conditions and clouds.*

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**H**eat absorption depends on whether it impacts water or land, and then even the type of land (desert, forest, snow-covered land), or the layout of the land (continental masses, or islands surrounded by seas). In some areas temperatures are climbing and in some areas they are dropping. Climate change is a topic of the talk associated to almost every ill, the human are facing on earth while living. The questions whether climate change is real, what are its good or bad effects on human beings, who are responsible to it and how to control the climate change are not only discussed in conferences and meetings but common people are also not behind in deliberating on these issues. More than 97% of climatologists think that climate change is caused by human activity. That means nearly all climate scientists think that both climate change is real and it is caused by human activity. Climate change is real, it is human made, and we are already experiencing its negative effects.

Climate change is still a politically divisive issue, despite scientists' near unanimous agreement on the issue. A plurality of Americans, 42%, believes global warming is "generally exaggerated." Forty percent believe that changes in global temperatures are due more to natural causes than human activities, according to Gallup polling. There is also a significant difference based on political affiliation.

Variable and unstable weather conditions are caused by local as well as large-scale differences in conditions (wind, rain, evaporation, topography etc). They naturally induce either warming or cooling locally, regionally, or worldwide. Unfortunately a lot of estimates and predictions are strongly based on theoretical computer models. Many now even trust models and their 'theoretical results' more than actual measurements and facts from reality. The scientific opinion on climate change is that the Earth's climate system is unequivocally warming, and it is extremely likely (at least 95% probability)



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that humans are causing most of it through activities that increase concentrations of greenhouse gases in the atmosphere, such as deforestation and burning fossil fuels.

In addition, it is likely that some potential further greenhouse gas warming has been offset by increased aerosols. This scientific consensus is expressed in synthesis reports, by scientific bodies of national or international standing, and by surveys of opinion among climate scientists. Individual scientists, universities, and laboratories contribute to the overall scientific opinion via their peer-reviewed publications, and the areas of collective agreement and relative certainty are summarized in these high level reports and surveys.

National and international science academies and scientific societies have assessed current scientific opinion on climate change. These assessments are generally consistent with the conclusions of the Intergovernmental Panel on Climate Change, the IPCC Fourth Assessment.

#### Summarized Report

- Warming of the climate system is unequivocal, as evidenced by increases in global average air and ocean temperatures, the widespread melting of snow and ice, and rising global average sea level.
- Most of the global warming since the mid-20th century is very likely due to human activities.

- Benefits and costs of climate change for [human] society will vary widely by location and scale. Some of the effects in temperate and polar regions will be positive and others elsewhere will be negative. Overall, net effects are more likely to be strongly negative with larger or more rapid warming.
- The range of published evidence indicates that the net damage costs of climate change are likely to be significant and to increase over time.
- The resilience of many ecosystems is likely to be exceeded this century by an unprecedented combination of climate change, associated disturbances (e.g. flooding, drought, wildfire, insects, ocean acidification) and other global change drivers (e.g. land-use change, pollution, fragmentation of natural systems, over-exploitation of resources).

#### Causes of climate change

Climate change is a long-term shift in weather conditions identified by changes in temperature, precipitation, winds, and other indicators. Climate change can involve both changes in average conditions and changes in variability, including, for example, extreme events. The earth's climate is naturally variable on all time scales. However, its long-term state and average temperature are regulated by the balance between incoming and outgoing energy, which determines the Earth's energy balance. (Learn more about the Earth's climate system here). Any factor that causes a sustained change to the amount of incoming energy or the amount of outgoing energy can lead to climate change. As these factors are external to the climate system, they are referred to as 'climate forcers', invoking the idea that they force or push the climate towards a new long-

term state – either warmer or cooler depending on the cause of change. Different factors operate on different time scales, and not all of those factors that have been responsible for changes in earth's climate in the distant past are relevant to contemporary climate change. Factors that cause climate change can be divided into two categories: those related to natural processes and those related to human activity. In addition to natural causes of climate change, changes internal to the climate system, such as variations in ocean currents or atmospheric circulation, can also influence the climate for short periods of time. This natural internal climate variability is superimposed on the long-term forced climate change.

- Natural Causes
- Human Causes
- Short lived and long lived climate forcers.

#### Natural Causes

The Earth's climate can be affected by natural factors that are external to the climate system, such as changes in volcanic activity, solar output, and the Earth's orbit around the Sun. Of these, the two factors relevant on time scales of contemporary climate change are changes in volcanic activity and changes in solar radiation. In terms of the Earth's energy balance, these factors primarily influence the amount of incoming energy. Volcanic eruptions are episodic and have relatively short-term effects on climate. Changes in solar irradiance have contributed to climate trends over the past century but since the Industrial Revolution, the effect of additions of greenhouse gases to the atmosphere has been about ten times that of changes in the Sun's output.

#### Human Causes

Climate change can also be caused by human activities, such as the burning of

fossil fuels and the conversion of land for forestry and agriculture. Since the beginning of the Industrial Revolution, these human influences on the climate system have increased substantially. In addition to other environmental impacts, these activities change the land surface and emit various substances to the atmosphere. These in turn can influence both the amount of incoming energy and the amount of outgoing energy and can have both warming and cooling effects on the climate. The dominant product of fossil fuel combustion is carbon dioxide, a greenhouse gas. The overall effect of human activities since the Industrial Revolution has been a warming effect, driven primarily by emissions of carbon dioxide and enhanced by emissions of other greenhouse gases. The build-up of greenhouse gases in the atmosphere has led to an enhancement of the natural greenhouse effect. It is human-induced enhancement of the greenhouse effect that is of concern because ongoing emissions of greenhouse gases have the potential to warm the planet to levels that have never been experienced in the history of human civilization. Such climate change could have far-reaching and/or unpredictable environmental, social, and economic consequences.

### Short-lived and long-lived climate forcers

Carbon dioxide is the main cause of human-induced climate change. It has been emitted in vast quantities from the burning of fossil fuels and it is a very long-lived gas, which means it continues to affect the climate system during its long residence time in the atmosphere. However, fossil fuel combustion, industrial processes, agriculture, and forestry-related activities emit other substances that also act as climate forcers. Some, such as nitrous oxide, are long-lived greenhouse gases like carbon dioxide, and so contribute to long-term climate change. Other substances have shorter atmospheric lifetimes because they are removed fairly quickly from the atmosphere. Therefore, their effect on the climate system is similarly short-lived. Together, these short-lived climate forcers are responsible for a significant amount of current climate forcing from anthropogenic substances. Some short-

**It is human-induced enhancement of the greenhouse effect that is of concern because ongoing emissions of greenhouse gases have the potential to warm the planet to levels that have never been experienced in the history of human civilization.**

lived climate forcers have a climate warming effect ('positive climate forcers') while others have a cooling effect ('negative climate forcers'). If atmospheric levels of short-lived climate forcers are continually replenished by ongoing emissions, these continue to exert a climate forcing. However, reducing emissions will quite quickly lead to reduced atmospheric levels of such substances.

A number of short-lived climate forcers have climate warming effects and together are the most important contributors to the human enhancement of the greenhouse effect after carbon dioxide. This includes methane and tropospheric ozone – both greenhouse gases – and black carbon, a small solid particle formed from the incomplete combustion of carbon-based fuels (coal, oil and wood for example). Other short-lived climate forcers have climate cooling effects, most notably sulphate aerosols. Fossil fuel combustion emits sulphur dioxide into the atmosphere (in addition to carbon dioxide) which then combines with water vapour to form tiny droplets (aerosols) which reflect sunlight. Sulphate aerosols remain in the atmosphere for only a few days (washing out in what is referred to as acid rain), and so do not have the same long-term effect as greenhouse gases. The cooling from sulphate aerosols in the atmosphere has, however, offset some of the warming from other substances. That is, the warming we have experienced to date would have been even larger had it not been for elevated levels of sulphate aerosols in the atmosphere.

### Effects of climate change

If we think of climate change as a

hazard for some far-off polar bears years from now, we're mistaken. That's the message from top climate scientists. If climate change continues, the panel's larger report predicts these harms:

**Violence:** For the first time, the panel is emphasizing the nuanced link between conflict and warming temperatures. Participating scientists say warming won't cause wars, but it will add a destabilizing factor that will make existing threats worse.

**Food:** Global food prices will rise between 3 and 84 percent by 2050 because of warmer temperatures and changes in rain patterns. Hot-spots of hunger may emerge in cities.

**Water:** About one-third of the world's population will see groundwater supplies drop by more than 10 percent by 2080, when compared with 1980 levels. For every degree of warming, more of the world will have significantly less water available.

**Health:** Major increases in health problems are likely, with more illnesses and injury from heat waves and fires and more food and water-borne diseases. But the report also notes that warming's effects on health is relatively small compared with other problems, like poverty.

**Wealth:** Many of the poor will get poorer. Economic growth and poverty reduction will slow down. If temperatures rise high enough, the world's overall income may start to go down, by as much as 2 percent, but that's difficult to forecast.

### Our role

All of us in our daily lives contribute our bit to this change in the climate. Give these following points a good, serious thought.

- Electricity is the main source of power in urban areas. All our gadgets run on electricity generated mainly from thermal power plants. These thermal power plants are run on fossil fuels (mostly coal) and are responsible for the emission of huge amounts of greenhouse gases and other pollutants.
- Cars, buses, and trucks are the principal ways by which goods and people are transported in most of



our cities. These are run mainly on petrol or diesel, both fossil fuels.

- We generate large quantities of waste in the form of plastics that remain in the environment for many years and cause damage.
- We use a huge quantity of paper in our work at schools and in offices. Have we ever thought about the number of trees that we use in a day?
- Timber is used in large quantities for construction of houses, which means that large areas of forest have to be cut down.
- A growing population has meant more and more mouths to feed. Because the land area available for agriculture is limited (and in fact, is actually shrinking as a result of ecological degradation!), high-yielding varieties of crop are being grown to increase the agricultural output from a given area of land. However, such high-yielding varieties of crops require large quantities of fertilizers; and more fertilizer means more emissions of nitrous oxide, both from the field into which it is put and the fertilizer industry that makes it. Pollution also results from the run-off of fertilizer into water bodies.

Therefore, we all should feel concerned/discuss about the climate change all around us and its present & future consequences related to living beings/earth but without any eagerness/commitment to sacrifice a bit of our comfort which in the present civilization is generally derived from energy sensitive devices. As we know that till now maximum energy production is by using fossil fuels and a recent study report says that present day carbon dioxide levels in atmosphere have touched the highest mark in the past 2.1 million years which may result in large scale climatic changes from greenhouse effect. Any individual or country is not ready to cut his/her carbon dioxide emission levels. So, to be in control of the climate change, use of renewable sources of energy like solar, wind, biomass, geothermal and many more is always tossed but without any serious laws to implement the same. There is always a tussle between the use of

conventional and non-convention sources of energy. Unless renewable sources of energy become as convenient in terms of their use & cost as conventional sources of energy, people will always find it difficult to switch over to them. Therefore, instead of promoting the use of renewable sources for general utilities on individual basis (except some specific applications) it will be better to link the generation of energy from them to convenient and efficient grid system. Because, people are not concerned from which source the energy is reaching to them but they are interested in its extensive use only. No one is interested to have power plants, hydroelectric dams, nuclear power plants, solar panels or wind farms near them but they just want silent, safe and continuous supply of energy.

Human population on the planet earth is increasing day by day (at present more than 600 crores) so is the dependence of human beings on energy driven devices. Human body is one of biggest miracle of nature in terms of its renewable energy capacity. Before, energy sensitive industrialization people used to make a lot of use of human body energy but with time people are becoming so lethargic and highly pumped with social status phobia that they are stopping to make use of the abundance source of this (human body) renewable energy and are totally becoming dependent on the external energy based devices. Some negative practices of energy using prevalent in masses at present are:

- People have stopped walking, cycling and using mass transportation even for small distances
- People are going from semi-automatic to fully automatic energy devices in which they have to do nothing
- Simple house hold chores (like water heating, utensil cleaning, cloth cleaning, grinding, cutting, kneading etc.) are all becoming totally energy dependent
- People are going for from cycle-scooter-car-big car
- People are going for fan-cooler-air conditioners

- People are going for individual than sharing/collective nature of use of energy devices like computers, TV, Lap tops, music systems
- People are going for single door-double door-triple door refrigerators.

There are so many things like that and it is appropriate to say that we wish that whatever we want/desire should take place through energy driven machines and we need not move even our finger. This type of growing mentality of masses is putting undue pressure on the generation of energy which is leading to unwanted climate change. We have to take a lesson and come forward to contribute by making use of our body's renewable energy in every possible job which will not only ease the energy pressure but will also keep us fit and fine.

## Conclusion

Climate change has moved from distant threat to present-day danger and no one on planet earth will be left unscathed. Climate change really is a challenge in managing risks. It is very clear that we are not prepared for the kind of events we're seeing. Climate change is already happening. More heat waves, greater sea level rise and other changes with consequences for human health, natural ecosystems and agriculture are already occurring in the United States and worldwide. These problems are very likely to become worse over the next 10 to 20 years and beyond. Need of the hour is that we care about it because it's going to affect nearly every aspect of human life on this planet. Climate change is already beginning to transform life on Earth. Around the globe, seasons are shifting, temperatures are climbing and sea levels are rising. And meanwhile, our planet must still supply us – and all living things – with air, water, food and safe places to live. If we do not act now, climate change will rapidly alter the lands and waters we all depend upon for survival, leaving our children and grandchildren with a very different world.

'The use of information retrieved through various references/sources of internet in this article is highly acknowledged.' ■

# Perspective to Green Building Design




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*Green building practices offer an opportunity to create environmentally sound and resource efficient buildings by using an integrated approach to design, since the design, construction, and maintenance of buildings have a tremendous impact on our environment and our natural resources.*

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The building sector alone consumes two thirds of electricity produced and is a significant contributor to air pollution and the pollutants that cause climate change. The challenge then becomes to build smart so that buildings use a minimum of nonrenewable energy, produce minimal pollution, while increasing the comfort, health, & safety of the people who work in them. Green building practices do not necessarily increase initial costs, but the certainly lower costs over the lifespan of a building.

When energy savings over time, increased durability, and enhanced occupant productivity is factored in, green design features and materials become easier to justify. While green technologies are usually less costly and

easier to incorporate into the original designs of a building, there are many cost-effective strategies for retrofitting existing buildings. Several successful examples of green buildings have been built proving that sustainable design is cost-effective and a great environment example. Many of these designs have received awards & national recognition.

A green building cannot be classified as sustainable unless it follows the process throughout a building's life-cycle: from planning to design, construction, operation, maintenance, renovation, and demolition. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort.

Building construction and operation have an extensive direct impact on the environment, society and economy. The

field of sustainable design seeks to balance the needs of the areas by using an integrated approach to harmonize needs and create a win-win-win design solutions.

The main objectives of sustainable design are to reduce or to completely avoid, depletion of critical resources like energy, water, and raw materials prevent environmental degradation caused by facilities & infrastructure throughout their life cycle and create built environments that are livable comfortable safe and productive.

Building use resources, generate waste and emit potentially harmful atmospheric emissions. Building owners designers and builders face a unique challenge to meet demands for new and renovated facilities that are accessible secure healthy and productive while



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transportation methods, and energy use. It is important to incorporate smart growth principles into the project development process, whether the project is a single building, campus, or military base. Siting for physical security is a critical issue in optimizing site design, including locations of access roads, parking, vehicle barriers, and perimeter lighting. Whether designing a new building or retrofitting an existing building, site design must integrate with sustainable design to achieve a successful project. The site of a sustainable building should reduce, control and treat storm water runoff. If possible, strive to support native flora and fauna of the region in the landscape design.

### Optimize Energy Use

With continually increasing demand on the world's fossil fuel resources, concerns for energy independence and security are increasing, and the impacts of global climate change are becoming more evident, it is essential to find ways to reduce energy load, increase efficiency, and maximize the use of renewable energy sources in federal facilities. Improving the energy performance of existing buildings is important to increasing our energy independence. Government and private sector organizations are increasingly committing to building and operating net zero energy buildings as a way to significantly reduce our dependence on fossil fuel-derived energy.

### Protect and Conserve Water

In many parts of the country, fresh water is an increasingly scarce resource. A sustainable building should use water efficiently, and reuse or recycle water for on-site use, when feasible. The effort to bring drinkable water to our household faucets consumes enormous energy

resources in pumping, transport, and treatment. Often potentially toxic chemicals are used to make water potable. The environmental and financial costs of sewage treatment are significant.

### Optimize Building Space and Material Use

The materials used in a sustainable building minimize life-cycle environmental impacts such as global warming, resource depletion, and human toxicity. Environmentally preferable materials have a reduced effect on human health and the environment & contribute to improved worker safety and health, reduced liabilities, reduced disposal costs, and achievement of environmental goals.

### Enhance Indoor Environmental Quality

The indoor environmental quality of a building has a significant impact on occupant health, comfort, and productivity. Among other attributes, a sustainable building maximizes day lighting, has appropriate ventilation and moisture control, optimizes acoustic performance, and avoids the use of materials with high-VOC emissions. Principles of IEQ also emphasize occupant control over systems such as lighting and temperature.

### Optimize Operational and Maintenance Practices

Considering a building's operating and maintenance issues during the preliminary design phase of a facility will contribute to improved working environments, higher productivity, reduced energy and resource costs, and prevented system failures. Encourage building operators and maintenance personnel to participate in the design and development phases to ensure optimal operations and maintenance of

minimizing their impact on society, the environment and the economy ideally building designs should result in net positive benefits to all three areas. In addition to including sustainable design concepts in new construction, sustainable design advocates commonly encourage retrofitting existing buildings rather than building anew. Retrofitting an existing building can often be more cost effective than building a new facility. Designing major renovations and retrofits for existing buildings to include sustainable design attributes reduces operation costs and environmental impacts & can increase building resiliency. The embodied energy of the existing building, a term expressing the cost of resources in both human labor and materials consumed during the building construction will be squandered if the building is allowed to decay or be demolished.

While the definition of sustainable building design is constantly changing, six fundamental principles persist.

### Optimize Site Potential

Creating sustainable buildings starts with proper site selection, including consideration of the reuse or rehabilitation of existing buildings. The location, orientation, and landscaping of a building affect local ecosystems,

the building. Designers can specify materials and systems that simplify and reduce maintenance requirements; require less water, energy, and toxic chemicals and cleaners to maintain; and are cost-effective and reduce life-cycle costs. Additionally, design facilities to include meters in order to track the progress of sustainability initiatives, including reductions in energy and water use and waste generation, in the facility and on site.

## LEED Program

LEED Program arguably has been the building industry's single-most powerful driver of change in the past several decades, and its success can be traced back to one man. As the creator of the US Green Building Council in 1992 and the World Green Building Council 10 years later, David Gottfried literally altered the course of human history specifically & ensuring that it continues.

Growth is at the heart of capitalism we need to look and understand the definition of growth, and need redefine it to reward profit on growth, when there's no cash, no energy, no physical materials, and no time, these being inputs on no waste: no landfill waste, no pollution, no health waste, which would be toxins and endocrine disrupters, this is the kind of growth we need pursue.

Mostly what is done is creation of road map for what a Green Building Council is, there's an eight-step road map to create a GBC that the World GBC recognizes. The road map is pretty simple and great - it's things like to be a nonprofit, to be open for membership, to have bylaws, and most importantly to have a budget which alone is quite huge but that's just getting them to organize and join the group. The key to do that is creating a network. Some countries are tiny and have different social values and conditions, and they might have illiteracy, and poverty, and no clean water, and war, so they bring a different agenda to the coalition for this "green corps" that just shows up at your home, makes it energy efficient and water efficient, finances the first cost, and the savings pay for it. Or they ramp up and amortize it through your bill, just like power purchase agreements to put solar

on roof. If you want solar, you just click the box, and you pay for it over 17 years through the utility bill.

Green interiors and new products may well be part of the buzz happening but what a building offers tangibly to those living in it and what it does to the people looking at it has to be somehow fused together, hence the emphasis on outdoor spaces achieves this and gives the building its unique appearance through extensive experience in community planning for cities, and getting to know how a neighbourhood works socially, environmentally & from a transportation perspective during the design process by holding meetings to discuss all aspects of the project: site plan, vision & the development program.

Well the integration of indoor and outdoor spaces accomplishes a lot in the way of sustainability, using native plant species, for instance, and minimizing heat island effect. Great Gulf promises many other green elements, including low-flow plumbing fixtures that will reduce water consumption by up to 40 percent, a rainwater collection system that will reuse water for the building's evaporative cooling, and innovative heat-recovery ventilators that will use heat from residents bathroom exhaust fans to heat their units. It also includes more requisite features such as low-VOC paints, adhesives, and flooring; daylight maximization; an on-demand fresh air system; and a "master kill switch" that residents can use to easily turn off all the lights in their homes when they're leaving it.

Most of what is covered under 'sustainability' has to do with the physical world, it's about materials, energy, and consumption, but there is also a whole social dimension, which has to do with the urban form and the mix of land uses, which encourage or discourage transportation and travel in the city. Urban concepts that get people to live closer to their jobs are a good thing. Those that force you to commute for two hours are less efficient - not just in terms of energy, but also in terms of human lives. These types of large-scale urban questions go well beyond individual buildings and have to do with the whole notion that mixed-use

development is better than single-use development, which is something needs to be encourage in every urban projects.

A building is just a tool to bring people together, when it's properly designed and thought out, the office gets out of the way and melts into the background creating a livable, sustainable community with a proportionately small footprint by setting LEED goals, creating its own sustainable guidelines for the community that aligned with the standards of LEED for New Construction through increasing the building's oxygen levels and air quality. Day-lighting strategies and shading reduce energy consumption and maintain a well-lit workspace. These features - combined with an advanced building management system, ensures optimal working conditions at all times. Creating a culture of sustainability through recycling. The key factor in achieving LEED - Platinum is still the location the community is accessible by bus and local suburban trains metro rail or a light-rail system that will be within walking distance for every resident from the property.

## Conclusion

Most environmental designers today conduct research on life-cycle product assessments, material chemistry, disassembly and recyclability, recycled content, and off-gassing for all its products for an architect or designer to easily find a product sustainability documentation in creating a space that is more comfortable and reflective of the company's core values of collaboration, innovation, sustainability, along with fun since people don't get excited about buildings anymore, they get excited about working together and being able to smile and be creative help others boost productivity and performance around the world. This people-based approach of a welcoming environment for employees, vendors, clients, and visitors to informally huddle, chat, and get coffee enjoying the relaxed atmosphere and easy conversation manifests itself in a facility that allows collaboration in all its work and living spaces. ■

# Acceptability of DuctSox has been proven



**DuctSox VGI is in the business of offering (HVAC) solutions. We undertake turnkey projects and offer customized solutions, as per the clients' requirement with the aim to deliver value for money. VGI represents the air dispersion pioneer - DuctSox Textile Air Dispersion Systems Headquartered in IOWA, USA. They offer the best products, designs, and sales support in our industry.**

**Gurmeet Singh**, Managing Director, VGI Power Systems Pvt Ltd in an exclusive interview with **Cooling India** says, the ultimate strength of our company lies in the extensive R&D effort.

found our product's mention in magazines exclusively for HVAC fraternity. The very fact that a prestigious group like yours has found us a cut above the rest, is testimony of our product. We believe in the efficacy of our product and our clients have endorsed our belief. We are sanguine the sales pitch will flow out of the clients' endorsement.

the leaders in fabric air dispersion, have the unique distinction of having a R&D department which is unparalleled in the fabric duct industry.

## What products and solutions do you have for the Indian Market?

We have tied up with DuctSox the leading fabric ducts manufacturer providing solutions for air dispersion. The world saw this product almost 20 years ago but somehow it was introduced in India only 6 years back. Nonetheless, the change of mind-set is evident from the sales that we are experiencing.

## What is status and scope of Market in India?

The key advantage of using fabric ducts lies in the Uniform Air Dispersion, which traditional metal ducts cannot assure. Another very important feature is the economical advantage apart from the other benefits of ease of installation, cleaning and aesthetic looks.

## Could you share about marketing Strategies that you adhere to?

Apart from the normal tactics of advertisements, mailers, participation in exhibitions/ symposiums, we have

## Could you share with us about overall Growth of the company?

The acceptability of DuctSox has been proven beyond doubt with the increased sales and enhanced customer base. With the parent company agreeing in principle to look at options of manufacture in India to boost sales with reduced costs, it can only get better. To start with we already have an agreement to manufacture Skelecore, a patented product available only with DuctSox, in place. The benefit of manufacture in India will make the product cheaper due to the customs and freight elimination & thus boost our sales further.

## Do you have collaborations with other companies?

As of now no, as I mentioned earlier, we are very happy in the relationships with DuctSox. And so many innovations are there that they carry on coming out with; our hands are full and we would like to believe that we are happy where we are. It is our good fortune that we have tied up with DuctSox, who apart from being

## Can you mention some of the projects that you have done so far?

Our biggest client in India, has been Nestle India. Our products are also now being used extensively in other food processing installations like Pepsi, Cadburys, ConAgra foods with enquiries coming from all quarters of the Indian industry. Suffice to say that we have representation of our product in almost all walks of the industry, be it the Automotive, office spaces, auditoriums, restaurants or any other sphere you can think of.

## Could you share in detail about your products?

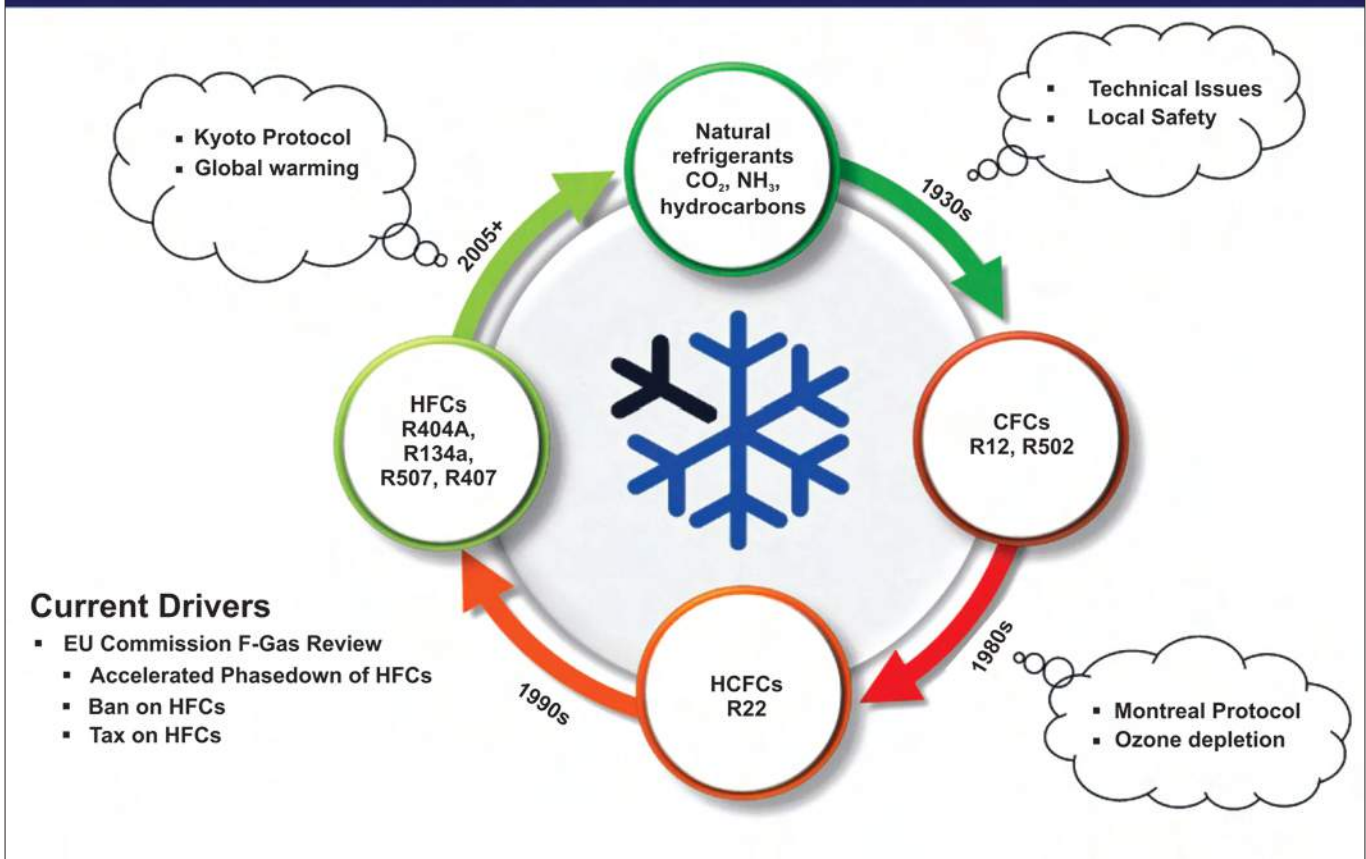
The ultimate strength of our company lies in the extensive R&D effort, which apart from providing customized solutions for the clientele is always endeavouring to bring out innovative products. A case in point is the skelecore, which no other fabric duct manufacturer has in its product range. This is a system which keeps the ducts round even when there is no air running through them.

## What were your anticipations from the Acrex 2014?

A one line answers: proliferation of our technology. ■



## The Closed Cycle....Driving Natural & Alternative Refrigerant Solutions



# Refrigerant -A Cooling Power

*Refrigerant is a working media which in a closed circuit produces cooling effect in a load area. It changes its phase by ejecting heat in a condenser and receiving heat from freezer or loading area. Refrigerant is nothing but cooling power to achieve the maximum performance.*

**T**here are many types of refrigerant used for domestic or industrial purpose; which one is best for which area can be easily identified from comparative Table 1 presented in this article.

### Refrigerant

A refrigerant is a working substance used in refrigerating machines. It is a working medium through which heat is transferred from a cold body to a hot body. The refrigerants commonly used are: Air, Ammonia (NH<sub>3</sub>), Carbon Dioxide

(CO<sub>2</sub>), Sulphur Dioxide (SO<sub>2</sub>), Freon Group, Methyl Chloride (CH<sub>3</sub>Cl), Methylene Chloride (CH<sub>2</sub>Cl<sub>2</sub>), Ethyl Chloride (C<sub>2</sub>H<sub>5</sub>Cl), etc.

The refrigerants of the "Freon" group are now largely used in modern plants. Freons are divided into two series:

- The Methane Series and
- The Ethane Series.

Of the methane (CH<sub>4</sub>) series of Freons, Freon -11 (CCl<sub>3</sub>F), Freon -12 (CCl<sub>2</sub>F<sub>2</sub>), Freon- 13 (CClF<sub>3</sub>), Freon -14 (CF<sub>4</sub>), Freon -21 (CHCl<sub>2</sub>F), and Freon- 22 (CHClF<sub>2</sub>) are widely used.



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Freon -113 ( $C_2Cl_3F_3$ ) and Freon - 114 ( $C_2Cl_2F_4$ ) are important members of ethane ( $C_2H_6$ ) series of Freons.

Freon refrigerants listed above belong to the fluorinated hydrocarbon family, whereas Methyl Chloride, Ethyl Chloride and Methylene Chloride are representatives of chlorinated hydrocarbon family. Fluorinated hydrocarbon refrigerants and chlorinated hydrocarbon refrigerants belong to the same family group known as Halogenated group.

**Desirable Properties:** An ideal refrigerant should possess the following desirable properties.

- **Suitable Considering and Evaporating Pressures:** The vapour pressure corresponding to  $30^\circ C^*$  in the condenser should not be high. High pressure in the refrigerating system increases the cost of the plant, as extra heavy pipes, fittings, etc, are required. Vapour pressure in the cooling coils of the evaporator should be slightly above atmospheric Pressure to avoid leakage of air may moisture into the system through loose joints. Moisture in the air may freeze in the expansion valve and cause trouble in operation. Air leakage in the system affects heat transfer. Air leakage in the system also increases compression work for a definite amount of refrigerating effect.
- **Low Boiling Temperature at Atmospheric Pressure:** The vapour temperature (saturation temperature) at atmospheric pressure should be low enough to give the desired temperature in the evaporator.
- **High Evaporation Enthalpy:** The evaporation enthalpy should be high in order that the quantity of refrigerant being circulated to obtain the desired refrigerating effect is minimum. This is more important in large plants.
- **High Critical Temperature and Pressure:** The refrigerant should have high critical temperature so that it remains in the vapour state at the highest operating temperature.
- **Low Specific Heat of Liquid:** Low specific heat of liquid is desirable to minimize the amount of vapour

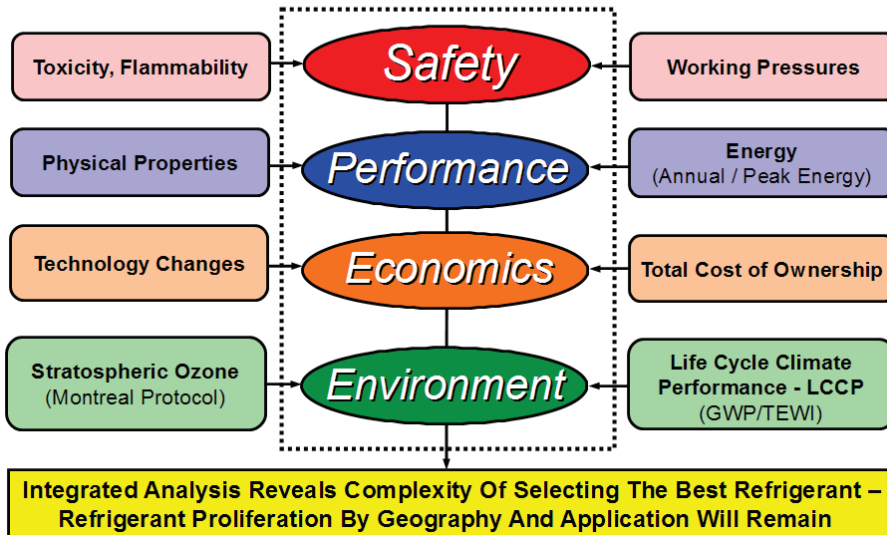
formed during throttling in the expansion valve. This results in increased refrigerating effect.

- **High Specific Heat of vapour:** It is usual practice to allow superheating of vapour (about  $5^\circ C$ ) to occur in the evaporator to prevent liquid refrigerant from entering the compressor. Vapour specific heat should be as high as possible to minimize degree of superheat.
- **High C.O.P.:** The refrigerant should have high C.O.P. and therefore, less power will be required to drive the compressor per tonne of refrigerating effect.
- **High Thermal Conductivity:** The refrigerant should have high thermal conductivity. This increases the efficiency of the condenser and evaporator.
- **Nonflammable and Nonexplosive:** The refrigerant should nonflammable (not easily set on fire) and nonexplosive even when mixed with air, so that undue danger will not result in case of fire or overheated condition.  
*\*Note: Water or air at normal room temperature ( $30^\circ C$ ) is used for condensing refrigeration vapour in the condenser. Therefore, in order that the heat transfer between vapour and water or air should take place in the condenser, the vapour in the compressor is compressed to a temperature above normal room temperature ( $30^\circ C$ ). The vapour pressure corresponding to  $30^\circ C$  is known as the condensing pressure (vapour pressure in the condenser).*
- **Noncorrosive to Metals:** The refrigerant should be noncorrosive to ferrous and other construction materials.
- **Chemically Stable at Maximum Operating Condition:** The refrigerant should be chemically stable (should not decompose) at the highest working pressure and temperature.
- **Nontoxic:** The refrigerant should be nontoxic (nonpoisonous) for the safety of servicemen in case of leakage. It should be non-injurious to

food stuffs and other materials with which it is likely to come in direct contact. Toxicity may cause irritation, suffocation and poisoning.

- **Odourless:** The refrigerant should be odourless, i.e. refrigerant should not have an irritating offensive pungent odour when present in small quantities.
- **Leakage Easily Detectable:** Leaks should be easily detected. Odour is desirable for leak detection.
- **Miscibility with lubricating oil:** The refrigerant should mix well with oil in the compressor and should be able to separate from oil before the vapour enters the condenser. Miscibility of refrigerant with lubricating oil is advantageous in that the oil is returned to the compressor by the refrigerant, thus avoiding accumulation of oil in the condenser and evaporator. This improves heat transfer rates and simplifies lubrication problems of refrigerators. The lubricating oil used should not react with refrigerant. i.e. refrigerant should remain chemically stable in the presence of lubricating oil.
- **High Electrical Resistance:** The refrigerant should have high electrical resistance i.e. the refrigerant should act as an insulating medium. This property of refrigerant is important in hermetically sealed (airtight closed) domestic units where the refrigerant is in contact with electric motor.
- **Low Cost and Readily Available:** The refrigerant should be cheap and easily available. There is always some loss of refrigerant because of leakage. Cost of refrigerant is more important in large plants.  
Although a refrigerant which has all these properties is yet to be found. Freon -12, carbon dioxide and ammonia

## Holistic Approach To Refrigerant Selection Avoid "Unintended Consequences"



are commonly used for very low temperature work because of their low boiling points. But for the units used in household refrigerators, there is a wide range of available refrigerants, each of which in comparison with others has certain desirable qualities.

Properties of the common refrigerants in use are given hereunder.

**Ammonia (NH<sub>3</sub>):** Ammonia is one of the oldest and most widely used of all refrigerants. It is the most widely used refrigerant in large ice making and cold storage plants. At atmospheric pressure it boils at -33°C and is therefore, suitable for low temperature work. It is much less expensive than some refrigerants. It is regarded as the most useful refrigerant because of its high evaporation enthalpy, moderate working pressures and high critical temperature. It requires low volume of gas to be circulated per tonne of refrigeration. It is very soluble in water forming ammonium hydroxide. When heat is applied to ammonium hydroxide, ammonia is released in vapour form. It is widely used as a refrigerant in units operating on vapour absorption system of refrigeration.

Ammonia burns when heated and may be explosive at high temperatures. It is toxic and has extremely offensive and pungent (irritating) odour. Leaks can be easily detected on account of its pungent odour. It attacks many non-ferrous metals (Copper, Zinc, Brass, etc)

in the presence of little moisture but it has no corrosive effect on iron and steel.

**Sulphur Dioxide (SO<sub>2</sub>):** It is one of the commonly used refrigerants in household refrigerators because of the very low working pressures. Its boiling point at atmospheric pressure is -10°C. It has a fairly large evaporation enthalpy and high critical temperature. It is non-flammable and nonexplosive. It is highly toxic. SO<sub>2</sub> when sealed within hermetic domestic refrigerating units, does not present a serious problem even though it is toxic. In the hermetic domestic units (sealed type), the motor and compressor are directly connected to one another, that is, the compressor and motor work on the same shaft and are enclosed in a common casing and sealed. It has a very pungent and suffocating odour. Leaks are easily detected on account of its pungent odour. Sulphur Dioxide gas leaks may be detected readily by the white smoke which is formed when strong ammonia water (28% Solution) is brought in the presence of gas. It is very corrosive when in contact with moisture and, therefore extreme care should be taken to prevent even the slightest bit of moisture entering into Sulphur dioxide to avoid the formation of sulphurous acid (H<sub>2</sub>SO<sub>3</sub>) which has corrosive effect. It will mix with oil in the compressor, but the difference in density between oil and SO<sub>2</sub> is so great that oil may easily separate before SO<sub>2</sub> vapour enters the condenser.

**Carbon Dioxide (CO<sub>2</sub>):** It has a small specific volume and therefore, the compressor of the CO<sub>2</sub> machine is small for relatively large refrigerating capacity and the machine is therefore, suitable for marine work. The high working pressure (74 bar), the low critical temperature (31°C), the low C.O.P. (2.6) and the excessive power required per tonne of refrigeration has restricted its use. It is nontoxic but will suffocate in high concentration. Leakage of CO<sub>2</sub> gas is difficult to locate for the reason that the gas is colourless and odourless. On account of this, leakage must be prevented. It is nonexplosive and nonflammable. It has no corrosive effect on copper, copper alloys, iron or steel. It has no effect on oil and greases. Its boiling temperature is -78.5°C at atmospheric pressure. This operating temperature is very low and hence oil which gives good service at very low temperatures should be used. Due to high working pressure required, the compressor and the condenser and pipes connecting them must be designed for greater strength. It is noncorrosive, except to iron and copper and that too when both moisture and oxygen are present. It is miscible with oil.

**Methyl Chloride (CH<sub>3</sub>Cl):** Methyl Chloride is suitable for small refrigerators. It has low working pressure, fairly high evaporation enthalpy and high critical temperature. Its boiling point is -23.7°C at atmospheric pressure. It is inflammable but does not burn readily. It is colourless and has sweet odour. Its odour resembles that of chloroform and hence leaks can be easily detected. It is somewhat toxic. It is poisonous refrigerant and should be treated with great care. Large concentration of its vapour in air may produce unconsciousness or even death but when well diluted with air it has little effect on human body. In the presence solvent action on rubber. It is noncorrosive in a dry state. It does not affect copper, iron or steel. Methyl Chloride dissolves practically all types of oils and glycerine. Since oil and methyl chloride mix together, provision has to be made for their separation when the two come in contact in machine lubrication. As mentioned earlier, methyl chloride belongs to the chlorinated hydrocarbon family.



**Fluorinated Hydrocarbon (Freon Refrigerants):** These refrigerants are halogen derivatives of saturated hydrocarbons, i.e. of methane, ethane, etc. Fluorine and Chloride are substituted for one or more of the hydrogen atoms. Investigations have shown that an increasing number of fluorine atoms reduces health hazard and flammability and increases stability.

The different types in use cover a large range of normal boiling points and molecular weights. Thus, some are well suited for reciprocating compressors and some for centrifugal compressors. Some are well suited for low temperature work and some for heat pumps.

They are all more or less miscible with oil. They are all safe as long as they do not come into contact with red hot surface or open fire. In these cases they decompose forming poisonous products, viz. hydrochloric acid (HCl), hydrofluoric acid (HF), and phosgene ( $\text{COCl}_2$ ). They are, however, nonflammable.

Like most other organic compounds their transfer properties are not so good as those of ammonia and water, and too much oil in the evaporator increases the boiling point considerably; so that care must be taken when they are used at low evaporating pressure.

As is well known, there are many different trade names for fluorinated hydrocarbons e.g. Freon, Arcton, Frigen etc. In order to avoid confusion, an international agreement has been proposed to use letter F, the mathematical expression for the unknown, followed by a number according to the original American System.

- **Trichloromonofluoromethane (Freon-11):** F-11 is the trade name for trichloromonofluoromethane, which is also known as Freon-11. This refrigerant is of low pressure type, well suited for centrifugal compressors. The high molecular weight reduces the number of stages necessary for a given pressure ratio. Freon-11 is the least stable refrigerant of Freon group but it is, however, more stable than methyl chloride.
- **Dichlorodifluoromethane (Freon-12):** In 1928, development of

the fluorinated refrigerants was started with the manufacture of Freon-12 which rapidly gained widespread application in household units and air conditioning plants. Later, it also competed successfully with ammonia in industrial plants up to about 40 KW and sometime even higher. It is well suited for reciprocating and rotary compressors. However, at normal temperatures, the swept volume necessary for a certain output is about 70 per cent larger than when ammonia is used. On the other hand, the terminal temperature of compression is much lower so that the difference in swept volume between Freon-12 and ammonia is somewhat reduced. At atmospheric pressure it boils at  $-29.8^\circ\text{C}$ . It has small specific volume, low working pressures and high critical temperature. Although its evaporation enthalpy is small, the C.O.P. is same as for ammonia. It is nonflammable and nonexplosive. It is nontoxic, odourless and colourless. It is costlier than other refrigerants and therefore precautions should be taken against leakage. Since leaks cannot be detected by smell, acetylene test lamp may be used for leak detection as flame burn with green colour in the presence of Freon. It will mix with lubricating oil without reacting with it. Special types of oil should be used in order to avoid copper plating, and care must also be taken when rubber is used, as Freon-12 attacks natural rubber as well some of the synthetic materials. At low temperature, lubricating oil mixed with the refrigerant increases the boiling point considerably. Therefore,

**Special types of oil should be used in order to avoid copper plating, and care must also be taken when rubber is used, as Freon-12 attacks natural rubber as well some of the synthetic materials.**

effective oil separators are recommended in order to avoid operating at lower evaporating pressures than those necessary with oil-free refrigerants. It is noncorrosive to any metal commonly used. The discharge pressures are lower for Freon-12 than for ammonia at the same temperature. Because of the high molecular weight of Freon-12, larger amount of refrigerant must be circulated for a given output than in ammonia plants. Care must be taken to secure ample cross-sectional areas in suction and discharge valves as well as in pipe lines, to avoid too high pressure drop due to friction.

- **Monochlorotrifluoromethane (Freon-13):** Formerly, pure hydrocarbons e.g. methane and ethane, were used in refrigerating plants for evaporating temperatures lower than about  $-50^\circ\text{C}$ . Great care had to be exercised because of the flammability and explosiveness of these refrigerants. Freon-13 is a most welcome substitute for the pure hydrocarbons. Freon-13 has very low normal boiling point, viz.  $-81.6^\circ\text{C}$ . However, the critical temperature is also low, viz.  $28.8^\circ\text{C}$  and therefore, it is recommended as a refrigerant on the low side only in cascade plants using Freon-12 or Freon-22 on the high side. Even in this case, care must be taken to avoid risk from too high pressures when the plant is out of operation as the critical pressure of Freon-13 is 39.5 bar. The charge of refrigerant should be as small as possible, so that the pressure fades out before it has risen too high. The coefficient of performance of Freon-13 is somewhat lower than that of other fluorinated refrigerants owing to the low critical point. Freon-13 is used for very low temperature work. In other respects, Freon-13 behaves quite like Freon-12.
- **Dichloromonofluoromethane (Freon-21):** This is a low pressure refrigerant which has not yet come into general use. However, in U.S.A. it has been used in household refrigerators with rotary compressor and in absorption units. It has been proposed as a refrigerant in plants

working with centrifugal compressors.

- Monochlorodifluoromethane (Freon-22):** It was mentioned above that the swept volume necessary for a certain output was about 70 per cent larger for Freon-12 than for ammonia. If Freon-22 is used instead of Freon-12, the necessary swept volume is only slightly higher if ammonia is chosen. Moreover, the terminal discharge temperature is low so that no injection of liquid in the suction line is necessary even at low evaporating temperature. Therefore, Freon-22 has been

increasingly used in recent years as a substitute for Freon-12. The advantage are greater at low evaporating temperatures at which it first came in general use, but now it is also used in plants working at higher temperatures. The range of application includes small commercial units to medium size industrial plants. It is mostly used in reciprocating compressors. Regarding inertness against materials it is similar to Freon-12 with the exception that it presents some special difficulties with regard to

rubber. With regard to miscibility with oil, Freon-22 is fully miscible with oil at the temperatures usually prevailing on the high side of the plant, whereas it is only partly miscible at usual evaporating temperatures. This has led to difficulties which are, however, now mostly overcome. Great care must nevertheless be taken with regard to the quantity of the oil, and an effective oil separator should always be used.

- Trichlorotrifluoroethane (Freon-113):** The fluorinated refrigerants described so far have

Refrigerant	Ammonia	Carbon Dioxide	Freon -12 (F-12)	Methyl Chloride	Sulphur Dioxide
Chemical Symbol	NH <sub>3</sub>	CO <sub>2</sub>	CCl <sub>2</sub> F <sub>2</sub>	CH <sub>3</sub> Cl	SO <sub>2</sub>
Cost	Very Cheap	Cheap	Very Costly	Costly	Cheap
Explosion Risk	Yes	No	No	Yes	No
Toxic Effect (Toxicity)	High	Medium	Low	Medium	High
Odour	Pungent	Non	Sweet	Sweet	Pungent
Corrosive to	Non-Ferrous Metal	--	Rubber	Rubber, A1	Fe
Chemical stability at working temp.	Good	Excellent	Excellent	Excellent	Excellent
Miscibility with lubricating oil	No	No	Yes	Yes	No
Electrical Insulation	Poor	Good	Excellent	Poor	Poor
Critical Temperature, °C	132.6	31.0	111.7	142.5	157.2
Boiling Temperature at atmospheric pressure, °C	-33.3	-78.5	-29.8	-23.7	-10.0
Vapour pressure at -15°C, bar (evaporation pressure)	2.41	23.34	1.862	1.487	0.823
Vapour pressure at 30°C, bar (condenser pressure)	11.895	73.34	7.581	6.658	4.71
Specific volume of saturated vapour at -15°C, m <sup>3</sup> /kg	0.509	0.017	0.093	0.279	0.406
Latent enthalpy at -15°C, KJ/kg	1,313.2	273.24	158.5	418.86	394.2
Specific heat of liquid at 30°C	1.10	1.95	0.243	0.40	0.340
*Coefficient of performance (C.O.P.)	4.76	2.56	4.61	4.85	4.73
+C.O.P. as percentage of standard Carnot cycle (C.O.P. = 5.74)	82.9	44.6	80	84.5	82.5
*KW per tonne of refrigeration	0.989	1.84	1.0	0.962	0.995
*Compressor piston displacement per tonne of refrigeration, m <sup>3</sup> /hr	5.83	1.63	9.85	10.1	--
Order of preference, large plants	1	4	2	3	--
Order of preference, small plants	--	--	1	2	3

**Table 1: Comparison of Physical and Thermal Properties of Common Refrigerants**

\*For a vapour compression cycle operating between temperature limits of -15°C and 30°C the vapour leaving the compressor being dry and saturated and no undercooling of liquid.

\*For standard Carnot cycle operating between temperature limits of -15°C and 30°C, C.O.P. = 5.74

been derivatives of methane, whereas Freon-113 and Freon-114 are derivatives of ethane (C<sub>2</sub>H<sub>6</sub>). Freon-113 is low pressure refrigerant used in centrifugal compressors for air-conditioning. It is possible to limit the number of stages because the molecular weight of Freon-113 is 187.4. Its properties are similar to those of the other fluorinated refrigerants.

- **Dichlorotetrafluoroethane (Freon-114):** This is also a low pressure refrigerants and is used in centrifugal compressors down to about -30°C, and in rotary compressors for household units. With regard to inertness against inaterials, it is similar to most of the other fluorinated refrigerants, but with regard to miscibility with oil it presents similar difficulties as Freon-22. Table 1 gives comparison of important physical and thermodynamic properties of common refrigerants.
- **Air:** Air was one of the earliest refrigerants and was widely used wherever nontoxic (non-poisonous) refrigerant was needed. Air as a refrigerant has two outstanding advantages: it is available free of cost and is completely safe. Thermodynamically, it is a poor

refrigerant (has low C.O.P.) and was abandoned (give up) with the development of vapour refrigerants with superior thermodynamic properties. However, air is now increasingly used as a refrigerant in aircraft refrigeration.

- **Water Vapour:** Water has excellent thermodynamic properties, with single exception that its freezing point is 0°C. However, since many refrigeration systems are operated at temperature above this point, water has been used as a working fluid. The specific volume of water vapour at atmospheric compressors, but the steam jet compressors or centrifugal compressors are used with success. Water vapour is the safest fluid for air-conditioning purposes as it is nontoxic and nonflammable.
- **Ethylene:** For low temperature refrigeration, ethylene has been successfully employed in cascade system which uses a secondary refrigerant to remove heat from the ethylene condenser. As the critical temperature is only 10°C, it can not be used in a multi-stage compression system where condenser temperature exceeds this value. Low freezing point (-169.2°C) gives a very wide operating range which cover many of the low temperature

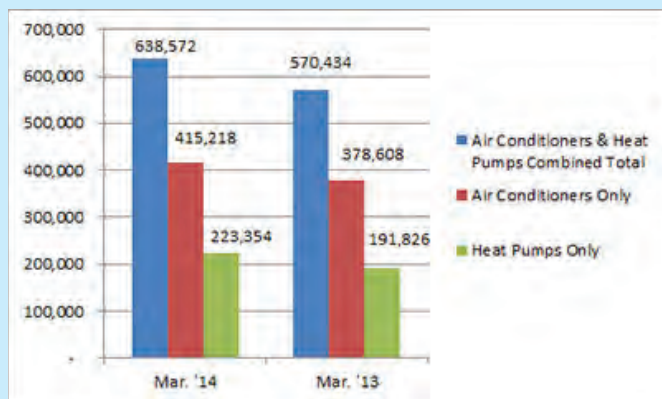
applications. One of the main advantage of ethylene is that the evaporating pressure is greater than one atmosphere at all temperatures above -103.7°C and that condensing pressures are not excessive. The ethylene gas is an anaesthetic when high concentrations are present in air, but in general the health hazard is low. It is easily inflammable and forms violently explosive mixture with air.

- **Methane, Ethane, Propane, Isobutene, and Butane:** These hydrocarbons have been proposed and used to a limited extent as refrigerants. Almost the entire range of temperature is covered by these five hydrocarbons. However, inflammability of these and their explosive properties when mixed with air have greatly limited the degree of utilization. Isobutene and butane are used for small units. Propane is used in refrigerated transport service, functioning both as the primary refrigerant and as fuel for the driving motor. Ammonia, carbon dioxide, methyl chloride and F-12 are available almost everywhere at reasonable cost. The rest of the Freon refrigerants may not be easily available and are costlier than other refrigerants. ■

## Central Air Conditioners and Air-Source Heat Pumps

U.S. shipments of central air conditioners and air-source heat pumps totaled 638,572 units in March 2014, up 11.9 percent from 570,434 units shipped in March 2013. U.S. shipments of air conditioners increased 9.7 percent, to 415,218

units, up from 378,608 units shipped in March 2013. U.S. shipments of air-source heat pumps increased 16.4 percent, to 223,354 units, up from 191,826 units shipped in March 2013.



Year-to-date	Mar. '14 YTD	Mar. '13 YTD	% Chg.
Air Conditioners & Heat Pumps	1,406,017	1,229,247	+14.4
Air Conditioners Only	871,826	789,588	+10.4
Heat Pumps Only	534,191	439,659	+21.5

Year-to-date combined shipments of central air conditioners and air-source heat pumps increased 14.4 percent, to 1,406,017 units, up from 1,229,247 units shipped in March 2013. Year-to-date shipments of central air conditioners increased 10.4 percent, to 871,826 units, up from 789,588 units shipped during the same period in 2013. The year-to-date total for heat pump shipments increased 21.5 percent, to 534,191 units, up from 439,659 units shipped during the same period in 2013. ■



# Improving our processes to reduce effect on the environment



**Nikhil Deshmukh**, Product Manager, Belimo Actuators India Pvt Ltd., in an exclusive interview with **Cooling India** says, we at Belimo offer a wide range of options for a product vertical to ensure that the required fit is available for the customer.

## Could you share your vast experience in the HVAC field and describe journey till now working as Product Manager for India with Belimo?

I started my professional journey with Voltas Ltd, as a project engineer. With Voltas, I got exposure of package air-conditioning projects as well as central air-conditioning projects. I worked with project planning & project execution departments. After completing MBA, I was associated with TA Hydronics SA (previously known as Tour & Andersson AB) as Area Sales Manager. During my early days with TA Hydronics SA, I was responsible for the sales of the products in South India and water balancing activities for the sites across India. Hence, I was involved in commercial as well as technical aspects of the products. Eventually, I started looking after the sales of West India and later on also managed sales across North, East and Bangladesh regions. Now, working as a Product Manager with Belimo, I am taking care of the technical aspects of the products. We have a product management department and we study the market requirements and try to offer a value to match the market demands. We meet contractors, consultants and clients, to understand their requirement and present our offering.

## What are your views on HVAC Valve & Actuators market domestically and globally with respect to volume and growth?

HVAC valves and actuators constitute to approximately 5% of the total HVAC value of the project. The HVAC sector in India has grown to over Rs 10,000 crore between 2005 & 2010 and reached Rs 15,000 crore in FY'14.

Developers are executing mega projects which involve district cooling, premium residential and commercial properties with central air-conditioning, premium hotel projects, etc. Due to which the market for valves and actuators has proliferated. In many foreign countries there is demand for cooling as well as heating applications. Hence, these markets offer better volume for these products. Global HVAC market is estimated to be more than USD 150 billion and is expected to grow at 3.4% CAGR through 2018.

## What would you suggest to make this HVAC products market competitive and driven on quality standards?

In current scenario, a lot of customers are not aware about the quality aspects of various products due to which the market consequently is driven on product price rather than its quality. There is a need to educate the customers about the product quality and its benefits for the project. Also, the claimed features and benefits should have documented proof so that the customers are convinced about the product.

## Could you detail about the product range and Solutions for HVAC sector? What are the various solutions for Air application in Indian context?

Belimo offers products for air side and water side applications. The air side applications include-

- Various HVAC damper actuators like general damper actuators, fast-running damper actuators, linear and rotary damper actuators, mechanical fail-safe damper actuators along with various electrical and mechanical accessories.

- Fire and smoke spring-return damper actuators & smoke extraction non-spring return damper actuators.
- We also offer pressure independent VAV controls with communication over standard protocols like BACnet/LONworks for BMS integration.

Water side applications -

- We have moved a step ahead with new range of pressure independent control valve- 'Energy valve' that documents, optimizes and proves water coil performance. This product offers several benefits like energy monitoring, combatting low  $\Delta T$  syndrome, enhanced energy optimization, improved commissioning, data logging etc.
- 2-way & 3-way characterized control valves with cast iron, nickel plated brass & stainless steel options, steam valves, PICCVs & Electronic pressure independent valves (EPIV).
- Manual and motorized butterfly valves, motorized ball valves and globe valves.
- Energy meters and fan coil valves- 2-way and 3-way with spring return and non-spring return actuator options.

We also offer products like temperature, humidity, mixed gas and CO<sub>2</sub>, pressure and air velocity sensors.

#### How does Belimo ensure the maximum functionality for HVAC?

We, at Belimo offer a wide range of options for a product vertical to ensure that the required fit is available for the customer. E.g. We offer multi-function actuators which can work as on/off, 3-point or modulating actuator. Its running time can also be varied as per requirement. Similarly, we offer damper and valve actuators with varying torque and angle of rotation for rotary actuators and varying force and stroke for linear actuators. We also offer fast running actuators (run time- 4 seconds) for fume exhaust and fresh air inlet. The wide product range offers precise solution for the customer requirement.

#### What is your business strategy as against competition with other companies dealing in similar product lines?

Belimo offers a wide product range of damper actuators for air and water flow control devices in HVAC installations to cater to the variety of customer requirements worldwide. We also offer customized solutions to the customers through our customizing center in India. Also, we ensure that the standard as well as customized products are delivered to the customers within 12 working days. All these strategies give us an edge over competitors dealing in the same product lines.

#### Could you share details about R&D of product market or strategy for innovating new product lines?

Belimo is focused towards innovating & improvising the product line. Hence, Belimo invests approximately 6.5% of the net sales in research & development of the products. We conduct periodic surveys at different platforms- global, regional and local. Local survey is country specific, regional survey is conducted across AP, EU and America.

Depending upon the market requirements, the products are developed for regional and global markets.

#### Belimo is committed to deliver energy efficient and environment friendly solutions. Could you elaborate on that?

We aim to deliver products to our customers that contribute to increased energy efficiency in their applications. Belimo is committed to meeting or exceeding all applicable federal, state and local environmental regulations. We strive to use our resources sparingly and request that our suppliers and employees do the same. We avoid the use of materials that place an unnecessary strain on the environment and are difficult to discard. We are mindful of energy consumption used in the manufacturing and operation of our products and strive to design innovative products that efficiently use our natural resources. We measure critical aspects of our environmental impact and we are constantly improving our processes to reduce the effect on the environment.

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#### How far advantageous was exhibition towards product display such as ACREX 2014 held recently?

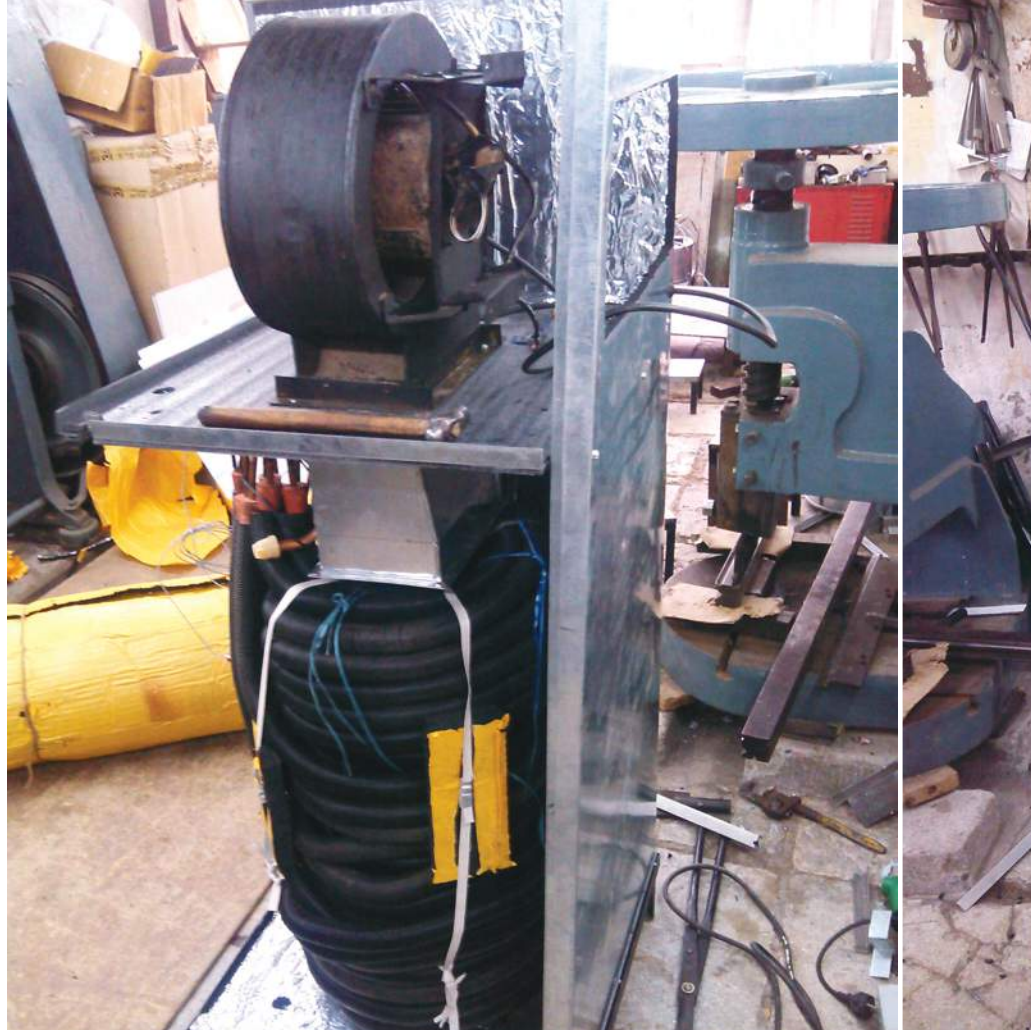
This year at ACREX 2014, we had only displayed our water side product range as we pioneer in the air side product range and the customers are aware of our air-side product range. We also displayed our newly launched energy valve for lower sizes- 15mm to 50mm. We got an overwhelming response at the exhibition from customers, consultants and contractors. They appreciated the product range and we managed to pick orders from the new customers who visited us at this exhibition.

#### How do you view the HVAC segment under new governance in the country and what do you envisage for the company in the next two years?

The result of the general election 2014 has brought positive sentiments in the market which is already reflected with the stock market touching new heights. As per the recent survey, the HVAC market is expected to grow approximately 30% from Rs. 15,000 crore to Rs. 20,000 crore by FY 2016. In 2013, Belimo India grew by approximately 20%, even though there was an economic slowdown which consequently deterred the HVAC market growth rate. Now, with the economic revival and the expected growth rate of approximately 30% over the next two years, we are confident of growing at higher rate. ■

**BELIMO India is subsidiary of BELIMO Automation AG, Switzerland - world leader in design & manufacture of electric actuators for dampers and valve technology for commercial HVAC market for about four decades. Belimo in Asia Pacific serves customers' business needs efficiently with standard product offering and global presence, to offer customized solutions in HVAC.**

# Design of a Pumpless Ice Thermal Storage System



*The present article deals with the design of a Pumpless Ice thermal storage system which has been applied for a patent 'Application 219/MUM/2008' for its innovative idea to eliminate the Pump from the system and make it more efficient and thus make the compressor and blower as the only power consuming devices.*

**A** Thermal storage system is an innovative way to store thermal energy, either cold or hot, in order to utilize it at a later time. A cool thermal storage system uses power during off peak periods or night time to store cold thermal energy in a phase change material as latent heat, which is then recovered during the peak load hours. A thermal storage system's operation reduces the peak demand and helps save on the electricity bill in places where the night time tariffs are lower.

After brief but intense interest in energy storage during the 70's and 80's,

the return of inexpensive fossil fuel dampened the sense of urgency created by insecurity about our energy future. Nonetheless, thermal energy storage for air-conditioning applications has matured into a robust commercial product, with broad manufacturing and marketing support. Recent interest on energy storage is founded on more compelling and comprehensive motivations. Climate change, energy independence and energy cost are some of the factors that are merging to reinvigorate efforts in energy storage development. And predictably, much of





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 BE Mechanical Engg, Clemson University, USA  
 is founder and owner of Panasia Engineers Pvt Ltd.



**Mahesh Shantaram Prabhulkar,**  
 Mechanical Engineer from Bharti Vidyapeeth, Mumbai  
 University, is working at Panasia Engineers Pvt Ltd, Mumbai.

the effort is related to the ability of storage to support renewable energy sources, such as wind and solar, that possesses some level of variability or where the availability of power may be temporarily out of phase with demand. A cool thermal storage system uses power during off peak periods or night time to store cold thermal energy in a phase change material as latent heat, which is then recovered during the peak load hours. A thermal storage system's operation reduces the peak demand and helps save on the electricity bill in places where the night time tariffs are lower. The condensing unit's efficiency is higher during night time due to lesser condensing temperature. Hence, the energy stored will be greener. It can also be utilized as a back-up to meet cooling loads during power cuts. Ice production techniques can be divided into two main groups namely Dynamic and Static systems and the produced ice can be used either directly or indirectly to chill the product or system.

**Dynamic Ice Production Systems**

Ice is periodically harvested from the freezing apparatus to a storage bin and the stored energy is recovered by circulation of water through ice in the bin to supply the chilled water system during normal operation. Described below are some of the Dynamic Ice Production systems:

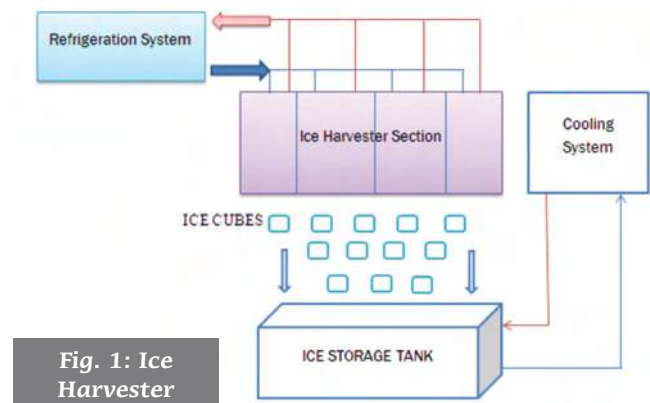
**Ice Harvester**

Ice is built on a vertical surface which is the evaporator section of the refrigeration system. Water is circulated from the storage tank, over the plates until a certain thickness; normally in the region of 8-10 mm ice is formed. This freezing process takes approximately 20 minutes. The ice is harvested

by means of hot-gas by-pass from the delivery port to the evaporator plates to warm the surface to about 5°C, resulting in the ice in contact with the plates melting and falling into a sump or ice tank, to which chilled water from the system is circulated. The process is illustrated in Fig. 1 given below.

**Slurry Ice**

In this system a binary solution is cooled below its freezing temperature within a Falling Film, scraper, vacuum or supercooling heat exchangers. The refrigerant which is circulated outside the tube supercools the binary solution into millions of fine crystals which are then pumped into a storage tank for later use, or directly to satisfy the process load. During the cooling mode, warm solution is circulated through the storage tank where it is cooled by the crystallised solution and then pumped directly to satisfy the air conditioning chilled water circuit.



**Fig. 1: Ice Harvester**

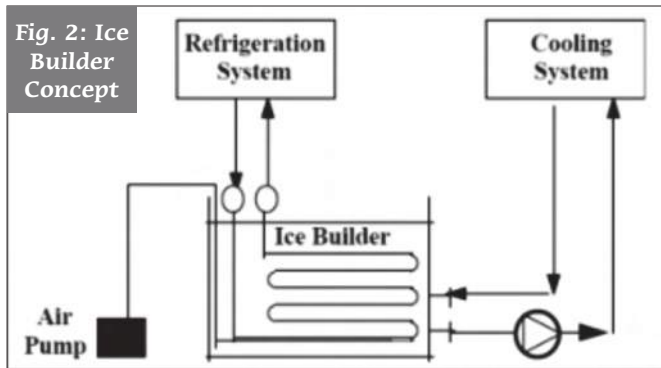
The Dynamic Ice Production System consumes Power in the form of Pumping out the continuous production of ice and circulation of brine through the ice. Thus, this kind of a system is not suitable for an energy storage system.

**Static Ice Production Systems**

In principle, the ice formation and melting takes place without any physical removal of the ice. Thus, this kind of a system is more energy efficient as compared to the Dynamic Ice Production System.

**Ice on Coil**

Refrigerant or Glycol water solution at a temperature of between -4°C and -10°C is circulated within a serpentine coil, which is submerged in an insulated tank of water in order to form ice on it. The ice builder tank consist of a low pressure air pump or paddle blade to agitate the system in order to achieve even distribution of ice melting and formation. The thickness of ice is measured by a sensor to control the operation and the relevant details can be seen in Fig. 2.



**Pumpless Ice Thermal Storage System**

The patent 219/MUM/2008 claims of a system that utilizes the natural flow of the refrigerant in place of a pump used in a thermal storage system. The lower unit is a flooded evaporator in which the secondary refrigerant circulates naturally. The lower unit acts as the cooling coil for the room. The upper unit is filled with the phase change material (water) and is connected to a condensing unit that charges the system during the night time. Thus, the system completely eliminates the use of a pump to circulate the refrigerant and the only power consuming devices are the compressor and the fans.

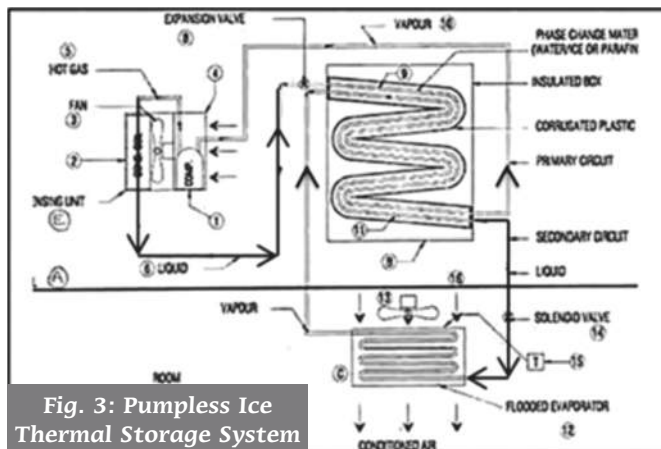


Fig. 3: Pumpless Ice Thermal Storage System



Fig. 4: Redesigned model

**Redesign of the system**

To make the system more compact, we redesigned it to eliminate the lower flooded evaporator. The blower was mounted on the above unit consisting the primary circuit. The air is blown into the above unit to form a plenum inside the cavity, formed by the surrounding corrugated spiral pipe structure. The air then comes in contact with the corrugated pipe surface and thus exchanges heat indirectly with the ice contained

within the polypropylene pipes. The conditioned air is then let out through a pressure opening and introduced into the room. Refer fig. 5 as the redesigned model.

**Thermal Analysis of the System**

For the efficient working of the system a thermal analysis has been performed on the prototype to be built using One dimensional Transient state conduction equation. The analytical solution thus approximates the important specifications of the system based on which manufacturing may be done. Similar solutions may be obtained for scaled models.

**Calculation for the Mass of ice**

For 1 ton ton hour we need to calculate the mass of ice required.

We know that to melt 1 kg of ice we require 334.9 kJ/kg of heat (Latent heat of ice = 334.9kJ/kg)

Now,

$$1 \text{ TR-hr} = 1 \text{ TR} \times 1 \text{ hr} \\ = 3.516 \text{ kW} \times (1 \times 3600) \text{ secs} \\ = 12657.6 \text{ kJ} = Q$$

If we intend to charge this system in 4 hours, then the R.E required would be

$$= 12657.6 / (4 \times 3600) \\ = 0.879 \text{ kW} \approx 0.25 \text{ TR}$$

Thus, the selection of the compressor can be made using the above data.

Now,

$$Q = M_{ice} [(C_{pi} \cdot \Delta T_i) + LH + (C_{pw} \cdot \Delta T_w)] \\ = M_{ice} \cdot [(1.9 \times (0 - (-2))) + 335 + (4.2 \times (25 - 0))] \\ 12657.6 = M_{ice} \cdot [443.8] \\ M_{ice} = 28.5 \text{ kgs} \approx 30 \text{ kgs}$$

Assuming C.O.P of the system as 2.5 we get,

$$W.D = 12657.6 / 2.5 \\ = 5063 \text{ kJ}$$

We intend to charge the system completely in 4 hours and hence the power required is

$$= 5063 / (4 \times 3600)$$

= 0.3516 kW... The approx. input Power that would be required by the compressor.

### Length Of The Pipes

The unit needs to be sized based on the amount of ice to be produced while charging. The polypropylene pipe chosen has an internal diameter of 26mm and 31mm at the regular and corrugation portion of the pipe respectively. Thus, we take the average value of 28.5mm for the calculation of the volume occupied by the ice. The copper tube inserted in the pipe has a diameter of 3/8 inch or 9.52 mm. Subtracting the volume occupied by the copper tube we get the volume occupied by water given as :

$M_{ice}$  required for the prototype of 1TR-hr is 30kgs as calculated above and density of ice is 917 kg/m<sup>3</sup>

$$V_{ice} = M_{ice} / \rho_{ice}$$

$$V_{ice} = 30 / 917$$

$$V_{ice} = 0.0327 \text{ m}^3$$

Also, Volume of the pipe is equal to the cross-sectional area multiplied by the length of the pipe which is unknown.

$$V = A_c \cdot l$$

$$= \frac{\pi}{4} \cdot (d_{pipe}^2 - d_{cu\_tube}^2) \cdot l$$

$$0.0327 = \frac{\pi}{4} \cdot (0.0285^2 - 0.00952^2) \cdot l$$

$$L = 57.69 \text{ m} \approx 60 \text{ m}$$

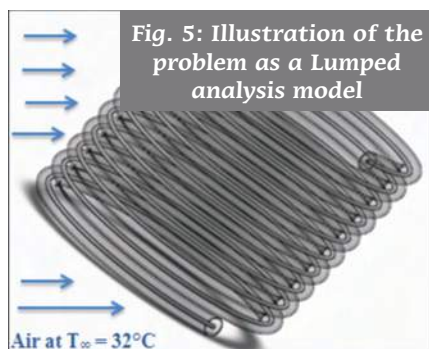
In order to increase the Effectiveness of the Heat transfer the surface area and the heat transfer co-efficient need to be high as they are directly proportional to the Efficiency of the Heat Exchanger. The minimum possible diameter for a 28.5mm polypropylene pipe is 130mm as it cannot be wounded beyond this point due to material properties.

Hence the innermost diameter of the coil is chosen as  $d_1 = 140$  mm. The height of the unit has been restricted to 1 m to avoid losses due to high pressure drop and make a compact design for the office at Panasia Engineers Pvt Ltd, Mumbai.

### Discharging Time

The Discharging time of the unit will depend on the velocity of the air being blown over it by the blower. Assuming the discharge time to be 1 hour, we have the lumped model analysis to predict the convective heat transfer co-efficient of the air which can then be used to

calculate the velocity of the air.



### Lumped Model Analysis and its failure

In Heat Transfer Analysis, some bodies are observed to behave like a "Lump" whose interior temperature

remains essentially uniform at any time during a heat transfer process. The temperature of such bodies can be taken to be a function of time only, T(t).

Heat Transfer analysis that utilizes this idealization is known as Lumped system analysis, which provides great simplification in certain cases of heat transfer problems without much sacrifice of Accuracy.

The above method is based on the principle of Energy balance

(Heat transfer into the body during dt) = (Increase in the energy of the body during dt)

$$h_{air} \cdot A_s \cdot (T_{\infty} - T_f) \cdot dt = M_{body} \cdot C_p \cdot dT$$

$$[T(t) - T_{\infty}] / [T_i - T_{\infty}] = e^{-bt} \dots \dots \dots \text{Final Equation}$$

Where,

$$b = h_{air} \cdot A_s / \rho_{ice} \cdot V_{ice} \cdot C_p$$

The Lumped system analysis certainly provides great convenience in Heat Transfer analysis, however it is necessary for the system to meet the criterion for the applicability of this analysis. The first step is to define a characteristic length which is defined as

$$L_c = V / A_s$$

$$V_{body} = \text{Volume of the body} = \frac{\pi}{4} \cdot (d_4^2 - d_1^2) \cdot H_{model}$$

$$= \frac{\pi}{4} \cdot (0.43^2 - 0.14^2) \cdot 0.9$$

$$= 0.1168 \text{ m}^3$$

$$A_s = \text{Surface Area of the body} = [(\pi \cdot d_1) + (\pi \cdot d_4)] \cdot h \cdot \text{Correction factor}$$

$$= [(\pi \cdot 0.14) + (\pi \cdot 0.43)] \cdot 0.9 \cdot 1.3$$

$$= 2.09 \text{ m}^2$$

$$L_c = 0.1168 / 2.09 \approx 0.0557 \text{ m}$$

The second step is to find the dimensionless Biot number. When a solid body is being heated by the hotter fluid surrounding it, heat is first convected to the body and subsequently conducted within the body. The Biot number is the ratio of the internal resistance of a body to heat conduction, to its external resistance to heat Convection. Therefore, a small Biot number represents small resistance to heat conduction, and thus small temperature gradients within the body.

Lumped system analysis assumes a uniform temperature distribution throughout the body, which is the case only when the thermal resistance of the body to heat conduction is zero. Thus, lumped system analysis is exact when Bi = 0 and approximate when Bi > 0. It is generally accepted that lumped system analysis is applicable if Bi ≤ 0.1. Thus, when Bi ≤ 0.1, the variation of temperature with location within the body is slight and can reasonably be accepted as being uniform. However, for the current project analysis the lumped system method cannot be applied as Bi is 7.53 as shown in above calculations.



Velocity of the air at which it hits the body is taken by trial and error method as 6.89 m/s

$$Re = \rho \cdot v \cdot d_1 / \mu$$

$$= (1.164 \cdot 6.89 \cdot 0.14) / 1.872e^{-5} \dots \text{Values taken from table A-15 (Properties of Air)}$$

$$= 6e^4$$

Pr = 0.7282.....Values taken from table A-15 (Properties of Air)

$$Nu = 0.023 \cdot Re^{4/5} \cdot Pr^{0.3}$$

$$= 138.97$$

Nu = h · d<sub>1</sub> / K<sub>air</sub>.....where K<sub>air</sub> = 0.02588 W/mK from the table A-15 (Properties of Air)

$$h = 25.68 \text{ W/m}^2\text{K}$$

$$Bi = \frac{\text{Heat Convection at the surface of the body}}{\text{Heat Conduction within the body}} = hL_c / K_{\text{pipe}} \dots \text{where } K_{\text{pipe}} = 0.19 \text{ W/mK}$$

$$= 7.53 > 0.1 \dots \text{Hence, the Lumped analysis cannot be applied to this system.}$$

The one-term analytical solution is applicable only if the fourier number > 0.2 as the solutions converge rapidly with increasing time and thus it results in an error under 2%. A large value of fourier number indicates faster propagation of heat through a body. Considering our problem to be of the plane wall type we have the relation given as : Center of Plane Wall.

### One Dimensional Transient Conduction Analytical Solution

The method has been used to approximate the time in which the discharge takes place. As it is a 1TR-hr unit, it is desired to be discharged within 1 hour and hence we try to develop a one dimensional analytical solution for the same. The assumptions made for the current method are :

- Heat conduction in the body is 1 dimensional because of thermal symmetry about the midpoint.
- The Thermal Properties of the body and the heat transfer co-efficient are constant.
- The fourier number is the dimensionless number representing time and it is a measure of heat conducted through a body relative to heat stored. It is given as :

$$\tau = (\alpha \cdot t) / x^2$$

Where,

$$\alpha = K_{\text{air}} / (\rho_{\text{air}} \cdot C_{\text{pair}}) \dots \text{Thermal Diffusivity of the medium}$$

$$= 2.2e^{-5} \text{ m}^2 / \text{s} \dots \text{For the current project work}$$

x = Thickness of the body

$$= 0.43 - 0.14 \dots (d_1 - d_4)$$

$$= 0.29 \text{ m}$$

The Bi number has been calculated as 7.53 from the above calculation. The corresponding value of A<sub>1</sub> and λ<sub>1</sub> is 1.255 and 1.38 respectively.

We have

$$[T(t) - T_{\infty}] / [T_i - T_{\infty}] = A_1 \cdot e^{-\lambda_1^2 \cdot \tau}$$

25-32

$$-2-32 = 1.255 e^{-1.38^2 \cdot \tau}$$

$$\tau = 0.94$$

> 0.2.....Thus, application of this one term analytical solution is possible

Now,

$$\tau = (\alpha \cdot t) / x^2$$

$$0.94 = (2.2e^{-5} \cdot t) / 0.29^2$$

Thus, time (t) is found out to be 3620 seconds or 60.3 minutes in which the ice at -2°C initially, discharges into water at 25°C

$$\theta_{o,wall} = [T(t) - T_{\infty}] / [T_i - T_{\infty}] = A_1 \cdot e^{-\lambda_1^2 \cdot \tau}$$

Where the constants A<sub>1</sub> and λ<sub>1</sub> are functions of the Bi number only and their values are listed in table no. 4-2 against the Bi number for all the 3 geometries viz. plane wall, cylinder and sphere.

### Simulation of the System

To approximate the results that may be obtained from the prototype manufactured, a model resembling the unit was developed in the CAD software SOLIDWORKS 2012[8]. The gap formed due to the corrugations between the consecutive layer of pipes in the experimental prototype was assumed to be circular in shape and were laid out in a circular and then in a linear pattern throughout the body of the Prototype in the CAD model.

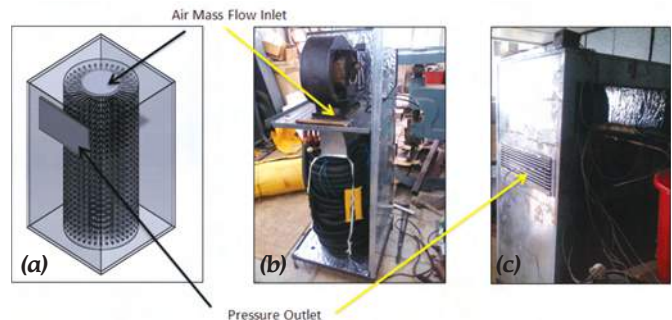


Fig. 6  
 (a) The model created in Solidworks 2012 has similar dimensional characteristics and hence it gives us a near exact value upon simulation.  
 (b) The Cut Section of the Actual Model prototype prepared based on the calculations and the similar conditions through which air flows in simulated model  
 (c) The actual model pressure opening during discharge

In the present study, 5 different cases have been considered for simulation wherein the temperature of the water is changed for each case and an approximate result has been derived. The results have been obtained at -2°C, 0°C, 5°C, 10°C, 15°C, 25°C.

The default values of the initial mesh are 0.1524m for the minimum gap size and 0.8123 for the minimum wall thickness.

For the current project, the holes on the cylinder face resembling the gap between the corrugations of the pipe are the smallest details and hence a minimum gap size of around 2mm fulfils our condition of obtaining a refined minimum size mesh of 2 mm cell size near the detailed structure and a bigger cell size in the other parts / volume of the unit.

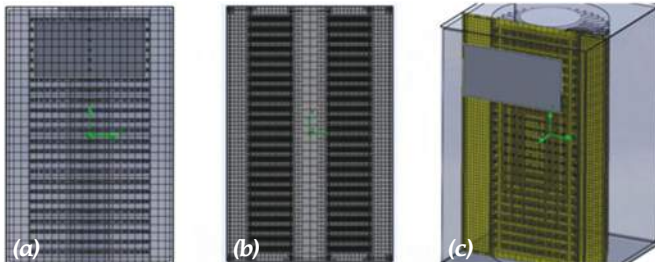


Fig. 7

- (a) Assembly showing basic mesh with an initial automatic mesh level of 5
- (b) Refined mesh using a minimum gap size of 0.002m
- (c) Isometric View of the Refined mesh Assembly

**Temperature Contour Plots**

The Contour plots show the distribution of the temperature in the unit. With the help of these plots it is now easier to predict the behaviour of the air in the prototype to be built for experimentation. We can validate the below simulation results with the experimental results.

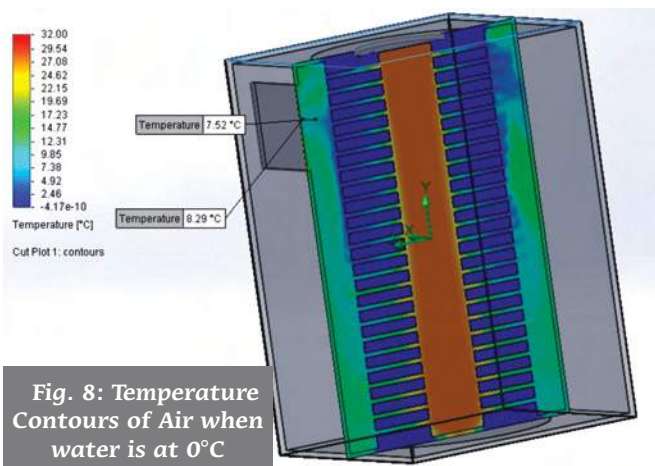


Fig. 8: Temperature Contours of Air when water is at 0°C

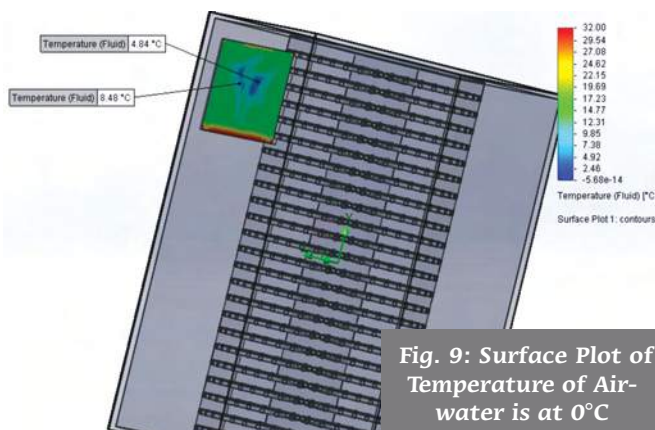


Fig. 9: Surface Plot of Temperature of Air-water is at 0°C

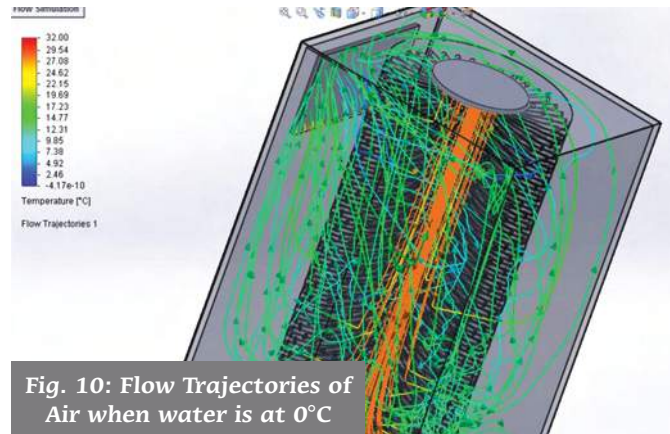


Fig. 10: Flow Trajectories of Air when water is at 0°C

**Prototype Setup**

The calculated mass of ice required for 1TR-hr cooling is 30kgs or 30 liters in terms of volume. Since we know the diameters of the copper tube and the polypropylene pipe, the length required for 30 liters of water has been calculated as 60m in previous chapters.

As per the calculation 60 meters of copper tubing was purchased from a Mumbai based dealer. 50 feet of copper tubing constituted 1 roll and hence to meet our requirements, 5 such rolls were purchased. The extra copper tubing of 15 meters was intended to be used for the extra piping as may be required by the unit

The straightened Copper tube was inserted into the polypropylene pipes and then folded to the desired outer diameter with the help of a refrigerant cylinder around which the pipe was wound.

The bundle height was limited to 1 meter as calculated for the optimum space utilisation for the given diameter and length of the pipes. The height was sufficient enough to accommodate 65 meters of pipe coiled in diameters of I.D  $\phi$ 140mm and O.D  $\phi$ 212mm,  $\phi$ 284mm,  $\phi$ 356mm and  $\phi$ 428mm. The bundles of pipes were firmly strapped together

as it may tend to loosen up and become shapeless once they are filled with water.



Fig. 11: Polypropylene pipes coiled and stacked above one another

The inlets and outlets were then segregated into their respective categories and were connected by a common distributor (supply to the cooling coil) and header (return line towards the compressor) by the brazing process. The plastic pipes were sealed with rubber corks to avoid any spillage of water. The rubber corks were drilled to provide passage for the temperature sensors (Pt 100) inserted to get the experimental data logged into the computer.



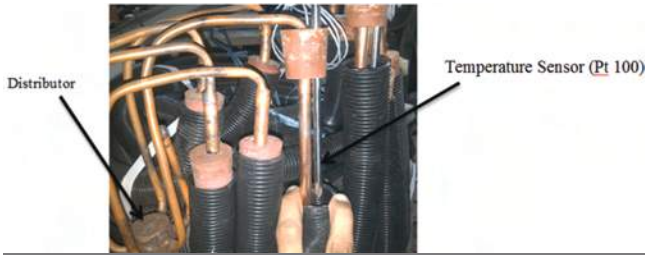


Fig. 12: Distributor end of the unit and temperature sensor Pt 100 inserted in the medium



Fig. 13: The condensing unit set up



Fig. 14: Sheet Metal work done on 22-Gauge Sheet

The condensing unit was assembled with the compressor model no. KCN416LAG of Kirloskar Copeland make with a capacity of 0.3 TR at  $-6.7^{\circ}\text{C}$  (Evaporating temperature) and  $43.3^{\circ}\text{C}$  (Condensing temperature).

The outer body was then made using Tin sheets of 22mm gauge. Sheet metal drawings were given to the workers to get the sheet cut into the required sizes and then bend or weld it

into the form of a box which would contain polypropylene pipes.

Once the box was made the blower was mounted atop the box. The desired mass flow for the blower, as per calculations, was 300CFM but due to unavailability of the blower we have used a blower whose volume flow is calculated to be 150 CFM.

$$\dot{Q} = A \cdot V$$

Where,

A = Area of the opening kept for return air (for measurement purpose)

V = Velocity of the return air measured in m/s by an Anemometer

$\dot{Q}$  was calculated to approximately 150 CFM. Now, using relation  $A_1V_1 = A_2V_2$  the velocity of the supply air to the room was recorded as 1.6 m/s using an Anemometer. The data has been further used for simulating the Air flow through the unit using software package Solidworks 2012.

The box was well insulated to avoid any infiltration of air and the PT 100 sensors were connected to the Data logger whose results have then been used for a regression analysis and to tally with the theoretical results obtained using thermodynamic relations.

The table below shows the bill of materials purchased for the construction.

**Bill of Material**

No.	Item	Quantity	Rate	Price
01	Condensing Unit-R134a (0.3 TR)	01	10000	Rs 10000
02	Copper Tubing	5 rolls of 50 feet each	Rs 670 per kg or Rs 1675 per roll	Rs 8800
03	Polypropylene pipes	65 meters	Rs 45 per meter	Rs 2925
04	G.I Sheet (22-gauge)	01 sheet of 8x4 feet (16 kg) 01 sheet of 5x4 feet (10 kg)	Rs 55 per kg	Rs 1430
05	Blower	01 blower $\phi$ 11 inch	Rs 5000	Rs 5000
06	Insulation	55 ft <sup>2</sup> or 5.1 m <sup>2</sup>	Rs 70 per ft <sup>2</sup>	Rs 3850
07	Rubber corks	10	Rs 45	Rs 450
08	Labour cost	7 working days	Rs 500	Rs 3500
09	<b>Total Cost</b>			Rs 35955

Table 1: Bill of Material for the current project

**Experimental Findings**

The Experimental charging and discharging of the system was conducted at Panasia Corporation under the guidance of Surendra Shah. Pt 100 temperature sensors were inserted to get the experimental readings data logged into the computer with the help of Smartlog hardware and software. The below figure shows the Smartlog software and slot no. 07, 08, 09, 10 connected to the PT sensors at the Distributor side water, header side water, supply air and return air respectively.

The condensing unit was connected with a Power meter to note the actual Power consumption by the condensing unit. The blower is not considered as a Power consuming device for the current project as it is supposed to run on Inverter Backup or Solar energy during Power Outages. The condensing unit was also connected with Pressure Gauges to record the suction and discharge Pressure.

The temperature data was logged at an interval of 2 mins. The pressure readings and the power consumption reading were taken manually at an interval of 15 mins. The table below represents the readings logged during the charging time which have also been used for regression analysis later in the report.

**By-pass Factor and Heat Exchanger Effectiveness**

The Air that flows through a cooling coil without making contact with the coil surface is known as the Bypass Air.



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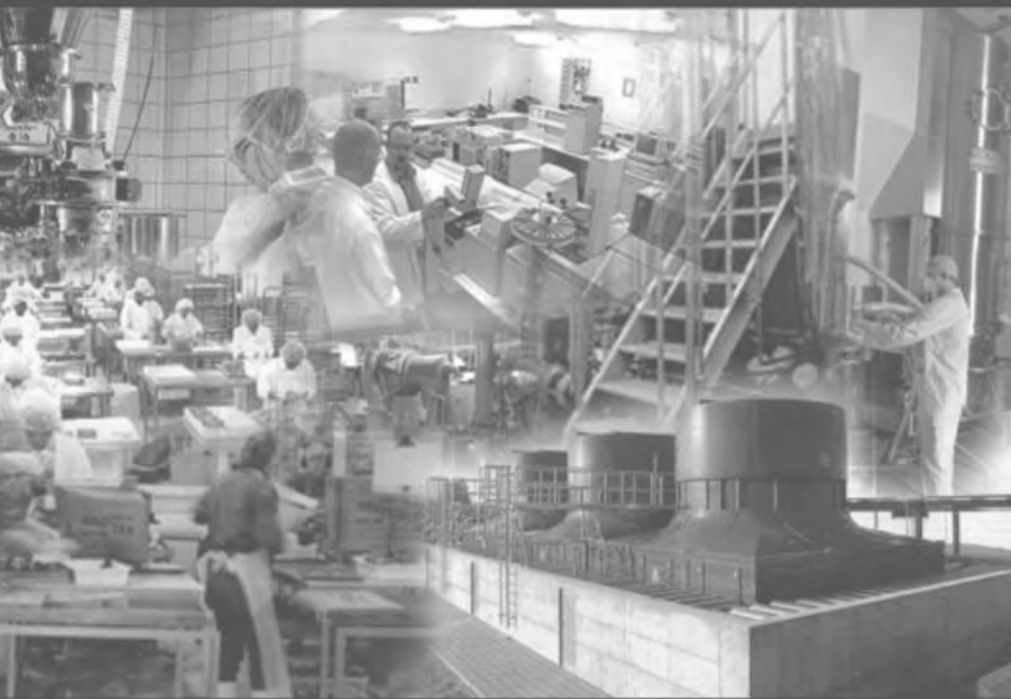
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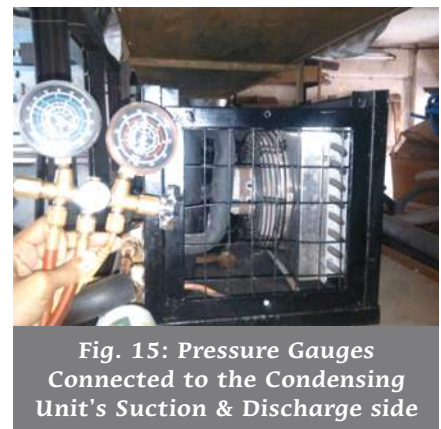
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**Table 2: Data logged using the Smart Log data logger on 01.06.2013**

Sr. No.	Date / Time	water ta	slab top	slab1bot	ret grid	red out	Amb sun	RP top	slab2bot	RP out	Amb slab
		Min.	0	0	0	0	0	-10.1	-0.2	6.1	25.1
		Max.	0	0	0	0	0	0	0	0	0
		Avg.	0.00	0.00	0.00	0.00	0.00	6.28	12.78	22.49	29.57
1	01-06-2013 08:50:27	Open	Open	Open	Open	Open	Open	26.2	25.5	29.4	30.7
2	01-06-2013 08:52:27	Open	Open	Open	Open	Open	Open	26.3	25.6	29.5	30.7
3	01-06-2013 08:54:27	Open	Open	Open	Open	Open	Open	26.3	25.6	29.4	30.7
4	01-06-2013 08:56:27	Open	Open	Open	Open	Open	Open	26.3	25.6	29.4	30.5
5	01-06-2013 08:58:27	Open	Open	Open	Open	Open	Open	26.3	25.6	29.3	30.4
6	01-06-2013 09:00:27	Open	Open	Open	Open	Open	Open	26.3	25.6	29.2	30.3
7	01-06-2013 09:02:27	Open	Open	Open	Open	Open	Open	26.3	25.7	29.1	30.3
8	01-06-2013 09:04:27	Open	Open	Open	Open	Open	Open	26.3	25.7	29.1	30.2
9	01-06-2013 09:06:27	Open	Open	Open	Open	Open	Open	26.3	25.7	28.9	30.2
10	01-06-2013 09:08:27	Open	Open	Open	Open	Open	Open	26.3	25.7	28.9	30.2
11	01-06-2013 09:10:27	Open	Open	Open	Open	Open	Open	26.3	25.7	28.9	30.1
12	01-06-2013 09:12:27	Open	Open	Open	Open	Open	Open	26.3	25.7	28.8	30.1
13	01-06-2013 09:14:27	Open	Open	Open	Open	Open	Open	26.2	25.7	28.8	30.2
14	01-06-2013 09:16:27	Open	Open	Open	Open	Open	Open	26.2	25.7	28.8	30.2
15	01-06-2013 09:18:27	Open	Open	Open	Open	Open	Open	26.2	25.7	28.9	30.2
16	01-06-2013 09:20:27	Open	Open	Open	Open	Open	Open	26.2	25.7	28.9	30.3
17	01-06-2013 09:22:27	Open	Open	Open	Open	Open	Open	26.2	25.7	28.9	30.3
18	01-06-2013 09:24:27	Open	Open	Open	Open	Open	Open	26.2	25.7	29.0	30.3
19	01-06-2013 09:26:27	Open	Open	Open	Open	Open	Open	26.2	25.7	29.0	30.3
20	01-06-2013 09:28:27	Open	Open	Open	Open	Open	Open	26.2	25.7	29.1	30.4
21	01-06-2013 09:30:27	Open	Open	Open	Open	Open	Open	26.2	25.7	29.1	30.4
22	01-06-2013 09:32:27	Open	Open	Open	Open	Open	Open	26.2	25.7	29.1	30.4
23	01-06-2013 09:34:27	Open	Open	Open	Open	Open	Open	26.3	25.7	29.1	30.5
24	01-06-2013 09:36:27	Open	Open	Open	Open	Open	Open	26.3	25.7	29.2	30.5
25	01-06-2013 09:38:27	Open	Open	Open	Open	Open	Open	26.3	25.8	29.2	30.5
26	01-06-2013 09:40:27	Open	Open	Open	Open	Open	Open	26.3	25.8	29.2	30.5
27	01-06-2013 09:42:27	Open	Open	Open	Open	Open	Open	26.3	25.8	29.2	30.6
28	01-06-2013 09:44:27	Open	Open	Open	Open	Open	Open	26.3	25.8	29.3	30.6
29	01-06-2013 09:46:27	Open	Open	Open	Open	Open	Open	26.2	25.8	29.3	30.6
30	01-06-2013 09:48:27	Open	Open	Open	Open	Open	Open	26.2	25.8	29.3	30.7
31	01-06-2013 09:50:27	Open	Open	Open	Open	Open	Open	26.2	25.8	29.3	30.7
32	01-06-2013 09:52:27	Open	Open	Open	Open	Open	Open	26.2	25.8	29.4	30.7
33	01-06-2013 09:54:27	Open	Open	Open	Open	Open	Open	26.2	25.8	29.4	30.7



**Fig. 15: Pressure Gauges Connected to the Condensing Unit's Suction & Discharge side**

Thus, the bypass factor is given as  

$$BPF = \frac{\text{Temp. of air leaving the coil} - \text{Coil Temp.}}{\text{Temp. of air entering the coil} - \text{Coil Temp.}}$$

$$BPF = \frac{6^{\circ}\text{C} - (-2^{\circ}\text{C})}{28^{\circ}\text{C} - (-2^{\circ}\text{C})}$$

$$BPF = 0.26$$
 Thus, we get the Heat Exchanger Effectiveness as  

$$(1 - BPF) \times 100\%$$

The unit has a Heat Exchange Effectiveness of 73.3%.

**Economic Analysis**

The capital cost for a 1TR-hr unit has been calculated in the previous chapter. A scaled model can be predicted to have a cost similar to the above calculated cost with just an increase in the copper tube and polypropylene pipe.

Hence, for every extra additional ton hour we need to add Rs 12000 approximately and the model can be scaled to any size unless there is a space restriction at the site.

The working cost of the system can be simplified as follows.

The total consumed power is that of the Compressor and the condenser fan which has been calculated using the power meter installed beside the prototype.

The total charging time is 4 hours and the power reading taken from an experiment conducted on May – 2013 gives us the total power consumed as 2.307KW-hr (Or 2.5 units). The BTUs obtained after discharging the system were calculated using a Psychrometric chart. By plotting the wet bulb and dry bulb conditions of the supply air's initial and final conditions we get the difference in the enthalpy which can

**Table 3: Experimental data logged on 30.05.2013 shows the timewise temperature drop of water**

System Charge Readings				
Time (Mins)	Distributor Temperature (°C)	Header Temperature (°C)	Suction Pressure (Psi)	Discharge Pressure (Psi)
0	26.1	26	35	230
2	24	25.6	35	230
4	21.3	25.2	35	230
6	18.9	25	34	225
8	17	24.6	34	225
10	15.5	24.2	34	225
12	14.3	23.8	33	224
14	13.3	23.4	33	224
16	12.4	23.1	33	224
18	11.6	22.7	32	223
20	11.2	22.2	32	223
22	10.6	21.8	32	223
24	10.1	21.5	31	222
220	-1.8	0.5	19	195
222	-1.8	0.3	19	194
230	-2.3	0	18	190
232	-2.4	-0.1	18	189
246	-3.4	-1.2	18	184
248	-3.5	-1.4	18	184
250	-3.7	-1.5	17.5	184
252	-3.9	-1.7	17.5	183
254	-4.3	-1.9	17.5	183
256	-4.6	-2	17.5	183



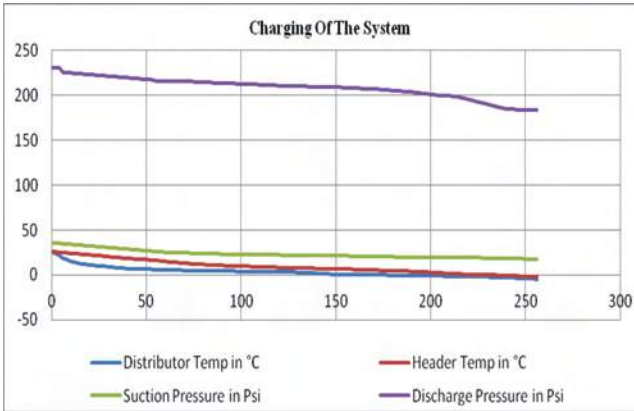


Fig. 16: Graph depicting the timewise decrease in temperature as shown in the above result table

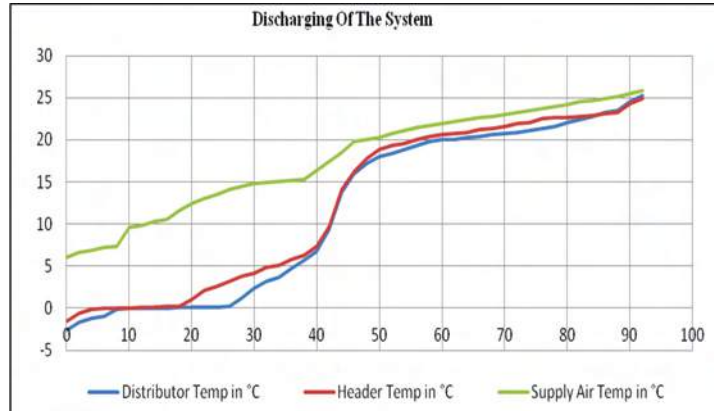


Fig. 17: Graph depicting the timewise increase in temperature as shown in the above result table

System Discharge Readings			
Time (mins)	Distributor Temperature (°C)	Header Temperature (°C)	Supply Air Temperature (°C)
0	-2.6	-1.5	6.1
2	-1.7	-0.6	6.6
4	-1.2	-0.1	6.9
6	-0.9	0	7.2
8	-0.1	0	7.4
10	0	0	9.6
12	0	0.1	9.8
14	0	0.1	10.3
16	0	0.2	10.6
18	0.1	0.2	11.6
20	0.1	1.1	12.4
22	0.1	2.1	13.1
24	0.1	2.6	13.5
26	0.2	3.2	14.1
28	1.2	3.8	14.5
30	2.4	4.2	14.8
32	3.2	4.8	14.9
50	18	18.8	20.3
52	18.4	19.3	20.7
54	18.8	19.6	21.1
56	19.3	20.1	21.5
58	19.8	20.4	21.7
60	20	20.6	21.9
80	22	22.7	24.2
82	22.4	22.8	24.5
88	23.5	23.3	25.1
90	24.5	24.3	25.5
92	25.3	24.9	25.9

Table 4: Experimental data logged on 30.05.2013 shows the timewise temperature increase of water

then be multiplied by mass flow of air to get the BTUs per hour using

$$Q = \dot{m} \cdot (h_1 - h_2)$$

Where

$$\dot{m} = \dot{Q} \times \rho$$

$$= 150CFM \times 4.719E - 4 \times 1.184$$

$$\approx 0.084 \text{ kg/sec}$$

Now,

$$Q = 0.084 \cdot (74 - 17)$$

$$= 4.788KW$$

$$Q = 16341.3 \text{ BTUs/hr}$$

Therefore, the EER is calculated as

$$EER = \frac{16341.3}{2500}$$

$$= 6.53$$

$$C.O.P = 4.788/2.5$$

$$= 1.9$$

### Fixed Cost

As stated earlier in the chapter, for every extra additional ton hour we need to add Rs 12000 approximately to the cost of the unit calculated as Rs 37205  
Fixed cost of an 8TR-hr unit:

Cost of a 1TR-hr Himoder + 12000 additional cost per TR-hr

$$Rs\ 37,205 + (12000 \times 7) = 1,21,205$$

Estimating the manufacturers margin at 20% we get the final Fixed cost as-

DIESEL FUEL CONSUMPTION CHART																	
This chart approximates the fuel consumption of a diesel generator based on the size of the generator and the load at which the generator is operating at. Please note that this table is intended to be used as an estimate of how much fuel a generator uses during operation and is not an exact representation due to various factors that can increase or decrease the amount of fuel consumed. Day = 24 hours, Week = 24 X 7, Month = 24 X 7 X 4.3 weeks or 30.1 days per month.																	
Size (kVA)	Size (kW)	1/4 Load (gal)				1/2 Load (gal)				3/4 Load (gal)				Full Load (gal)			
		Hr	Day (24)	Week (168)	Month (722.4)	Hr	Day (24)	Week (168)	Month (722.4)	Hr	Day (24)	Week (168)	Month (722.4)	Hr	Day (24)	Week (168)	Month (722.4)
25	20	0.6	14	101	433	0.9	22	151	650	1.3	31	218	939	1.6	38	269	1,156
38	30	1.3	31	208	939	1.8	43	302	1,300	2.4	58	403	1,734	2.9	70	487	2,095
50	40	1.6	38	269	1,156	2.3	55	386	1,662	3.2	77	538	2,312	4.0	96	672	2,890

Fig. 18: The approximate fuel consumption of a 20kW Diesel Generator

Fixed Cost = Rs 1,51,506 for an 8TR-hr unit  
(Neglecting the Wholesale cost for mass production)

**Operating Cost**

The operating cost is calculated based on the electricity tariff chargeable to the customer. The present analysis is

for the city of Bangalore, and thus the Tariff applicable under Karnataka Electricity Regulatory Commission (KERC) has been used to calculate the operating cost for the unit (charging time is 4 hours) and a normal 1 ton AC unit working for 8 hours.

**Savings Through the Operating Cost**

The savings obtained for the operating cost is calculated as the difference between the operating cost of the normal air-conditioner and a Pumpless Ice Thermal Storage unit. As calculated above the two costs are 28944 and 12753 respectively.

$$28944 - 12753 = 16,191$$

Thus, we calculate a total saving of Rs 16,191 per year in the operating cost alone. This also means that we save about 2417 units of electricity per year. Mandating such a project could save loads of electricity and prevent load shedding in rural parts of the state. The state can easily generate a surplus of electricity.

**Payback**

The difference between the fixed cost of a 1 ton Air-Conditioning unit and an 8 TR-hr Pumpless Ice Thermal storage unit is

$$1,51,506 - 25,000 = \text{Rs } 1,26,506$$

The payback for the unit shall be 7.8 Years based just on the electricity Tariff rebate applicable for the state. However, detailed statistics prove that the

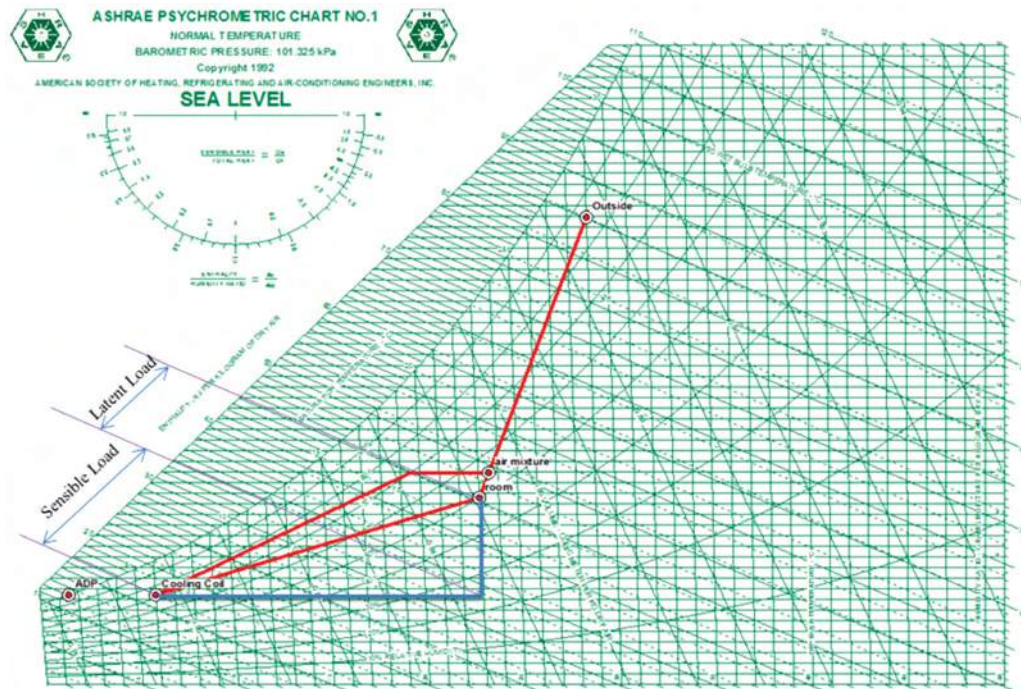


Fig. 19: Psychrometric Chart Plot for the above considered data

POINT	LABEL	AR FLOW	UOM	PROCESS	GIVEN	DB	WB	RH	W	v	h	DP	d	vp	AW	START POINT	SECOND POINT
Outside	AR	15	STD CFM	Add State Point	POINT	84.2	80.6	85.8	0.0219	14.19	44.30	79.5	0.0721	1.015	10.823		
room	AR	150	STD CFM	Connect State	POINT	73.4	61.2	50.0	0.0088	13.62	27.22	53.7	0.0741	0.415	4.513		
air mixture	AR	165	STD CFM	Air Mixing	POINT	74.4	63.4	54.8	0.0100	13.67	28.76	57.1	0.0739	0.470	5.107	Outside	room
ADP	AR	165	STD CFM	Cooling Coil	POINT	42.8	39.2	72.8	0.0042	12.75	14.84	34.7	0.0788	0.201	2.320	air mixture	
Cooling Coil	AR	165	STD CFM	Add State Point	POINT	34.7	34.7	100.0	0.0042	12.54	12.88	34.7	0.0801	0.201	2.358	air mixture	
	AR	165	STD CFM	Connect State	POINT	73.4	53.5	24.2	0.0042	13.52	22.24	34.7	0.0743	0.201	2.187	ADP	

Start Point	Process	Current Point
air mixture	Cooling Coil	DB 42.800 DP 34.70000
165	Total Cooling	0.9 Air Flow 165
74.379	Total Energy	42.800 Total Cooling (tons)
63.374	Sensible Energy	39.164 WB
54.8	Latent Energy	-5.672 RH 72.8
0.00998	Dehumidification	4.3 W 0.00423
13.674	Sensible Heat Ratio	0.548 v 12.749
28.765	Enthalpy/Humidity Ratio	2.422 h 14.836
57.106		DP 34.700
0.0739		d 0.0788
0.4705		vp 0.2011
5.107		AW 2.320

### Pumpless Ice Thermal Storage System

Considering the usage of the project in a commercial complex based in Bangalore whose tariff rate is Rs 6.70 per unit till the first 2 lakh units.

The electricity used by a 1TR-hr unit while charging is 2.307 units. Considering a 30% increase in Power consumption, per TR-hr rise for a bigger model and a putting a correction factor of 30% we get

$$2.307 \times (7 \text{ TR-hr} \times 0.3) \times 1.3$$

≈ 6.5 units of electricity consumed for charging an 8TR-hr machine

The rebate given to the company in Bangalore is Rs 1.25 per unit and so the reduced cost becomes Rs (6.7x6.5) - Rs (1.25x6.5) which comes to Rs 35.42 per day and Rs 1062.75 per month and Rs 12,753 per year.

### Normal 1 Ton Air-Conditioning Unit

However, a one TR air conditioning unit with a 5 star rating consumes 1500W or 1.5 units per hour. Continuous operation for 8 hours calculates to 12 units per day and hence an operating cost of Rs 80.4 per day and Rs 2412 per month and Rs 28,944 per year.

During the power outage The Diesel Generator consumes about 0.5 litres of fuel per hour for 1.5 kW-hr load. Thus, the total fuel consumption for 8 hours of power outage on a working day amounts to

$$0.5 \text{ liters} \times 8 \text{ hrs} \times \text{Rs } 55 = \text{Rs } 220 \text{ per day.}$$

Assuming an 8 hour power outage per week, we get the fuel consumption of Rs 220 x 4 = Rs 880 per month. More importantly the conventional system would consume 16 litres of fuel per month per tonnage of refrigeration. Thus, a large amount of fuel can be saved if we consider about a thousand offices running at the same time in the city.

fixed cost of a diesel generator set needs to be taken into account while calculating the fixed cost of a 1 ton AC unit as it shall run on the diesel generator during power outages. The cost of diesel too should be considered. Now, the initial cost of a 20kW, 25kVA diesel generator set is approximately Rs 3,00,000 and the cost of diesel in Bangalore is Rs 55 per liter.

The fuel consumed on an average for full load condition is 6 liters per hour. However the load for a 1 ton unit is just 1.5kW per hour and hence the fuel consumed reduces to 0.5 litres for Air-conditioning load. Hence, for 8 hours the fuel consumption is 4 litres. If the cost of diesel currently is taken to be as Rs 55 per litre then the total cost comes to Rs 220 per working day.

Adding the Diesel Generator set fixed cost to the cost of the 1 ton AC unit, it is clear that the Pumpless Ice Thermal storage system would prove far more economical than the conventional system being used. The operating cost however would differ from region to region as every state has a different Electrical tariff but in general it is assumed that there shall be a rebate of at least Re. 1/- for usage during off-peak hours. Also the unit can be most efficiently employed in regions experiencing heavy load shedding and hence the huge amount of fuel can be saved.

### Conclusion

- The basic design of a Pumpless Ice Thermal Storage System has been discussed in the given chapter, simulation results have been further obtained for the final condition of the supply air and a prototype has been developed to further match the results and hence the results can be regressed and used to develop a commercial model.
- Designing, optimizing and commercializing such a Thermal energy storage unit could prove a short term solution to the increasing gap between supply and demand in the Power sector, and offices can operate smoothly in the remotest of places.
- The Ideal COP overall is considered 2.5 in the calculations. However, the ideal COP that may be found by experimentation is approximated at 1.9 to 2.0.
- The current paper sees the designing of a 1TR-hr prototype unit, however a scaled model can be prepared using similar calculations.
- Also 1 dimensional transient heat conduction solution shows us that the unit shall be discharged from -2°C to 25°C in 60.3 mins if the heat transfer co-efficient of the air is maintained at 25.68W/m<sup>2</sup>K. However, the time can be calculated

using similar set of equations for a bigger model and reversibly the required blower speed can be calculated.

- The simulations on the prototype have been performed using Solidworks 2012 software package and The Boundary conditions applied in the current paper shall be applicable to scaled models as well and the results can be approximated at various temperatures of the volumetric source.
- The amount of reduction in electrical power depends on the operation strategy that is selected for Thermal Storage. Full storage has the highest electrical reduction; however, chiller and storage sizes are high compared with partial storage strategies.
- Better score points by the bureau of energy efficiency in India for the greener building initiative.
- It has been also found that the amount of energy consumption can be reduced by shifting the charging time from morning hours to night time where the condensing temperatures are less.
- Precise cooling (substitute to cassette units) may be obtained using the unit even during a power outage.
- Elimination of DG sets enables a company to lower the overall cost. ■



# Danfoss India in Chennai rewrites Sustainability Story



In a world dabbling with power and energy constraints, time has come for companies to think beyond profits. Companies should not only retrospect about what they do with profits, but the manner in which they make the same.

Danfoss India, a Danish company that is headquartered in Chennai, in the climate and energy space, goes beyond the calling of profits to be environment friendly and keeps a check on its carbon footprint.

The company actively takes part in reducing carbon footprint of companies by providing valves, drives, compressors and controls that help them save or use energy efficiently. Beyond this, the company believes in a zero waste environment where its upcoming facility in Oragadam, Chennai will source a part of its energy requirement from a 1 MW solar park that will be set up by the company. 500 saplings were also planted in its campus to spread awareness about conserving the environment and going green. Plans are on to add another 1500 to this existing number.

"Planting of trees is just one of the many signals that Danfoss is sending out to the world to reduce carbon footprint and conserve energy. It is in line with our

philosophy of zero-waste environment to minimise energy consumption", said Ravichandran Purushothaman, President, Danfoss India.

## What does Danfoss do Essentially!

Let us start from the beginning. The entire product portfolio of the company delves in energy efficiency and significantly lowers power consumption of its clients. This is the theme based on which, all R&D happens in the company. Danfoss products include drives, valves, compressors and controls that find application in a range of areas like refrigeration, heating, cold storage, cooling in sectors like Mining, Pharma, Chemicals, etc.

## Going the Solar Way

Every day, Danfoss contributes significantly to improve energy efficiency – but, now the company is also focusing on its own energy consumption. The Danfoss Denmark facility is a completely eco-friendly venture and runs on the power generated by the Solar Park set up by the company. Danfoss India is working towards replicating a zero waste work environment at its new upcoming

500 crore green field & manufacturing R&D facility in Oragadam, Chennai. The proposed green Danfoss India campus coming up in the cultural capital of India, is a Platinum LEED rated manufacturing facility.

## Five-pronged Approach

Danish by lineage, Danfoss is a keen believer in a five pronged approach towards conservation; right from providing products that conserve energy, sourcing its own energy needs from solar power, equipping farmers to triple their income, empowering farmers, initiating industry academia initiatives where it nurtures talent in rural colleges instead of recruiting from IIMs and IITs and conserving the environment it runs in where it is in the process of creating the Platinum LEED rated Oragadam facility which will source 15% of its energy requirements from a solar plant set up by the company.

Though these initiatives may be the first step taken by a company in bringing about a greater change in the society, every small step in unison helps create a movement that will assist in bringing about awareness to conserve the environment. ■

## Frigesco's new low-energy flash defrost reduces energy use in **retail refrigeration**

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*British company, Frigesco has developed a new type of flash defrost technology that promises to dramatically reduce running costs for retail refrigeration equipment. The company claims that the patented innovation can also extend the life of plant, raise food hygiene standards and improve profitability for retailers. It is currently being trialled in stores across the UK by several leading supermarket chains. David Walter, Frigesco's managing director, explains how the innovation works and outlines its enormous potential for the Indian market.*

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**E**skimos are wise about snow and frost. Not for nothing do they make their homes out of compacted snow. An igloo makes a great shelter from arctic conditions, and while it may be  $-25^{\circ}\text{C}$  outside, temperatures inside can be in the balmy  $10$  to  $20^{\circ}\text{C}$  range.

An igloo makes a good shelter because of the excellent insulating properties of snow. Whereas, solid ice makes a very poor insulator, compacted snow contains a matrix of small air pockets that work very effectively, along similar lines to modern polymer-based, closed-cell insulation. Being highly reflective also helps keep out radiated thermal energy. While the insulating properties of snow are a boon for eskimos, they present a serious problem for the refrigeration industry and retailers. The rapid build-up of frost that occurs on the cold surface of evaporators significantly reduces the efficiency of refrigeration systems. The cold, bare metal of an evaporator is good at transmitting its "coolth" to the surrounding air (or, indeed, absorbing thermal energy from it). However, it is not long before water vapour from the air passing over the cold surface is deposited, as air reaches dew point, resulting in a dusting of frost over the metal surface. Unless active steps are taken, frost build-up will continue to accumulate to many inches in thickness, rendering the refrigeration system ever more inefficient, and in the worst cases putting food safety at risk.

To overcome this, and restore the refrigeration plant to proper functioning, frost build-up must be removed through the application of energy. This process, known as defrosting, has to be carried out on each system a number of times each day – depending on humidity levels in ambient air and the level of activity in the cabinet or local cold store environment.

Energy for defrosting is traditionally obtained from so-called hot gas, via the

refrigeration system itself, or directly from the mains in the form of electric defrost. The latter uses small heaters within the cabinet, near the evaporator, to warm the local environment and melt frost build-up. There are a number of downsides to these conventional approaches. Hot gas defrosting carries a significant energy and performance penalty, as it requires the refrigeration system to operate outside its optimum envelope for significant amounts of time in order to generate the additional heat for defrosting. This reduces the efficiency of the refrigeration system and increases running costs for end users.

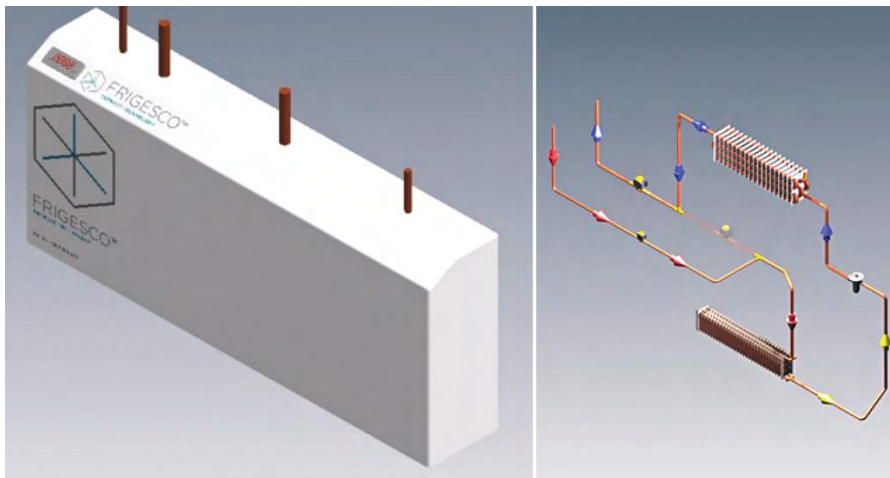
Electric defrost incurs a direct energy penalty, through the consumption of electricity to melt frost using dedicated heaters. The use of electric fans in defrost systems adds further to energy consumption.



In both cases, the addition of significant quantities of indiscriminate heat energy to refrigerated spaces must be offset by increased refrigeration input, again leading to higher electricity consumption. On the legal and safety front, there is growing concern that repeated heating of food in refrigerated spaces may lead to hygiene risks.

Due to its high specific heat capacity and good insulation properties, accumulated frost requires a considerable amount of energy to melt it. Defrosting a refrigerated display case typically accounts for around 30% of total energy use. When multiplied across





**David Walter,**  
Managing  
Director  
of Frigesco.



integral and remote refrigeration systems, with equal success.

Traditional defrosting methods are extremely inefficient, with as little as 20% of the energy being used in the defrosting process. Not only is this inefficient, it adds a

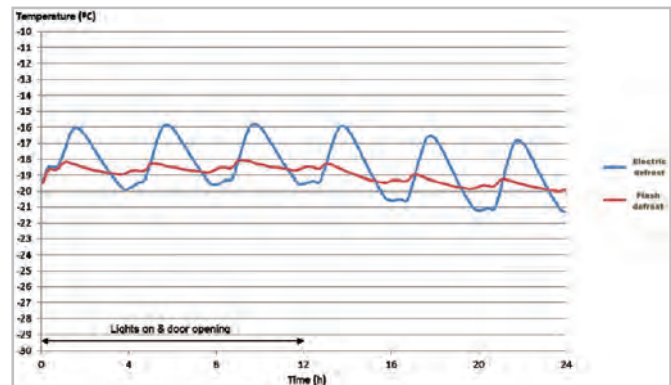
a supermarket's estate, or indeed the combined refrigeration systems in the food supply chain across a whole country, this amounts to an immense drain on energy supplies and a huge additional cost for end users.

Despite this, over the past five decades there have been few significant developments in the field of defrosting technology. During this time, the cost of energy has continued to rise, grid supplies have become "maxed out" in some cities, and concern has grown about the risks of exposing refrigerated food to repeated surges of heat over long periods.

Recognising the problem, Frigesco has for some time been working on a new approach to defrosting refrigeration systems that overcomes the downsides of conventional approaches. Following an intensive period of development and testing, our new low-energy flash defrost system was recently granted full patent protection. We are now finalising trials in working UK supermarkets prior to a planned global roll-out of the system.

Frigesco's flash defrost system dramatically reduces the amount of energy required to maintain optimum frost-free conditions in refrigeration systems. Trials have shown that it can cut the overall energy consumption of refrigeration systems by up to 25%. It uses a specialist food-safe phase-change material to store heat energy generated by the refrigeration system in the course of normal operation. It then uses the latent heat energy stored in the phase-change material to defrost evaporators, as and when required.

Efficiency is improved, as it does not require electrically-driven components to deliver heat energy to the frosted evaporators, although small pumps can be used to improve the speed of the process if required. In addition, as it sequesters heat produced by the refrigeration system during normal operation, it adds a sub-cooling effect, improving performance and yielding further energy savings. It can be used on both



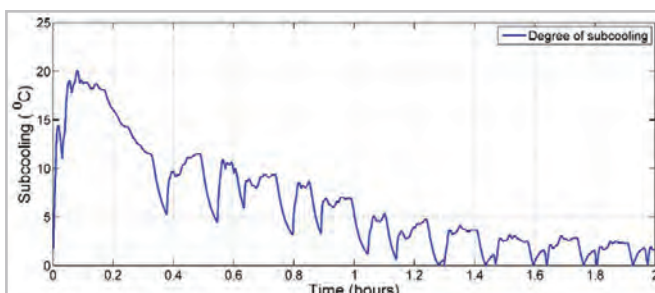
Temporal variations in ice cream tub core temperature for both defrosts

significant unnecessary heat gain to the refrigerated space. The new system uses much lower temperatures, better targeted to effect a complete defrost of the evaporator. This means that the temperature of stored product is maintained within much narrower limits, rather than fluctuating wildly as in the case of a traditional defrost (See Figures).

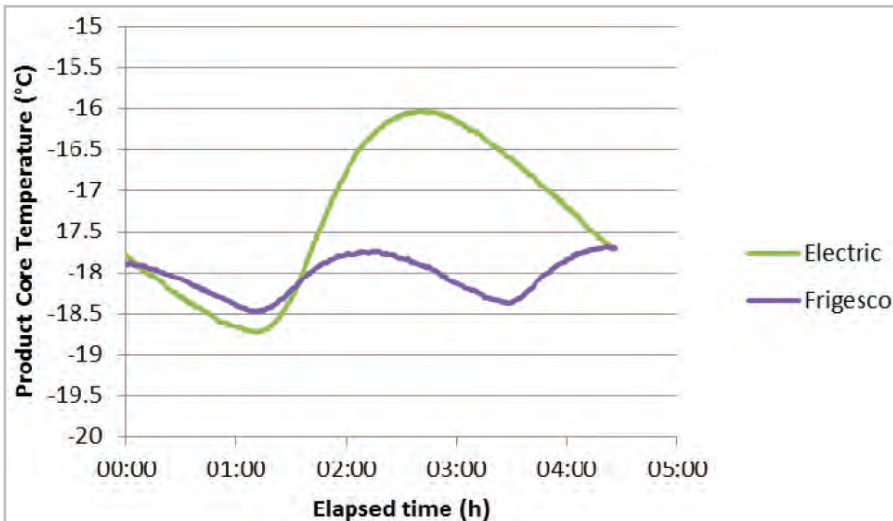
The flash defrost system has been developed by a team headed by Professor Tom Davies in the UK. It uses a heat store containing a waxy phase-change material, carefully calibrated to change phase at a specific temperature. This is placed in the refrigeration circuit after the condenser, so that heat from the warm liquid leaving the condenser is collected and stored for use during a defrost.

This has two benefits. First, heat which would otherwise be wasted is harvested and put to later use for defrosting. And second, the resulting sub-cooling of the liquid arriving at the expansion device has a beneficial effect on the overall efficiency of the system. In thermodynamic terms, the sub-cooling gain effectively pays for the post-defrost re-chilling required.

Therefore, with no additional energy required for defrost and little extra energy needed for re-chilling, the defrost process is virtually energy-free. It has been calculated that if supermarkets adopted the system worldwide, it would save around £1.6 bn in energy costs. This reflects adoption on display cases only. If flash defrost was also applied to store freezer rooms, the saving could potentially be doubled. With energy prices increasingly sharply, pay-back times are getting shorter and the scale of potential energy savings increasing







Core temperatures of m packs during and after electric and flash defrosts

beat 22 rival entries from 11 countries to win the top accolade for Excellence in the field of Environmental Technology Development.

Having proven the technology, Frigesco is working with a number of major UK food retailers on in-store trials. Once proven in cold rooms, the next stage will be to apply the system to refrigerated display cases.

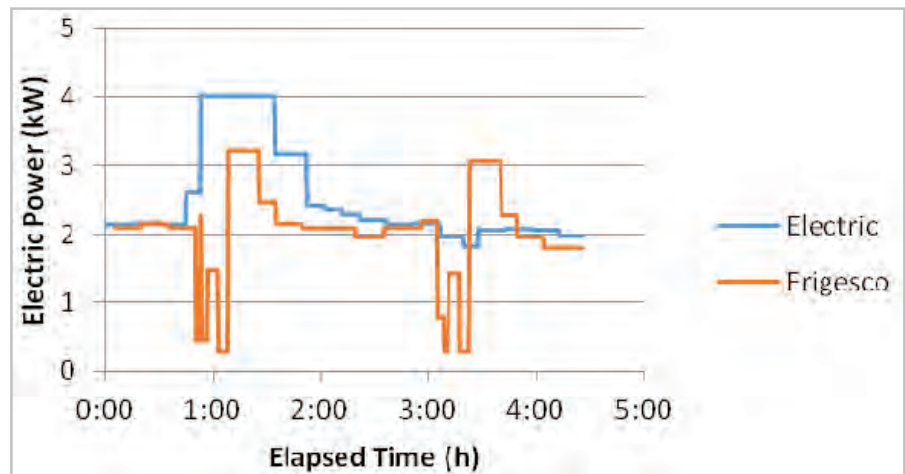
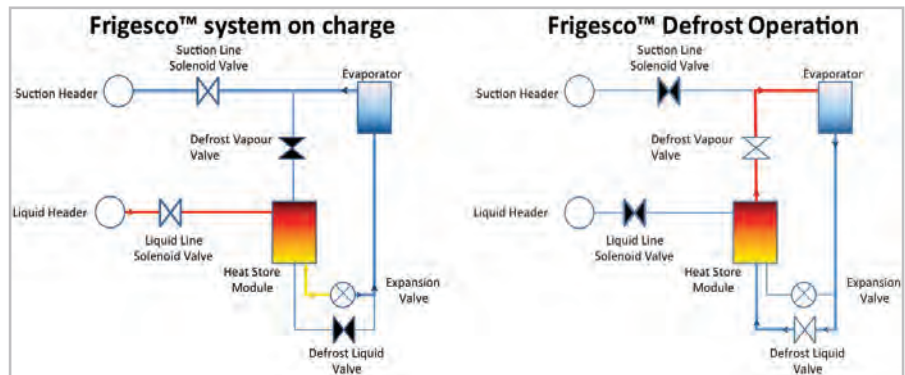
Bob Arthur, former president of the British Refrigeration Association, and a respected international authority on retail refrigeration, has joined the Frigesco team to help develop and commercialise the technology. Arthur said, "The Frigesco flash defrost system

with each passing day.

Although the main benefit is a reduction in energy use and lower running costs, the Frigesco system delivers other attractive benefits. These include:

- Improved food hygiene and safety due to more effective defrosts, and more stable temperatures in the refrigerated space
- Increased working life and fewer breakdowns for refrigeration plant, due to more complete defrosts and improved equipment operation
- Potential reductions in equipment capital costs due to design optimisation possible with the use of flash defrost
- Reduction in a retail store's overall maximum electrical draw, giving "head room" in locations where power supplies are near the limit, which may be vital in extreme weather conditions, as experienced in hot summer months
- The more efficient defrost process stops the build-up of frost on floors and walls in the immediate environment of refrigeration plant, eliminating the so-called "Santa's grotto effect", and reducing slip hazards for store staff.

The importance of the innovation, in terms of its energy saving potential in particular, has been recognised by the UK Government. It awarded Frigesco a Department of Energy and Climate Change (DECC) grant to develop and commercialise the



technology. We were subsequently invited to participate in Cleantech Innovate, the leading UK green technology event, backed by DECC and the Institution of Mechanical Engineers.

As a result of our participation, we were invited to take part earlier this year in Clean Equity Monaco 2014, an international showcase of the most promising sustainable and energy-saving technologies from around the world. Frigesco's flash defrost system

is a genuine innovation, and the savings are substantial and proven. Retailers are understandably keen to carry out trials, to prove the system for themselves.

"Given the potential savings and relatively low capital cost, I believe Frigesco flash defrost technology will be widely adopted by food retailers and supermarkets in the near future. It deserves to become a mainstream technology across the industry." ■

# Systemair Inaugurates Green Facility in India



Systemair's modern state-of-the-art factory at Greater Noida

**S**ystemair India announced opening of their modern state-of-the-art Green facility of 12,000 sq mtr on March 14, 2014 in Greater Noida, India.

It is a huge achievement for Systemair India by opening this ultra-modern facility which has AMCA certified test rig, innovative expo center and systematic manufacturing set up to cater to the diverse requirements. Factory is designed and constructed as a Green Building under LEED BD+C-NC 2009.

The inauguration was initiated by Sapling Ceremony to mark our continued commitment to be eco-friendly. In Indian Tradition before a new beginning, it is customary to seek the blessings of the almighty by lighting lamp. Systemair was overwhelmed by customers who came forward and participated in the ceremony. Many dignitaries like Dr. P C Jain, Ashish Rakheja, R V Simha, R S Kulkarni, Pankaj Dharkar were present on the precious occasion of Lamp Lighting.

The momentous occasion in the history of Systemair came when ribbon was cut by CEO Gerald Engström to inaugurate new facility in India officially. All the guests were then taken to a Factory & Expo area tour where they had a hands-on experience on our certified products. Systemair India is manufacturing Eurovent Certified Air



Gerald Engström  
CEO

Mats Lund  
VP, Production

Asokdas  
MD, Systemair India

Handling Units, UL Listed Fire Dampers and AMCA certified Fans under one roof in Greater Noida. The feedback from all the guests was quite satisfying who trusted in our abilities and our efficient products. Gerald Engstrom then addressed the gathering of more than 250 distinguished guests expressing his feelings and interests in investments in India and future plans of Systemair for Indian HVAC market.

It was then followed by the address by Mats Lund who has been the driving force for Systemair's growth by initiating the developments for Factory in India. He expressed his views over his experiences and path ahead. Asokdas, Managing Director then expressed his thoughts by acknowledging the useful contribution by his team and thanking customers from different parts of the world. He also shared his thoughts over Systemair India's journey so far and conveyed the positive message Systemair India has to give to Indian HVAC industry. ■

The dignitaries like Kavy Pradeep, R S Kulkarni, Pankaj Dharkar addressed the audience by sharing their views and experiences with Systemair in past few years. Finally, colors and cultures of India set the tone for the beautiful evening with lanterns soaring high in the sky.

Systemair started its business in India in 1999 through a distributor. Through Swedish Trade Counsel, Systemair had its own presence in India in 2006. Initially the operations were started in the name of Systemair Fans Pvt Ltd. Acquisition of Ravistar in 2009 and IAPL in 2011 gave a boost to company by expanding the business in Indian HVAC market through diverse product portfolio. The brand was then emerged as Systemair India Pvt Ltd. Starting with 4 sales offices regionally and a warehouse in Alwar, company has grown in leaps and bounds with operations in nine major cities and two manufacturing hubs in Greater Noida and Hyderabad. ■



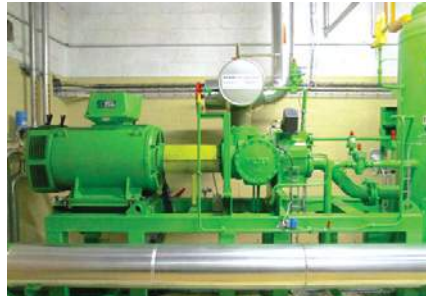
# Energy Efficiency Innovative solution with Emerson Technologies

The subsidiary of the Bongrain Group is pursuing a policy to reduce its energy usage & CO<sub>2</sub> emissions by investing in a facility designed by CofelyAxima, a leader in industrial refrigeration and a subsidiary of GDFSuez. This solution stands out for its use of a process that heats and cools within a single cycle and its use of key components supplied by the Emerson Group – a Vilter single-screw compressor from Emerson Climate Technologies and a Leroy-Somer variable-speed drive from Emerson Industrial Automation.

La Compagnie des Fromages is part of the Bongrain Group, the world's fifth-largest milk-processing company and an employer of 18,870 people.

"Because we serve as a consultant to our customers, we conducted an energy audit with la Compagnie des Fromages' plant in the town of Vire," says Jean-Yves Druillennec, Sustainable Development Manager for CofelyAxima-GDF Suez. The audit, which was based on a series of measurements, provided a snapshot of the Vire plant's consumption levels and suggested replacing its four piston compressors, which provided only cooling, by a thermo-refrigerating pump.

A thermo-refrigerating pump is a thermodynamic heat-transfer system that can cool and heat at the same time. The refrigeration system makes it possible to provide cooling capacity to the evaporator and heating capacity to the condenser. When 1000 kW of chilled water is produced at Vire, 1300 kW of energy is recovered at the same time and combined with just 100 kW of electricity to heat water to +62°C. All the energy produced and used is fully recovered. A 150 m<sup>3</sup> buffer storage unit allows energy to be used to produce hot water as needed by the process (particularly cleaning operations). With the old system, this water was heated by gas, which has a much higher carbon footprint. In addition, the heat produced was rejected to the atmosphere by a cooling tower instead of being



Vilter single-screw compressor driven by a Dyneo® PLSRPM permanent-magnet synchronous motor

recovered & reused. The new system saves 9000 m<sup>3</sup> of water a year and has reduced use of the cooling tower, which, with its plumes of steam, always reflects negatively with local residents.

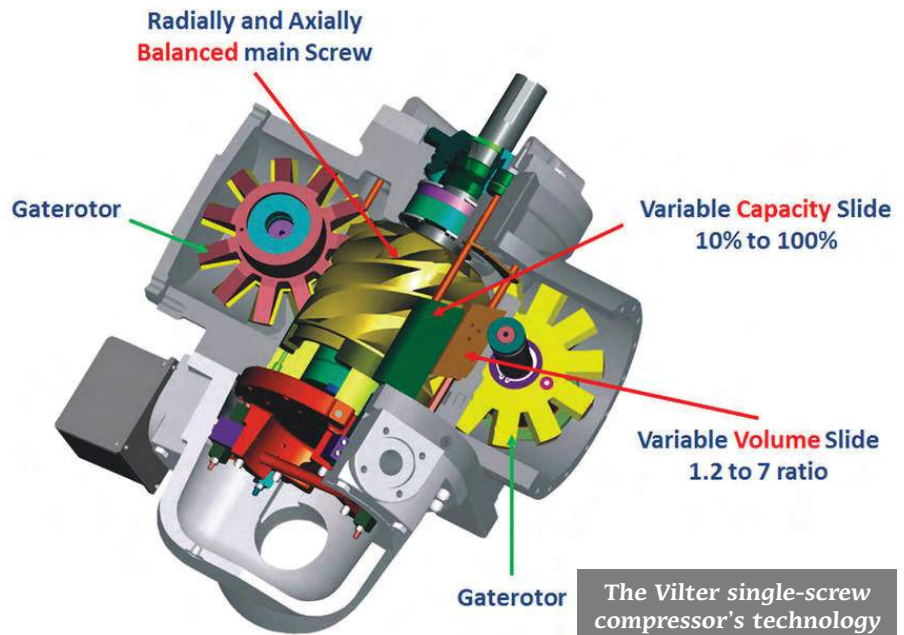
At the heart of the system are a 390 kW motor and a variable-speed drive. Both are made by Leroy-Somer and power a Vilter single-screw compressor with 1000 kW of cooling capacity. The refrigerant circulated in the system is ammonia (NH<sub>3</sub>), a natural heat-transfer medium commonly used cases such as the present one. Cooling and heating are simultaneously produced for one-third of the time. To raise the

water temperature from 15 to 58°C (with a combined COP of 7.67), the ammonia, after having removed heat from the cold side to produce chilled water, is compressed to achieve the right pressure and temperature. As this temperature is much higher than the usual temperature for a conventional cooling system, the ammonia condenses at 59°C. The water is heated by transferring the heat from the ammonia via the condenser and other heat exchangers located at various points in the system for heat-optimisation purposes. During the remaining one-third of the time, chilled water is produced conventionally with a COP of 5.75. Ultimately, the system will recover all the heat extracted during the production of chilled water.

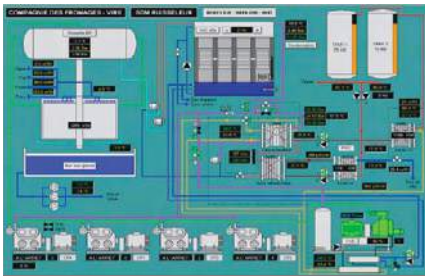
'COP: Coefficient Of Performance expresses the energy efficiency of a machine and corresponds to the ratio of heating or cooling provided to electrical energy consumed. The higher the COP, the lower the electricity bill.'

## An Eighteen month Return on Investment

Chilled water at 1 to 7°C and 200 m<sup>3</sup> of hot water at 60°C are produced







Mimic display of an Emerson Industrial Automation drive, Vilter single-screw compressor, heat exchangers and hot-water storage system. The pre-existing reciprocating compressors remain connected to ensure maximum safety

daily at the Vire plant. To do this, the old system consumed an average of 820 kW of energy per tonne of production per year. With the new system, this level is now only 560 kW. "As a result, the payback period is particularly short, even when you factor in the aid, which amounts to less than 20% of the funding," says Patrick Marie, Maintenance Manager of la Compagnie des Fromages. "The process for producing heat with less grid electricity is not the only source of energy savings," says Jean-Yves Druillennec. "The use of much more energy-efficient components is the other source."

### Dyneo drive systems: High efficiency and high reliability

The Dyneo LSRPM is a range of permanent-magnet synchronous motors incorporating technology patented by Leroy-Somer. The innovative design of the magnet rotor significantly increases efficiency to levels approaching 98%.

"It is 7% more energy efficient than high-efficiency induction motors, which is significantly beneficial in terms of profitability, especially considering that electricity costs are expected to rise by 25% in the next five years. What sets this motor apart is that it is ideal for speed control. We noticed that some induction motors were under excessive load under non-steady-state conditions. We don't have this problem with Leroy-Somer's motors. They stay reliable whatever the load applied to

them. Had we used induction motors, they would have had to be oversized."

The low losses of the magnet-rotor technology considerably reduce heating of the bearings. As a result, they need to be lubricated much less often and the life of the motor is increased. "We've implemented more than 30 applications in four years without experiencing the slightest problem," adds Jean-Yves Druillennec.

### Vilter technology for greater reliability and energy efficiency

Vilter is a brand of Emerson Climate Technologies, which employs more than 16,000 people worldwide. Instead of standard twin-screw compressors,



Hot-water buffer storage tank

the company uses a highly distinctive process – single-screw compressors. Compression is accomplished by a single screw and two star-shaped gate-rotors. The compressor is designed to balance the single screw both radially and axially. This balance ensures that very low loads are placed on the bearings, thus achieving a high level of reliability with considerably reduced vibration and noise levels. This design allows Vilter to offer its exclusive 5/15 warranty (5 years for the compressor and 15 years for the bearings).

The key to the single-screw compressor's high energy efficiency is Vilter's exclusive Parallelex™ slide system, which allows the compressor to run



Coeur de Lion camembert is one of la Compagnie des Fromages' best-known brands

at optimum efficiency throughout its capacity range. The capacity and volume slides (with an expanded volume ratio of 1.2 to 7.0) move independently of each other under all operating conditions, eliminating over- or under- compression and saving motor horsepower. "What makes these compressors stand out is their ability to independently adjust their capacity and volume ratio. That makes a real difference under partial load conditions. We have always found Vilter compressors to be clearly more energy efficient than the standard twin-screw technology. Depending on the application, they can be as much as 10% more efficient," says Jean-Yves Druillennec.

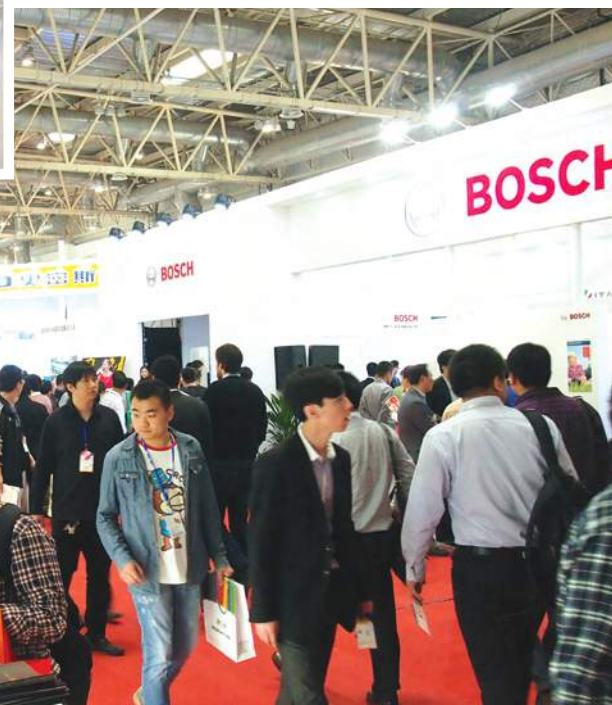
### It is Total cost that counts

CofelyAxima was in charge of managing every aspect of the project, from engineering and installation, to control and supervision (PLC control, instant performance monitoring and traceability of all parameters). Only the electrical wiring was contracted out. La Compagnie des Fromages' process was down for only 3 hours, during the commissioning phase. CofelyAxima is installing many systems in countries such as Thailand, Kuwait and Italy. "We are seeing a downward pressure on prices. Our clients are interested only in solutions that pay for themselves in less than two years. It is important to be able to make promises that you are sure you can keep. Overall, Emerson's solutions are more efficient and reliable and much more flexible for non-steady-state conditions. The entire system makes it possible to make a real difference on the total cost," says Jean-Yves Druillennec. ■



# ISH China & CIHE 2014

## May 13-15



Wealth of business opportunities offering at fair

Show's 50 informative concurrent events



Regarded as Asia's largest event for the HVAC, plumbing & sanitation industry, ISH China & CIHE – the China International Trade Fair for Sanitation, Heating, Ventilation & Air-Conditioning concluded its 2014 edition with record-setting visitor attendance and exhibitor participation. Show was held from May 13–15 at Beijing's New China International Exhibition Center. Organised by Messe Frankfurt (Shanghai) Co Ltd and B & D Tiger Exhibition Co Ltd, the fair attracted 999 exhibitors from 18 countries and regions. A total of six halls were utilised, covering 85,000 sq mtr of space, resulting in a 13.4% and 6.3% increase in both exhibitors and

exhibition space respectively from 2013. Visitor attendance totalled 41,238, an 11.8% increase from 2013, from 40 countries and regions. The top ten visiting countries and regions include Germany, Hong Kong China, Iran, Italy, Japan, Korea, Mongolia, Russia, Taiwan and Turkey. During the three-day show, visitors were able to source items including boilers and wall-hung boilers, heat pumps, solar energy devices, radiators and fittings, heat exchangers, floor-heating, pipes, valves, ventilation systems, control systems, heat meters as well as energy-saving HVAC products. Richard Li, General Manager of Messe Frankfurt in China noted, "With factors

such as higher energy conservation and greater efficiency dictating the goals of China's HVAC and plumbing sectors, the Beijing show's significance has never been greater. We are delighted to have gathered an astounding group of HVAC and plumbing experts and suppliers from around the world, particularly from Germany and Italy to showcase their environmental friendly and state-of-the-art products. Overall, I am pleased with the show's results, and I believe its international footprint will continue to grow for the years to come." Li Hongbo, General Manager, Beijing B & D Exhibition Co Ltd remarked: "I am more than pleased with the



performance of the show's 2014 edition. Not only did we record our best figures for exhibitors and visitors but they have also overwhelmingly expressed positive views regarding the organisation and professionalism of the show. Their participation has once again confirmed that ISH China & CIHE is one of the most comprehensive platforms for HVAC and plumbing solutions."

### Exhibitors and visitors praise wealth of business opportunities offered at fair

At the 2014 show, exhibitors expressed unanimous praise in the fair's ability for bringing together both industry leaders and decision making buyers.

The increasing popularity of ISH China & CIHE had once again drawn the return of the Italian Pavilion with an even stronger line-up to display their specialised technology in HVAC, ventilation as well as plumbing sectors. Antonio Laspina, Trade Commissioner for the Italian Trade Commission (ICE), which strongly supported the Italian Pavilion, noted, "ISH China & CIHE is a great platform for introducing new companies and products while increasing numbers of Italian companies will be involved in the Chinese market. Our organisation will continue to work and alert more Italian companies of the great potential in the technical part of the home, building and heating sectors in China."

Klaus Jesse, Director Marketing and Sales International for Vaillant Group expressed, "The fair serves as an annual meeting point for the industry in Asia and we wanted to utilise this opportunity to invite our dealers to the show and talk about the new products offered at the company. We foresee that China's HVAC sector will flourish in the years to come. The show is without a doubt one of the most important shows in Asia. We will be back again next year."

Another returning participant at the Beijing Show was Haier White Goods Group. Zheng Zhi Gang, Engineering Director for the company commented: "This is the biggest HVAC show in China with a track record for attracting significant amounts of industry professionals to the show. During the

three-day exhibition, we are pleased to have connected with clients from South China. The show not only allowed us to learn more about current HVAC trends but also get a better understanding of the South China markets."

Leo Group attended the exhibition in order to expand its company brand and promote its collection of industrial pumps. Dong Qian, Deputy Sales Director shared: "Our products are manufactured according to international specifications and we hope to use that as our selling point to attract local markets. During the course of the show, we managed to exchange over 100 name cards and are pleased to say that the show has aided in expanding our company brand within the Chinese market."

Visitors were equally impressed with the participation of world-class brands. With such a wide range of HVAC and plumbing solutions on offer, attendees were given the chance to source products and technologies for all areas of their business.

Second time visitor, Liang Min Bo, Engineer, Jiangsu Sunrain Solar Energy Company Limited shared, "My company specialises in solar heating system and I came to the show to seek for new innovative products and obtain market intelligence. At the fair, I noticed that the solar heating industry is under transformation and has started to integrate its functions with heat pump as well as wall-hung boilers. The show has benefited my company by providing me new ideas for developing products to suite the market. This was definitely a fruitful trip."

### Attendees commend show's 50 informative concurrent events

Concurrent events have played a significant role in ISH China & CIHE. The sector's leading players from business and academia were invited to share their views on current industry developments and future trends. In 2014, 50 events were held alongside the fair and categorised into four major themes, including technology exchange, idea innovation, match-making and technology display.

Fu Lin, Vice Professor, Tsinghua University Building Energy Conservation

Center, speaker at the Sino European HVAC Congress – Central Heating Session stated: "The Congress is expanding every year and the increase in scale indicates that people are paying a closer attention to central heating solutions that are both energy-efficient and environmentally sustainable. I think the seminar topics are well-formulated, covering an array of HVAC related topics. The increasing number of attendees highlights the success of the congress."

Gao Feng, Senior Engineer, Chief Engineer's Office, China Architecture Design & Research Group Architecture Design General Institute stated: "This is my first year at the show and I came specifically to the China International Building Water Supply and Drainage Forum to learn more about the building technology for rainwater harvesting and utilisation management. The forum was extremely beneficial as I got a chance to be in touch with the industry technology as well as policy developments."

Following the success of last year's LOHAS Cocktail, property developers and industry leading brands were invited again this year to discuss the needs of their respective projects. Li Xian Zong, Sales Director, Guangzhou Mayer Corp Ltd Beijing Office expressed: "The cocktail helped to promote our products as we were able to approach developers and introduce our company as well as products. Additionally, we also befriended other guests. The event was very well executed and served as a professional networking platform for our company. We will include this event into our promotion plan next year."

ISH China & CIHE is headed by the biennial ISH event in Frankfurt, the world's leading trade fair for the Bathroom Experience, Building, Energy, Air-conditioning Technology and Renewable Energies, taking place from March 10 – 14, 2015. The next ISH China & CIHE will be held May 13–15, 2015.

Furthermore, the next edition of ISH Shanghai & CIHE is scheduled to take place from September 3-5, 2014, concurrently with Shanghai Intelligent Building Technology Fair, Building Solar China and Shanghai International Lighting Fair at the debut edition of the Shanghai International Expo Center. ■



# Cool Chain Strategies Summit 2014



Powering Growth Through Innovation & Integration



**Cooling India** invited to participate in the 3rd Edition of Cool Chain Strategies Summit, held May 29, 2014 at The Westin Mumbai Garden City has insightful information to share with you. With path breaking sessions, the summit focused on various topics related to Cold Chain industry & its trends.

## Sessions

The first session focused on "Ensuring Quality throughout the Product Supply Chain: From Manufacturer to Customer" wherein panellist shared their views on managing perishable supply chain. Besides being a knowledge sharing platform, the summit brought forth best practices implemented by pharma & food industry to cater to growing market challenges for the movement of refrigerated goods.

Private Equity panel session discussed about Impact of PE on

development of Indian Cold Chain Industry. Panellist spoke about how PE industry looks at Cold Chain sector in terms of structuring a deal, during the investment phase and exit phase (strategic vs secondary exit)

The last session discussed about "Cold Chain in Pharmaceutical Industry: Risk, Security & Integrity of Supply Chain" that focused on challenges faced by local distributor in India, Green pharmaceutical cold chain & identifying regulatory gaps in the cold chain.

## Presentations

The summit had 6 individual presentations that focused on various topics such as Government initiatives in creating cold chain infrastructure in India, Freight optimisation, Constant climate, Costs & e-Freight, Modernizing the Apple Supply Chain in Himachal Pradesh, Cold Chain Management for Pharmaceutical Products, Efficiency and

Transparency in Cold Chain Logistics & Store and Save" A breakthrough Innovation for Cold Storage.

This year's summit had very interesting & important session on Reefer operation. Perishables are carried in reefer containers and reefer trucks. Yet some transport units do not move under temperature control despite high ambient temperatures and unexpected delays, even on shorter transport routes. Panellist discussed about Indian Reefer transportation scenario & Challenges.

Having registered around 150 participants from Pharma, Food & Dairy Industry, 3PL Service providers, IT Companies, Refrigeration Industry & Packaging industry, the event managed to get the best of cold chain professionals on one platform.

The summit was conceived & managed by "Kamikaze B2B Media" & supported by Gati Kausar, DelEx, CHEP India & Cargo Service Centre. ■

# GEA HyPower Powerful Duct Fan Coil Unit

To extend the existing product portfolio of GEA MPower-Geko duct fan coil units, GEA Heat Exchangers has introduced a new, more powerful series - GEA HyPower. These new models ventilate, heat, and cool, as required, and offer maximum cooling and heating duty from 25 to 50 kW. The EC fans of these models, installed as standard, contribute to energy-saving operation by enabling continuously variable and demand-controlled regulation of fan speed.

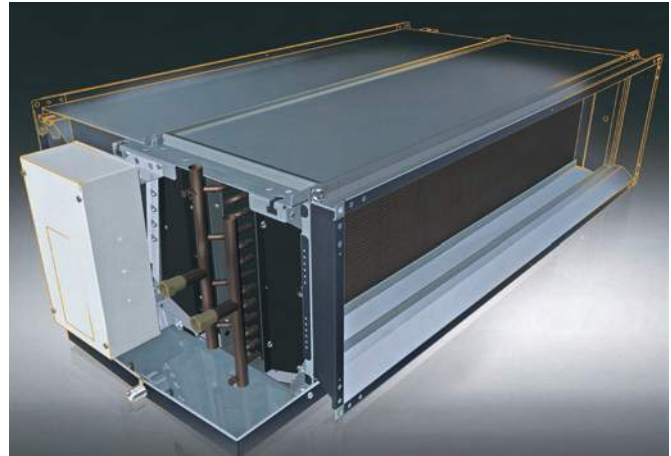
The innovative, powerful condensate pump operates entirely toward the goal of energy efficiency. It functions according to the membrane pump principle and is characterised by quiet, vibration-free, and extremely economical operation. With these properties, the GEA HyPower duct fan coil units satisfy the strict stipulations of Eurovent Efficiency Class A.

## VDI 6022 certificate

GEA HyPower is available in three unit models: without fan casing, with fan casing, or with acoustically insulated fan casing. The model variants with fan casings, as well as the associated duct components, comply with the hygiene requirements of Directive VDI 6022. Design of these models was focused on hygiene aspects and good accessibility for maintenance work. For example, the hinged condensate tray can be rotated downward, & the fans are easily accessible through the large service hatch.

## Pressure-stable up to 150 Pa

The modular design of HyPower modules allows selection in accordance with the user's requirements. For two-pipe operation, three output ratings are available, with up to six tube rows. For four-pipe models, two output ratings are available.



**GEA HyPower fan coil units offer power performance, adherence to strict hygiene requirements, and energy-efficient operation. Duct components are also available for the duct fan coil units**

The two-pipe models with six tube rows deliver 20 kW cooling duty at 100 Pa, under standard cooling conditions. All units in the GEA HyPower series are pressure-stable up to 150 Pa. They are controlled by GEA MATRIX 3000/4000 modules, which assure energy-optimised operation of the EC fans. In the near future, the CET-EC small controller will also be available for the HyPower-Geko models.

Despite their powerful output, GEA HyPower duct fan coil units are quiet. Quietness of operation and the fact that the compact units can be discreetly installed above suspended ceilings make them particularly suited for use in hotels, restaurants, shops, and doctors' offices. ■

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# Reflective Insulation

The radiant heat is invisible and has no temperature, just energy. When this energy strikes another surface, it is absorbed and increases the temperature of that surface. In summer, radiation from the sun strikes the outer surfaces of walls and ceilings and is absorbed causing the surface to heat up. This heat flows from the outer wall to the inner wall through conduction which is then radiated again, through the air spaces in the building, to other surfaces within the building. Radiation between surfaces is through invisible, infra-red heat rays.

Different types of insulation products reduce the heat transferred by conduction, convection and radiation to varying degrees. As a result, each provides different thermal performance and corresponding "R" values. The primary function of reflective insulation is to reduce radiant heat transfer across open spaces, which is a significant contributor to heat gain in summer and heat loss in winter.

There are many types of materials that reduce heat gain and heat loss. Some materials provide greater resistance than others, depending on the mode of heat transfer: convection, conduction or radiation. Most insulation materials work on the principle of trapped air gas being

a good insulator. Mass insulation like, 'INSUshield'- closed cell, FR crosslinked polyethylene foam, use cellular walls of plastics, Fibre glass wool uses glass fibers to reduce convection thereby decreasing the transfer of heat. These materials also reduce heat transfer by conduction due to the presence of trapped air. (However, these products, like most building materials, have very high radiant transfer rates. Most building materials, including fiberglass, foam and cellulose have "E" values in excess of 0.70.

Reflective insulation typically have "E" values of 0.03 (again, the lower the better). Therefore, reflective insulation is superior to other types of insulating materials in reducing heat flow by radiation. When reflective insulation is installed in building cavities, it traps air (like other insulation materials) and therefore reduces heat flow by convection thus addressing all three modes of heat transfer.

In all cases, the reflective material must be adjacent to an air space. Aluminum, when sandwiched between two pieces of plywood or between two concrete layers for example, will conduct heat at a high rate. The conductive insulation material should always be in contact with the substrate for better insulation.

## Understanding a Reflective Insulation System

A reflective insulation system is typically formed by layers of aluminum or a low emittance material and enclosed air spaces which in turn provide highly reflective or low emittance cavities (Air bubble film) adjacent to a heated region.

The performance of the system is determined by the emittance of the material(s), the lower the better, and the size of the enclosed air spaces. The smaller the air space, the less heat will transfer by convection. Therefore, to lessen heat flow by convection, a reflective insulation, with its multiple layers of aluminum and enclosed air space (INSUreflector), is positioned in a building cavity (stud wall, furred-out masonry wall, floor joist, ceiling joist, etc.) to divide the larger cavity (3/4" furring, 2" x 4", 2" x 6", etc.) into smaller air spaces. These smaller trapped air spaces reduce convective heat flow.

### Reflective insulation differs from conventional mass insulation in the following.

- Reflective insulation has very low emittance values "E-values" (typically 0.03 compared to 0.90 for most insulation) thus significantly reduces heat transfer by radiation
- A reflective insulation does not have significant mass to absorb & retain heat
- Reflective insulation has lower moisture transfer and absorption rates, in most cases
- Reflective insulation traps air with layers of aluminum & Air bubble film plastic as opposed to mass insulation which uses fibers of glass, particles of foam, or ground up paper
- Reflective insulation does not irritate the skin, eyes, or throat and contain no substances which will out-gas
- The change in thermal performance due to compaction or moisture absorption, a common concern with mass insulation, is not an issue with reflective insulation.

### Supreme's Thermal Insulation Division offers solutions in the following areas.

- Ducting insulation in hospitals,







shopping malls, airports, PEBs, IT/ BPO etc.

- Pipe insulation for split AC tubings, chiller piping, drain pipes, chilled water lines etc.
- Floor insulation in server rooms, data centres, medical & diagnostic centres, & control rooms for petrochemicals.
- Underdeck insulation in PEBS, textile units, malls, airports etc.
- Overdeck and wall insulation in commercial buildings, residential buildings, cold storages etc.

'INSUreflector' offered by Supreme is made of polyethylene Air bubble film (ABF) laminated with aluminum foil on one or both sides. The bright surface of the aluminum foil reflects 96 to 99% infra-red radiation received by the surface of a heated slate roof. It

protects the building from undesirable heat gain. The thin reflective foil having low emissivity and high reflectivity when installed with an air space restricts the transfer of far-infrared radiation making it an ideal material to be used for underdeck application.

'INSUshield' is a non-fibrous, fire retardant, closed cell, tri-dimensional chemically crosslinked polyethylene foam XLPE. An ideal environment friendly insulation material, with a perfect solution for all your insulation needs for ducts, roofs, pipes, vessels, etc. The divergent advantages of 'INSUshield' are ease of installation, low thermal conductivity and good moisture and vapors resistance preventing microbial growth and optimum condensation protection. ■



**Atul Khanna,**  
General Manager  
Thermal Insulation Division,  
The Supreme Industries Ltd.

## Chillventa 2014: Looking positively to the future

The preparations for Chillventa 2014 are entering the hectic phase. Experts from all over the world will come to Nürnberg from 14–16 October 2014. Chillventa Congressing takes place the day before on Monday, 13 October. The reason for the positive mood already exists today: the display space at the previous event has already been exceeded 6 months before the start of the event. "Anyone still wanting to apply to exhibit at Chillventa 2014 must be quick: The display space used in 2012 is already virtually booked up. We still have vacant stand spaces, but not very many. Besides the space, the number of exhibitors will increase strongly once again. If everything continues to develop this way, we can expect 950 exhibitors," says Alexander Stein, Director Exhibitions at NürnbergMesse.

### Trends: energy efficiency and environmental protection

The exhibiting companies at Chillventa 2014 present the whole variety of products from the industry's broad-based spectrum for refrigeration, air conditioning, ventilation and heat pumps. The themes in 2014 are both innovative and pioneering: energy efficiency, F-gases, ecodesign, energy stores and the amendment of the German Energy Conservation Act (EnEV) determine the trends at Chillventa 2014.



### Key theme: heat pumps as alternative

The heat pump is also of special importance in 2014. "Over the past years the heat pump has established itself as an attractive alternative to other fossil heat producers despite rising electricity prices. The growing demand in this segment makes further technical development almost inexorable," explains Dr.-Ing. Rainer M. Jakobs, coordinator of the Chillventa supporting programme. This innovation is pioneering, especially in commercial and industrial production processes. According to the requirement, small, medium or large heat pumps can be employed to use surplus energy and thus appreciably reduce the total energy requirement.

The visitors can get to know the energy world of the future at Chillventa: Whenever and wherever heat and cold are required at the same time, the hybrid use of a refrigeration or heat pump system is highly efficient and sustainable right from the first days. The special show in hall 7 focuses mainly on these hybrid systems in 2014. ■

### Ductable Split Units by Prijai

Prijai Heat Exchangers Pvt Ltd is bringing range of air cooled ducted split AC Units designed to be energy efficient and compact. The units are given sleek design as a result it fits unobtrusively above false ceiling. Prijai has great strength in manufacturing and wants to utilize its strength to benefit its customers by supplying them the value added products as an OEM.



#### Features

- Reliability: products are made with support of in house manufacturing plant equipped with latest and sophisticated machineries & testing equipments.
- Energy Efficient: system is designed with the energy efficient compressors, the optimized selected heat exchanger, the precisely balanced refrigeration system, etc. To ensure the low consumption of power & thus saving money with reduced electricity bills.
- Refreshing Air: synthetic woven filters removes the dust particles and supplies hygienic & fresh air creating please of environment.
- Green Series Model: eco-friendly refrigerant design with R407-C, R410.
- Controller: micro processor based controller. ■

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

### CHECK-Mate by Panimpex NV

Panimpex NV is part of a group of family owned and family run companies based in De Panne, Belgium. They are in association with Blondelle, Metreco, Inficon, and Refrigeration Technologies.



#### Check-Mate

- Examine the level of contamination with this simple refrigerant and oil test.
- It has Simple oil test, a single test for all oils; MO, AB, PAG of POE.
- It indicates the contamination via colour scheme. Refrigerant test are done for acid/moisture content.
- For all HFC, HCFC or CFC refrigerant. Detector tubes separately available.
- Ready to use, durable and affordable. ■

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

### Voltas offers Horizontal Chest Cooler (Metal Top)

It is designed in a contemporary and sturdy way and has high density, high pressure 60mm insulation ensuring minimum heat ingress and low power consumption. Corrosion resistant with outer body in pre-coated steel sheet.



Tropicalized and energy-efficient R 134a compressor: It's got multiple door with sunken handles and spring-loaded hinges in doors. The castor wheels are applied for free and easy movement; It has optional accessory but have elegant door trims and has customized branding of machines. ■

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

### LAC Extreme by Refco

Refco Manufacturing Ltd is one of the world wide leading companies in refrigeration service products. The world wide distribution is locally assisted by REFCO Manufacturing (US) Inc. in Springfield, MA (USA). The LAC Extreme is a low ambient controller for all air cooled condensing units in air conditioning and refrigeration units with fan motor. The intelligent logic programmed into these high specification controllers decides the correct speed for the outdoor fan, whether the fan should stop and for how long, to provide the maximum system efficiency.



#### Technical Data

Supply voltage is 230 V, 50 Hz; fan motor running current is 4A; ambient temperature is -300 C to +500 C; set point condensing temperature range is +30 0C to +60 0C; input voltage from reversing valve is 24-240 V, 50/60Hz; dimension is 130 x 69 x 38 mm. ■

Website: [www.refco.ch](http://www.refco.ch)

## Robotically welded Dock Levelers by Gandhi Automations

**E**lectro-hydraulic, mechanical and air-powered Dock-Levelers are not simply "a bridge for connecting a vehicle". It facilitates fast, smooth and safe transition by compensating the difference in heights between the loading bay and the vehicle. This contributes to minimizing energy used, savings on heating and chilling costs resulting in maintaining the quality of the transported goods. Dock Levelers are designed as per EN 1398 standard for the most demanding loading and unloading operations.



### Efficiently loading and unloading the goods

The importance of efficiently loading the goods has always been evident, and it has increased with the years essentially for two reasons: the lesser availability and the higher cost of manpower. Gandhi Automations offers Dock Levelers that ensure loading and unloading with the lesser effort and it comes with the most secure safety devices and accessories. Radius lip Dock-Levelers allow the dock to connect with the truck-bed. Telescopic lip Dock-Levelers are ideal for connecting vehicles unable to drive near to the dock (e.g. sea containers, side loading railway wagons etc.), or where it is imperative to reach a longer total length of the Dock-Leveler itself. These types can be supplied with a lip extending up to 1 m. ■

Website: [www.geapl.co.in](http://www.geapl.co.in)

## AlfaCubic Commercial air cooler by AlfaLaval

### General information and application:

A commercial unit coolers designed for use in small and medium cold rooms from 10 up to 400 m<sup>3</sup>.



Models designed for easy maintenance with immediate access to inspection areas. This series is available as evaporator (DX or pump, HCFC, NH<sub>3</sub> and CO<sub>2</sub>) and brine unit cooler. A sub-selection of models is available from stock.

### Benefits

Wide and versatile cooler range, designed for all working conditions. Advanced product selection software available.

It has Low noise level, gives reliable performance; and is Eurovent certified.

It is energy efficient and is Low total cost of ownership.

It gives two-year product guarantee. ■

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

## AFS brings COMBIAFS-HEAVY

**A**FS Flexible Duct Co. is a global brand From Turkey. COMBIAFS-HEAVY it is flexible. It is made from multi-layer aluminium & polyster strengthened with high tension steel spring wire, covered with a PVC Layer. The surface temperature of the duct should be kept higher than the dew point of the air surrounding it in order to prevent condensation. To make the duct more waterproof to water and keeps surface temperature higher a PVCA layer on the outer surface of COMBIASF-HEAVY acts as an insulation.



### Advantages

It is highly durable and resistant to deformation; It has seamless construction and is easy to storage, transport, low installation cost, airtight, low energy consumption, minimal pressure loss, low operational cost, anti-static/ dust-proof interior. ■

Website: [www.afs.com.tr](http://www.afs.com.tr)

## Tru Pointe Refrigerant Leak Detector by Bacharach

**T**he hand held refrigerant leak detector is easy-to-use, reliable, and inexpensive leak detector that can quickly and accurately mark any leak spot. The Tru Pointe® instantly responsive to all refrigerants. It is even accurate when used in environments where high levels of refrigerant vapors are present. No manual sensitivity adjustments are necessary during the inspection process. Simply turn the unit on, and let it mark the spot. The Tru Pointe® is suitable for HVAC service technicians, refrigerant service technicians, plant maintenance departments, automotive service facilities, and refrigerant & environmental chamber manufactures who are in need of a small, lightweight, and rugged refrigerant leak detector. The Tru Pointe® is capable of detecting and then pinpointing small to large refrigerant leaks in tight spaces such as those found in refrigeration units and automobile engine compartments.



### Features

Detects all CFC, HFC, and HCFC refrigerants. Patented Heated Diode Sensor Technology. Instantaneous response time. Innovative sensor replacement design. It has battery-powered with low battery indication. It has DC brushless fan and has high and low-sensitivity modes. Automatic zero and background compensation. It gives audible & visual leak detection and no user calibration required. ■

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



### ESCO GmbH brings Spilt Air precision air conditioners

With its Telecom Line, ESCO offers a range of air-conditioning solutions for telecommunications infrastructure and for switch cabinets. All units are designed for 24/7 operation, 365 days a year, and offer maximum reliability and availability. Service is guaranteed through a worldwide network of specialist partners and branches. The Split-Air is the space and energy-saving version for the reliable cooling of telecommunications containers. This special air-conditioning set with free cooling function consists of an evaporator and a compressor-condenser unit. Because the indoor unit can be installed either on the ceiling or wall, the Split-Air is also suitable for use when space is at a premium. And the low noise level of the outdoor unit means it can be used without problem in residential areas too.



#### Technical Features

Refrigerant R-407C, R-410A, EU4 air filter, filter monitor, back up ventilation via 48V DC emergency power supply, outside air conditions-20/+45 C winter/summer, proportional free cooling facility with mixed mode, MICOM microprocessor control, quiet operation, speed-controlled condenser and evaporator fan, automatic restart after power failure. ■

Website: [www.esco-klimtechnik.de](http://www.esco-klimtechnik.de)

### Wafer Type Check Valves by Castle Valves Limited

Castle wafer type Check Valves have distinct advantages over conventional swing Check Valves.



#### Features

It is stronger, lighter and smaller in size, weighting 1/8th weight of a conventional valve and is hydraulically engineered.

#### Product range

Single Plate Wafer Type Check Valves and its size is 40mm to 1200mm.

Dual Plate Check Valves and its size is 50mm to 600mm.

Pressure Rating: PN 1.0 and PN 1.6. ■

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

### Gesytec GmbH offers GesySense Configurator

PC interface to GesySense® wireless network. Receiver for measures values. Parameterization tool for wireless modules. The GesySense configurator is a receiver and transmitter device connecting a PC to the wireless sensor network via USB. On one hand the configurator is the PC's receiver for messages transmitted in the network. On the other hand it serves as a tool for commissioning the wireless sensor network and to configure and read out GesySense sensors and loggers. The GesySense Configurator represents the radio bridge to the system. It broadcasts and receives within the 433 MHz or 915 MHz band and inductively, at a frequency of 13.56 MHz transmits configuration data to the sensors or triggers logger modules to transmit archived values. The Configurator is supplied by the PC via the USB connection. ■



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

### Talos from Halcor

TALOS copper tubes are manufactured according to (a) the Harmonized European Standard EN 1057 for use in plumbing installations and (b) the Harmonized European Standard EN 12735-1 for use in air conditioning and refrigeration installations. TALOS copper tubes meet the current requirements, imposed by the new green refrigerants (R 410-A, etc), adopted by major refrigeration and air conditioning unit manufacturers, both in Greece and abroad. TALOS copper tubes have been awarded most major international quality marks and are exported to more than 50 countries, throughout the world. TALOS copper tubes, with their high quality of manufacture, provide: unlimited lifetime, resistance to pressure, temperature and fire. Complete network impermeability. Hygienic, safe, bacteria-free potable water. Quality and reliability of installation. It has versatile applications and comprehensive range sizes. It has low thermal expansion as well it is stylish and space saving. ■



Website: [www.halcor.gr](http://www.halcor.gr)

## Mitzvah introduces Air Curtain

The air curtains are engineered to perfection, efficient in performance, effective in maintaining atmosphere, elegant in design, economical in use.



### Product Characteristics

It is easy to open, convenient design in which the cover does not use screws. The stainless cover is made for high-strength aluminium and engineering plastic. The ingeniously designed casing is 40% lighter than normal machines suitable for installation over glass doors and marble. With a uniquely designed air guide bar, it can produce wind in all directions, working well in various environments. It can be operated either by remote control or at the touch of a button. It has high, medium, and low speed switch functions. Adopting optimized electrical machinery; it operates reliably, and run safely for 24x7 hours. The air curtain has got left side view, right side view, top view, remote sensor. It has got advanced electrical machinery which is designed to run continuously with low noise level. The irregular distancing and ultra-quiet wind wheel can produce a powerful air-flow. It is used by remote control, with surge protection. Some of the vast ranges of sizes are 600mm, 900mm, 1000mm, 1200mm, 1500mm, 1800mm, 2000mm, 2100mm, 2400mm. ■

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

## Beverages chilling cum display unit by Rinac India Ltd

Cabinet is made of polyurethane insulated pre moulded panels, of suitable thickness with features for quick assembly at site. Display doors are with low emissivity glass, filled with inert gas and with LED lights. One lockable panel door at the storage / replenishing area. Sapphire units are provided with adjustable shelving, made of anodized aluminium alloy frames & polyethylene shelf conforms to NSF standards. Some of the features of the cabinet is that they are world class aesthetics and quality, display-cum-storage, easy back-end loading, easy access to customer, energy efficient, ease of transport and assembly, easy maintenance, low operating cost, convenient racking system. ■



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

## Sight Glass by Nantong OEM Refrigeration Equipment Co Ltd

### Sight Glass

Sight glass is used to indicate: the condition of the plant liquid line, the moisture content in the refrigerant; the flow in the oil return line from the oil separator; it is fitted with an indicator which changes color to show the moisture content in the refrigerant, the moisture indicators in the sight glasses are dirt repelling.



### Feature

Indicates too high water contents in the refrigeration system; indication of lack of sub-cooling; indication of refrigerant deficiency; flare or solder connection; for CFC, HCFC and HFC refrigerants. ■

Website: [www.filterdrier.cn](http://www.filterdrier.cn)

## Series ES OEM compact by Pego srl

Electrode steam humidifiers EasySteam COMPACT OEM series has been designed to reduce dimensions to a minimum and to be easily installed in small spaces due to the wall-fixing plate. Control electronic is separated and can be installed inside an electrical panel. It is available without display or with integrated display (the display can be remoted with an optional kit). The OEM kit contains the unit of reduced dimension with drain pump, solenoid valve and interconnection hoses, one cylinder and one control electronic. EasySteam COMPACT OEM series is particularly suitable for air handling units and for all applications that needs space and industrialization.



### Technical Data

Compact kit with fixing plate for OEM application humidifying.  
Electrodes steam humidifiers.  
Single-phase power supply versions with steam producing up to 6 kg/h.  
Easily interchangeable cylinder with stainless steel electrodes, limestone filter on the bottom, maximum level sensor and connector connections.  
Solenoid valve for water charging.  
Management of second duct humidity probe to avoid condensation in the air duct.  
Large accessories range.  
The kit does not include power contractor, terminal and wiring. ■

Website: [www.pego.it](http://www.pego.it)

**Pressure vessel units for refrigeration systems by TH. WITT Kältemaschinenfabrik GmbH**

Pressure vessel units are designed and manufactured to specifications, after checking the specific refrigeration calculation including correct gas velocities, down leg designs and connection sizing entire package units including piping, valves and oil return systems, e.g. ammonia and carbon dioxide cascade plants, are manufactured in their boiler shop. Vessel construction follows the AD-regulations, production drawings are produced taking WITT work specifications into account. Drawings are sent for approval prior to start of production. Pressure vessels are certified according to PED and supplied with the respective CE documentation. WITT pressure vessels are suitable for all common refrigerants, e.g. ammonia, R 134a, R4Q4a, R507 and carbon dioxide with design pressure up to 56 bars. A very fast delivery is possible using their extensive stock of materials for pressure vessel production, including equipment such as high efficient separations systems, stainless steel stand-pipes, modular support frames, maximum level switches, oil return systems, pre-assembled pipe-work and more. ■



**Website: [www.th-witt.com](http://www.th-witt.com)**

**VKA by Nadi**

Nadi Technologies Pvt Ltd is a part of the Nadi Group of companies which is in fan technology and air movement products. Since 1974, their parent company, TCF-NADI Industrial Fans Pvt Ltd, (An Indo-American joint venture company) has been manufacturing a wide range of high quality industrial fans. They have tied up with the following global giants to bring contemporary technology to the Indian customer. SALDA UAB, Lithuania for in-line duct fans. Klimatechnik Weiss GmbH, Germany for plastic gravity louvers & shutters.



**VKA**

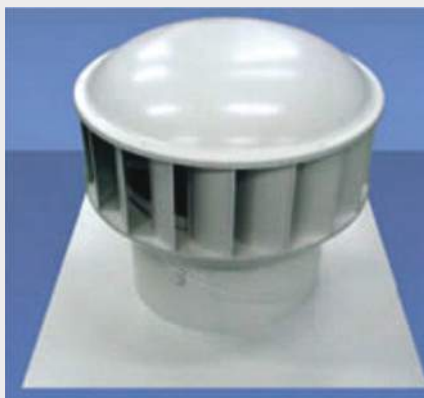
Circular duct fans are used for air supply or extract in ventilation and air conditioning systems. They are mounted into a system of round air ducts. It can be installed in any position. Not suitable for polluted air, aggressive and explosive gases. Impeller with backward curved blades. VKA powder coated painting RAL 7035. ■

**Website: [www.naditech.in](http://www.naditech.in)**

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## ecopower Energy Efficient Ventilator Technology by Envira-North Systems Ltd



**E**copower utilizes an electronic commutating (EC) motor installed in the head of the ventilator to enable motorized boost during periods of low wind speed of special ventilation needs. The ecopower ventilator has no motor or blades in the throat of the vent. This is extremely important as research has shown that any obstruction in the throat

of a wind ventilator will greatly decrease vent performance under wind load. The bearing system of the motor becomes the bearing system of the ventilator. This means that the vent can be free spinning under wind load or power activated as conditions require. The motor can be activated by a switch (not included) or any digital measures, such as temperature, humidity, wind speed etc. ecopower® is available in 4 sizes, 100 mm, 150 mm, 400 mm and 600 mm throat sizes to fit most applications.

**Benefits** - Ecopower offers customers the following unique benefits

- Optional powered ventilation without reducing the performance of wind exhaust levels (which occurs when motor and fan blades are installed in the throat).
- High levels of energy efficiency.
- Much lower operational noise levels

compared with similar capacity axial fan products.

- Dependable ventilation that performs when required.
- Advanced German motor technology.
- CSR Edmonds' vertical vanes vent technology, which outperforms traditional spherical shape metal vents of the same throat diameter. Based on Flow Coefficient Test performed under AS4740:2000 by CSR Edmonds.
- Lighter weight than comparable axial fans.
- Single phase (EP400 & EP600) & low voltage (EP100 & EP150) power, allows simpler electrical installations.
- ecopower® is available in 4 sizes, 100 mm, 150 mm, 400 mm and 600 mm throat sizes to fit most applications. ■

**Website:** [www.enviranorth.com](http://www.enviranorth.com)

## PureAir PIP by Zeco Environmental Solution Pvt Ltd



**Z**eco Environmental Solution Private Limited ('Zeco') is a subsidiary of Zeco Aircon Limited, which now brings to India a completely new range of products for improving the 'Indoor Air Quality' under the brand name 'PureAir'.

### PureAir PIP

The PureAir Plug In Air Purification System by Zeco designed by RGF Environmental Group to eliminate bacteria, mold, odor, and VOCs. The advantage of the PureAir Plug in is its ability to be used in any room and can be completely inconspicuous.

The PureAir Plug in can be used with or without its internal fan. The PureAir Plug in is an air treatment system not a filter. Ideal for homes, hotel rooms, suites, public restrooms, offices, locker rooms and more.

### The problem

Indoor air pollution is now considered by the EPA to be one of the most serious environmental health concerns. Tightly sealed buildings and hotels may be more energy efficient but can trap pollutants and microbes indoors causing

allergies, odors, mold, and illness.

### The solution

The PureAir Plug In has proven to drastically reduce odors, smoke, mold, fungi, VOCs, chemical odors, and bacteria found in many contaminated rooms. Airborne bacteria and mold reduction is normally in the 90+ percentile.

### PureAir Plug In

The PureAir Plug In utilizes RGF's Photohydroionization technology which creates Hydro-Peroxides, Super oxides Ion, Hydroxides, with the help of a UV light targeted on a hydrated quad-metallic target to develop an advanced Oxidation Process. This product can be customized as per customer requirements.

Reduces Airborne smoke, mold, VOCs, odors, bacteria, viruses. Benefits are that such it is economical, low maintenance, light weight, compact, hidden mounting screws prevent theft, washable filter. ■

**Website:** [www.pureair.co.in](http://www.pureair.co.in)

## Retro style Germ Guardian ultrasonic humidifier



The retro styled Germ Guardian ultrasonic humidifiers gives one an option of warm and cool mist. New nano-silver technology prevents bacteria and mold build-up in the tank and ensures that the humidifier disperses ultra clean mist. Germ Guardian makes two retro models - H3000 Digital ultrasonic humidifier and H2000 Manual ultrasonic humidifier. Both are suitable for bedroom, office, family room or den up to 400 sq ft, alleviating symptoms of sore throat, dry nose, lips or skin. The virtually silent ultrasonic humidifiers are also ideal to have on while

you sleep. Both models come with empty tank indicator. The retro styled digital ultrasonic humidifier senses the humidity in the environment and automatically adjusts to a pre-set level and has an option for warm or cold humidification. An adjustable spray function regulates the volume of spray. Built-in digital humidistat control helps to set the humidity to preferred level. Digital display, 4 mist output speeds - low, medium, high and turbo, humidity output is up to 2.5 gallons per day, air cleaning filter, timer function, sleep mode and night light button. ■

## Coway OXY generator and humidifier



Coway OXY works as both, oxygen generator and humidifier. This stylish dual function device provides the simultaneous supply of moisture and oxygen, which is particularly beneficial to your health. The decorative OXY is fitted with mood illumination and a wake-up lighting to rouse one at a

predetermined time. Unlike zeolite-based oxygen generators that often deliver very dry oxygen, the Coway OXY supplies a combination of moisture and pure oxygen. The oxygen generator can either be docked on the main body or can be disconnected and used as a separate unit. ■

## Smeg Fiat 500 fridge



A chopped Fiat 500 holds advanced cooling technology from Smeg. Here you have a modern 'A+' energy rated retro fridge with 100 litre net capacity in a very original format. Smeg Fiat 500 fridge features 3 removable bottle holders and a removable glass shelf. You can even turn the headlights on, but

that would bring the 'A+' rating a bit down. Available in SMEG500B white, SMEG500V green, SMEG500R red, SMEG500G yellow and SMEG500BL blue. ■

## Air purifier robot from Moneual

Rydis H800 is a self-moving air purifier robot, able to detect an air polluted area, suck dust and purify air. Once the air quality improves, the robot looks for another area to purify. Moneual superior 5-step air filtration system consists of dust, HEPA, deodorizing, Semi Alpha and impregnated activated carbon filters. Equipped with special



Location Detection Sensor, the self moving air purifier provides clean indoor air in quiet, unobtrusive fashion. Equipped with quite a few sensors and mapping system, this air purifier robot acts like a floor cleaning robot, with the key difference being of course, that it cleans air. And when the battery goes below a certain level, the Rydis H800 goes back to recharge. ■

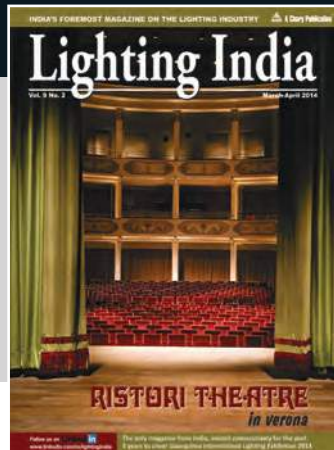
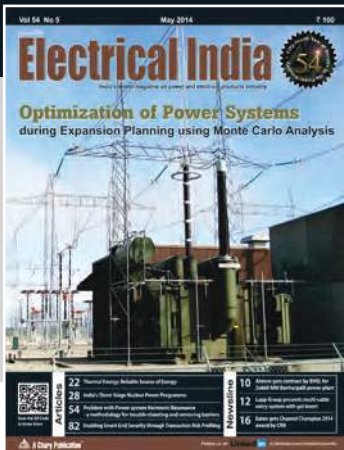


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