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May 2014

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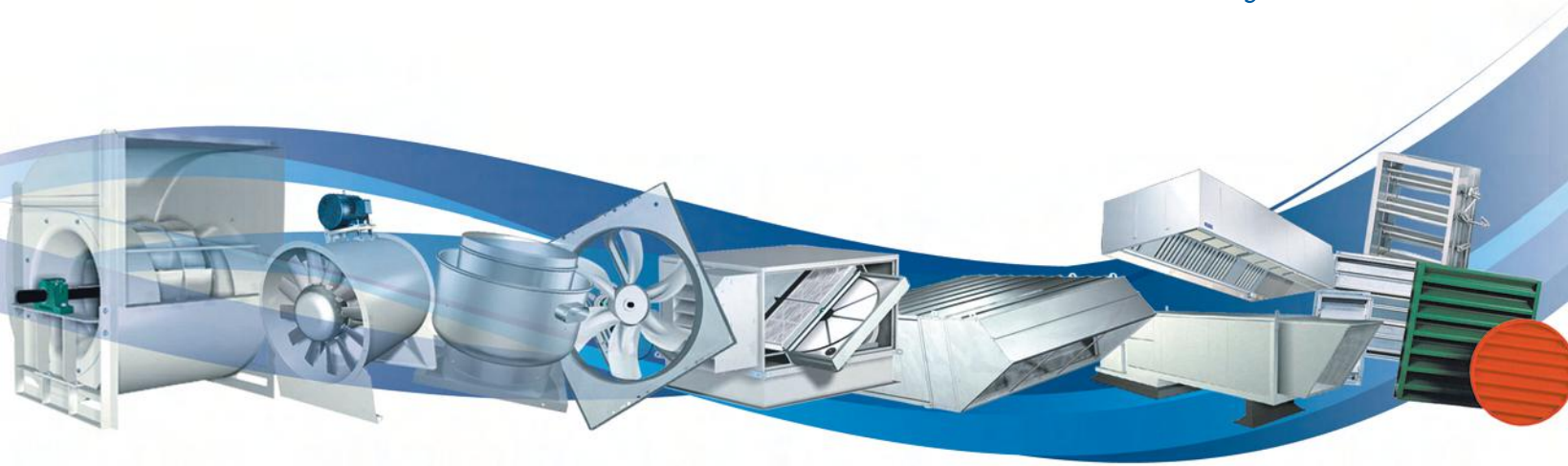
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Publisher's Letter

HVAC solutions are Integral part of Infrastructure

Energy demands are increasing gradually due to booming industries, information and technology and new buildings. The growth in these economic sectors result into high energy consumptions for operation of HVAC to maintain the thermal comfort within the buildings. The article 'Application of Renewable Energies in HVAC Systems' reviews the possible applications of renewable energy, different technologies and demonstrates their capability to improve the performance of HVAC systems in order to reduce energy consumption.

With increasing use of solar photovoltaic power in the grid, the need for energy storage arises for round the clock sharing of the load. 'Thermal energy storage systems for solar cooling and solar thermal based heating systems for Indian households', discusses the results of thermal energy storage for both cold storage as well as heat storage and points out that solar water heater based hot thermal energy storage are useful in winter for room heating.

HVAC solutions, as an integral part of the infrastructure and real estate planning processes is viewed as a major contributor to the continual growth of the economy of the land. Indian HVAC sector will contribute greatly to domestic GDP on developmental aspects, highlights an interesting write up on 'Indian HVAC Market Outlook.' There is yet another article deliberating that globally, the water consumption from coal-fired power plants is becoming an increasing concern. Some are arguing that, countries like India and China lack water resources for the cooling needs of their coal-fired power plants.

And, all the more, we present a new layout in the magazine for you and would appreciate feedback.

Please send your comments at pravita@charypublications.in

Pravita Iyer
Publisher & Director



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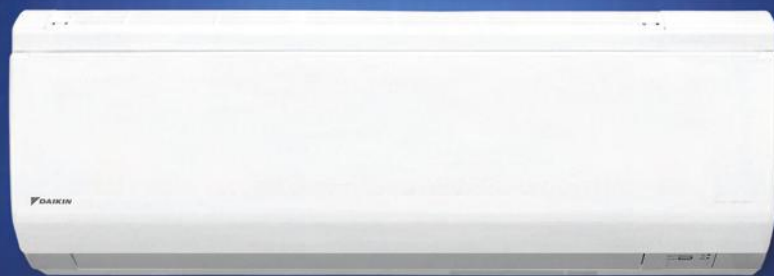
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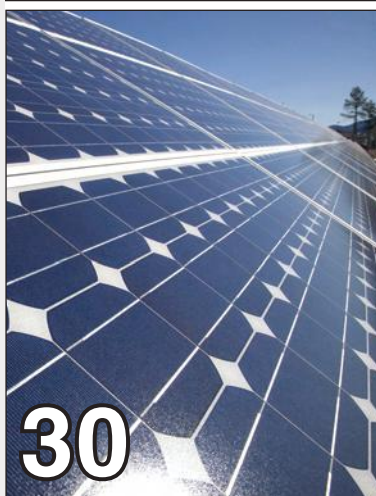
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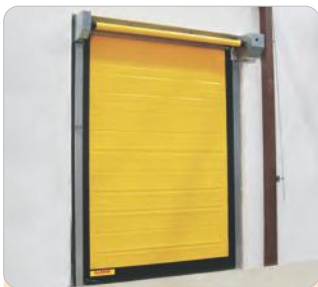
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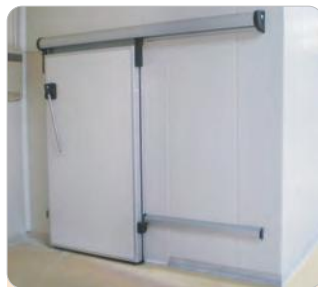
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Editorial

Cold Storages and Reefer Transport Opportunities



India's cold chain industry, currently valued at Rs 245 billion, is expected to reach Rs 520 bn by 2017, growing at a CAGR of 20%. While country is the second largest producer of fruits and vegetables in the world, its cold chain industry is experiencing a wide demand-supply gap. Cold storages lack of cool rooms and refrigerated transport is causing more than 40% losses in annual produce.

Surface cold storage holds more than 90% market share. Studies indicate operating costs for the cold storage business in India is approximately Rs 80-90 per cubic ft per year as compared to Rs 40 per cubic ft per year in the West. Cold storage reports and studies have pegged the value of fruits, vegetables and grains wastage in India at Rs 440 bn annually. Also, 18% of India's fruit and vegetable production, valued at Rs 133 bn, is wasted annually, according to data from the Central Institute of Post-Harvest Engineering and Technology, because of the country's lack of adequate cold storage facilities and refrigerated transport. The private sector accounts for 90% of cold storages in India. Also in 2017, private players will dominate the surface storage segment, which is estimated to reach 95 mn MT.

Country's cold chain industry - a combination of surface storage and refrigerated transport - has been growing at 18%. Cold chain service providers need to focus and research hi-tech technologies to make reefer trucks more energy efficient to withstand the variations in the ambient temperatures at drop-off points. Private ventures need to tap the relevant sectors to their fullest potential.

A thrust of new incumbent governance in the country appears to augment ample infrastructure activity propelling HVAC/R sector into an economic resurgence. More of cold storages mean lot of refrigeration and AC activity, increasing logistical support and investment by MNCs. And, new technologies that decrease operational costs, with new connectivity and increased reefer transport would create more opportunity and education in the sector and this obviously would impact budgets in R&D process. Yet, it is possible with a do instinct.

Gopal Krishna Anand



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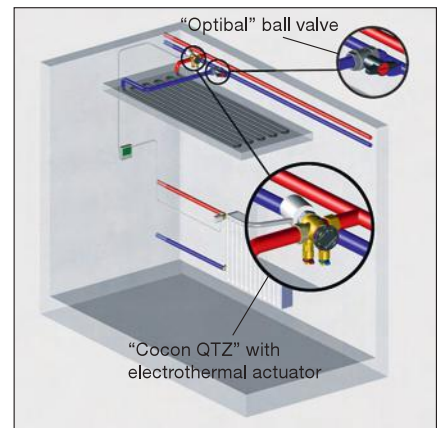
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Editor: Gopal Krishna Anand

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Emerson Climate Technologies Partner+ Program launched in India



Emerson Climate Technologies (India) Ltd., a business unit of Emerson, recently launched its Emerson Climate Technologies Partner+ program in India. Under the program, Emerson will provide professional & customized trainings, expert design solutions and other value-added services for its dealers, OEM manufacturers, contractors and other service providers, helping them gain and improve technical competence to contribute to the growth of the refrigeration industry. India is the world's largest producer of milk & the second-largest producer of fruits and vegetables. Building infrastructure and an energy efficient cold chain eco-system along with trained manpower is critical. In a relatively unorganized & under developed sector like cold chain, there is an absence of skilled manpower. This leads to ineffective usage of systems thereby increasing costs & hampering food quality. According to Sridar Narayanswami, Vice President & MD, Emerson Climate Technologies (India) Ltd, "About INR 133 Billion worth of fruits and vegetables are wasted in India annually. Two of the biggest contributors to this loss are the lack of refrigerated transport and the lack of high quality cold storage facilities for food manufacturers and food sellers. While Government of India is putting in many efforts in building the Cold Chain infrastructure, it is important for the industry to contribute with adequate products & technologies." As a first of its kind, Emerson has gone a step ahead with the Emerson Climate Technologies Partner+ program for India market so as to meet the rising and diverse needs of the market. The program invests in classroom training, hands-on practice area and a showroom area. The class includes designing cold rooms, introducing technical know-how & essential troubleshooting techniques required by OEMs & contractors. The hands-on practice area showcases professional equipment such as low-temperature cold room, maintenance tools and compressor cut-away with on-site demonstration. The training not only helps the technician in understanding the increasingly complex refrigeration systems but also helps the technician provide cost effective solutions to his customers. As a leading provider of refrigeration solutions, ECT is devoted to providing customers with integrated value-added services to enhance their business competitiveness. ■

SHARP launches four Door Refrigerators with Plasma Cluster technology in India

Sharp Business System (India), the leading consumer Japanese brand with over 100 years of lineage in white good industry, with various patent technologies on their name is announced the launch of new series of four door refrigerators SJFS 79 (Supreme Model) and SJFP 79 (Premium Model) costs 1,59,990 and 1,24,990 INR respectively. Sharp Refrigerators are the only one of its kind which uses its patented plasma cluster Ion technology which sterilizes air inside the refrigerator and fight against mold, thereby preserving food for longer period. Bread stays fresh for 7-10 days without fungus or mold. It also comes with Ag+ Nano deodorizer which removes bad odour; the supreme model has a capacity of 600 Ltr and dimensions 890X1830X770 where as the premier model has the capacity of 605 Ltr with the same dimensions. It can make ice of different shapes and sizes. It has an advanced glass touch control panel which gives it an elite look, and a sleek door handle which can bring style to any Indian kitchen. It has a hybrid cooling system and has full rear lighting (LED). ■



Embracing ecologically sound principles, LG meets Greenhouse Gas Target seven years early

LG Electronics (LG) cut emissions from the use of its products by 38 million tons in 2013. This exceeded company's target to reduce emissions from the use of LG products by 30 million tons in a year, a target which LG had previously projected would not be reached until 2020. On Earth Day, LG has set itself the even more challenging goal of cutting emissions associated with product use by 60 million tons a year in 2020 - an accumulated reduction of approximately 420 million tons between 2008 to 2020. A decrease of this size will have the same positive impact on air quality as the planting of 3 billion pine tree seedlings a year. LG's advanced technologies helped to lower greenhouse gas emissions through impressive energy saving performance. The company's Linear Compressor used in refrigerators and Direct Drive technology in its washing machines are clear proof of LG's commitment to, and leadership in, delivering environmentally friendly products. LG's LED-backlit LCD TV achieved 67% improved energy efficiency by using Smart Energy Saving Technology. For its continued leadership in manufacturing and promoting efficiency, LG was recognized by the U.S. EPA with the 2014 ENERGY STAR Partner of the Year-Sustained Excellence Award, the highest distinction bestowed upon ENERGY STAR partners. In Korea, LG has earned 112 low-carbon product certifications in the field of home appliances from the Ministry of Environment and Korean Environmental Industry & Technology Institute, more than any other manufacturer to date. Furthermore, LG was ranked first in the Carbon Management Global Leaders Club by CDP (Carbon Disclosure Project) Korea from 2009 to 2012. Reaching this milestone could not have been possible if not for the dedication of our employees who have led the way in environmental stewardship," said Joon-ho Kim, senior vice president and head of LG's Quality Center. "We will continue to push the boundaries to bring innovations to our customers that are both technologically superior and environmentally responsible." ■



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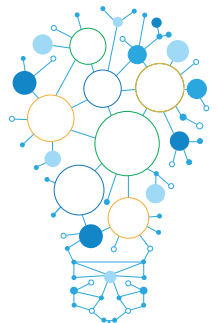
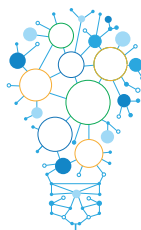


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Symphony introduces India's first branded 'Window Range' of air coolers

Symphony World's largest air cooler company, Symphony Ltd has introduced India's first branded 'Window Range' of air coolers for the summer season to strengthen its product range in residential air coolers by offering innovative cooling solutions. Company has unveiled five models of window air coolers, 3 with plastic body and 2 made of metal body, with advanced features like Dura Pump Technology, in-built float valve for automatic water refill, full function remote, feather touch control panel, to name a few. "India is a traditional air cooler market with a huge unorganised segment dominated by window installed metal body coolers. We could foresee that by tapping into this segment we could achieve tremendous incremental growth in the near future," said Chairman and Managing Director, Symphony Ltd, Achal Bakeri. The plastic window coolers will be available in 3 models, Window 70, Window 41 and Window 51 while R28 and R28i are two models in metal body. The new range of coolers with advanced features and digital control panel are perfectly suitable for places experiencing long and harsh summer months. Specially designed 'Window Range' coolers are rust proof and shock proof and are loaded with advanced features like Dura Pump technology, in-built float valve for automatic water refill, inverter compatibility etc. This range will have all-weather composite plastic made of specially engineered corrosion, heat and UV resistant polymers which can withstand harsh weather conditions. The corrosion free metal body coolers are made of automotive steel with special 4-stage powder coating rendering extremely long life. These metal window coolers are manufactured at the company's state-of-the-art plant in North America. Air cooler market in India is estimated to be around Rs 2,500 – 3,000 crore and growing at 15-20% per annum. Symphony Ltd is the market leader in the Indian air cooler industry and commands 50% market share among organised players. In the year 2013, Symphony brand had over 70% of the voice in media in the air cooler category. "In a power-starved country like India, we see a big potential for air coolers in both urban and rural areas as air coolers consume around one tenth the electricity compared to an air conditioner," said Bakeri. ■

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Greenheck industrial dampers are heavy-duty, flanged-style frame dampers with various blade styles and pressure classes designed to control airflow and provide shut-off in HVAC and industrial process control systems. Built under an ISO9001-2008 Quality Assurance Program, Greenheck industrial dampers offer heavy-duty options for air control, shut-off, balancing and isolation for higher pressures, temperatures and airflows than commercial grade dampers. Ideal for nuclear, tunnel, bio lab, and power generation applications, Greenheck's complete line of industrial dampers includes control, backdraft and pressure relief, UL rated smoke, tunnel transit, blast, tornado, and bubble tight dampers. Greenheck, the worldwide leader in manufacturing and distributing air movement and control equipment, offers the most UL certified dampers and the largest selection of AMCA licensed dampers in the industry. ■



Haier launches new Side By Side Refrigerators with Home Bar

Haier, one of the largest Home Appliances & Consumer electronics brand globally and world's No. 1 brand in refrigeration appliances, launched its new SBS-Side by Side refrigerator with a home bar, HRF 628 AF6. The launch brings together yet another combination of technology and style which can satisfy need of the modern day urban consumer. Features like a luxury home bar, a 3 in 1 dispenser provide the product all the necessary ingredients to make the product a must have in a modern household. This SBS refrigerator is a luxury with utility ensuring an unmatched performance and convenience for an Indian consumer with various needs. The product certified with the European A+ rating thus consumes minimal energy. Some of the astoundingly impressive features include a full DC Inverter compressor ensuring noise level remains below 40 db. A fascinating feature of the range is the One Touch Holiday Function that intelligently switches off the refrigerator section, keeping the freezer on while the user is away for days. Introducing such up-gradation is testimonial to the fact that Haier has always believed in smarter technology for inspired living. Another interesting feature of the refrigerators is the 1 Hour Icing Technology which enables it to make ice within an hour, making it one of the fastest ice-making refrigerators. Commenting on the launch, Eric Braganza, President, Haier Appliances (India) said, 'A refrigerator is no longer a product meant only to store food but has become an extension of the home décor. The industry has witnessed a surge in technology advancements and awareness and this product brings together the perfect amalgamation of both. The new SBS refrigerator brings in the perfect mix to suit the requirements of the modern day urban consumer.' A new line up of the Frost Free and DC with 1HIT (One Hour Icing Technology) are aesthetically designed to suit the modern day décor. The 1HIT technology in Haier's new line up makes the refrigerators the fastest cooling in the industry. Matching with current trends, the design also gives it a family look. ■



Yet another
innovation
 from the leaders in indoor air quality



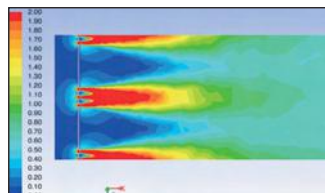
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Arise India introduces a range of Fans and Room Coolers

arise Arise India Ltd, the industry leader in electrical goods, introduces its new range of summer products which includes the 'Diamond' ceiling fan, 'Premier' cooler, etc. Arise's Premier Cooler and Diamond Ceiling Fan promises cool air every time. Arise has launched a room cooler range including Premier, Glacier, Frosty and others, to name a few. With a massive tank capacity from 45 to 65 litres, these have an impressive air delivery from 25 to 40 ft and covers nearly 550 to 970 sq ft of area. The high-performance motor coupled with a submersible type water lifting pump, delivers exceptional performance. Featuring shock proof body, the air-coolers have a rust-proof blower water level indicator along with caster wheels for easy movement. The MOP of these, ranges between Rs 6000 – 10000. Ceiling Fans range has aluminium top and bottom with Copper winding motor. Range, throughout is ISI certified adhering all the quality & performance norms leaving no room for discomfort to its customers. Range also carries along a 2 year warranty. The ceiling fan range has an air-delivery range of 190-200 cu.mtr/min. The MOP of the range is Rs 1490 – 2190. ■

Mumbai airport Cold storage facility

Country's largest cold storage facility for imported goods set up at the Mumbai airport. can accommodate, at a time, goods from eight cargo aircraft, airport officials said. The lack of cold storage facilities leads to perishable goods decaying. "The new facility, set up in a modular building constructed over an area of 1,400 sq mtr, can handle all kinds of temperature-sensitive products. It will surely be a boon for the high-end food and hotel industry that depends a lot on imported food materials," said an official from Mumbai International Airport Limited, who was involved in development of the facility. The new installation will also have a separate section for storing hazardous goods. According to industry sources Delhi, Chennai & Mumbai are the major export-import hubs in the country. Centres like Hyderabad and Bangalore fast catching up. But Mumbai, now city is among the largest importers of high quality meat, cheese, exotic fruits and vegetables in the country. Most of these products are sourced by five star hotels and hi-end restaurants. ■

Ingersoll Rand launches Centac C800 Centrifugal Compressor

Ingersoll Rand, a global leader in air compressors, tools, fluid management and material handling equipment, is introducing the new Centac® C800 centrifugal air compressor for assembly, automotive food and beverage, oil and gas, petrochemical, pharmaceutical, processing & other industrial manufacturing applications. The Centac C800 is built on the latest generation, integrated and simplified centrifugal compressor platform, and is an extension of the Centac C1000 product line. Certified as ISO 8573-1 Class 0, the C800 provides 100 percent clean, oil-free air, and is designed to minimize downtime, increase efficiency and lower total cost of ownership. The single largest contributor to life-cycle cost is loss of production. The Centac C800 is designed with features to maximize asset availability including tapered polygon attachments to create a precision fit and evenly distribute torque and a simplified oil piping system with an integrated oil filter to keep the system running at ideal conditions. The compressor's integrated gears, flex pad hydrodynamic bearings and components work to reduce vibration and error-proof alignment, minimizing downtime and lowering operational costs. ■



Johnson Controls named a 2014 World's Most Ethical Company for eighth consecutive year

Johnson Controls, announced that it has been recognized by the Ethisphere Institute, an independent center of research promoting best practices in corporate ethics and governance, as a 2014 World's Most Ethical Company. This is the eighth time that Johnson Controls, a global multi-industrial company with established core businesses in the automotive, building, and energy storage industries, has been honored with this award, which recognizes organizations that continue to raise the bar on ethical leadership and corporate behavior. World's Most Ethical Company honorees understand the correlation between ethics, reputation and daily interactions with their brand. Johnson Controls is one of only 17 companies to receive this award eight years consecutively. "Johnson Controls is pleased to be named one of the world's most ethical companies. This recognition is a tribute to our 170,000 employees around the world, who embrace and demonstrate our values and high standards on integrity and ethics every day," said Jerry Okarma, vice president, secretary and general counsel for Johnson Controls. "The entire community of World's Most Ethical Companies believe that customers, employees, investors and regulators place a high premium on trust and that ethics and good governance are key in earning it," said Ethisphere's Chief Executive Officer Timothy Erblich. "Johnson Controls joins an exclusive community committed to driving performance through leading business practices. We congratulate everyone at Johnson Controls for this extraordinary achievement." The World's Most Ethical Company assessment is based upon the Ethisphere Institute's Ethics Quotient™ framework. The Ethics Quotient framework has been developed over years of effort to provide a means to assess an organization's performance in an objective, consistent and standardized way. The information collected provides a comprehensive sampling of definitive criteria of core competencies. ■



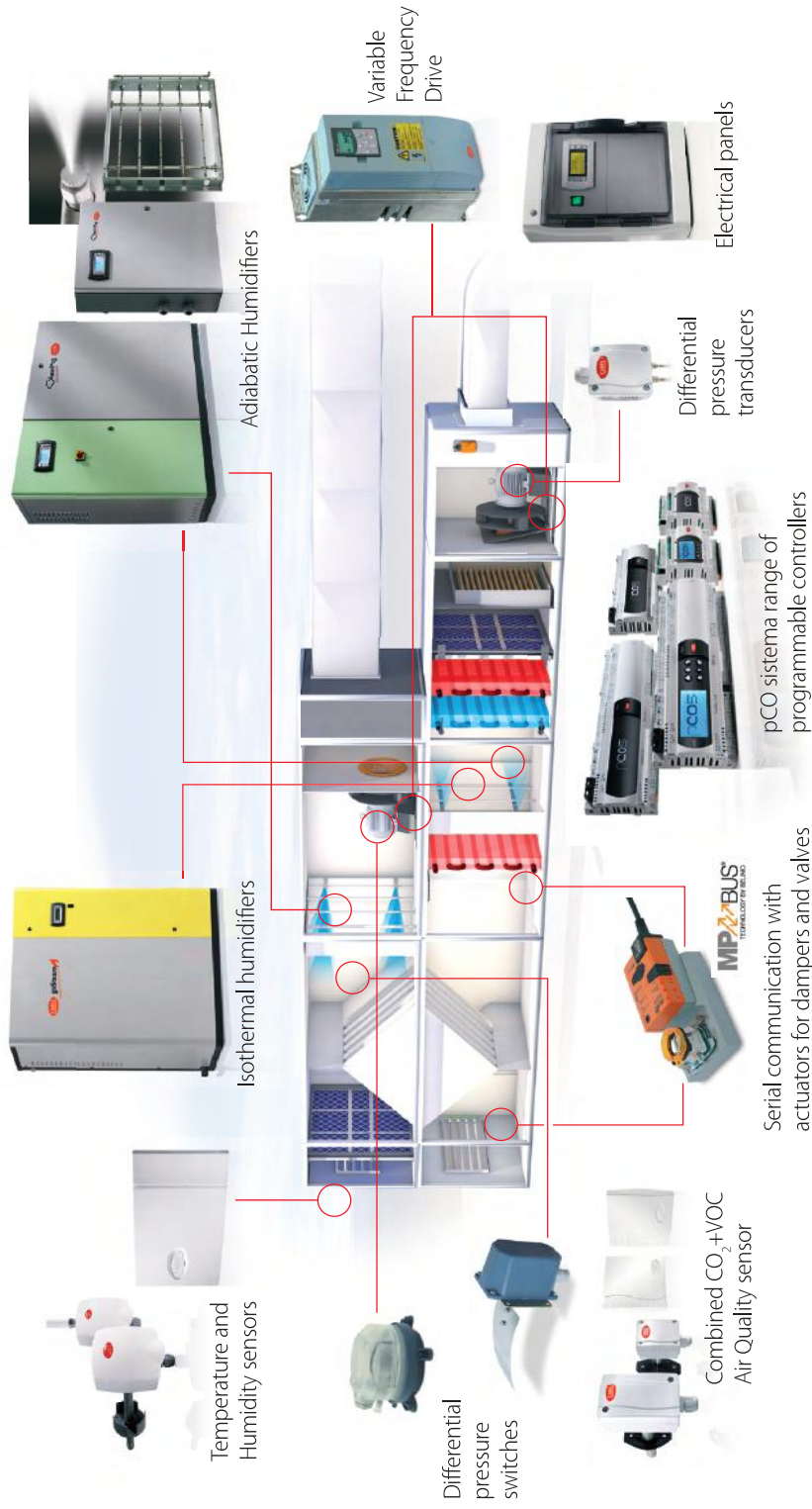
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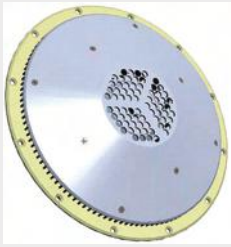


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Heat exchanger from AMETEK Rotron cools sealed electronics without contaminated outside air



AMETEK Rotron in Woodstock, N.Y., is introducing the Discus Self Ventilating Heat Exchanger (SVHE) that cools sealed airborne or ground-based electronic and optical compartments without introducing contaminated external air. The thermal-management device for electronics cooling offers greater cooling capability and reduced weight compared with previous technologies, company officials say. Designed for pod-mounted airborne optical systems, the Discus also can cool other aircraft, helicopter, drone, and ground-based electronics requiring air segregation. The product has two separate airflow channels with active induced air circulation via an integrated set of motorized impellers, keeping compartment air separate from the external cooling air. Heat transfer occurs by convection from the circulating air and then by conduction through a common bulkhead connecting two sets of integrated aluminum pin fins. A brushless DC motor turns two impellers on a common shaft, each circulating air past the exposed pin fin exchanger surface. The mounting bracket, common bulkhead and both sets of pin fins are all incorporated into one homogenous aluminum structure for maximum heat conduction, robustness and precise product dimensions. ■

Honeywell & DuPont to manufacture New Automotive Refrigerant

Honeywell and DuPont announced a manufacturing joint venture to produce a new refrigerant for use in automotive air conditioning systems. The new refrigerant has 99.7 percent lower global warming potential (GWP) than the current refrigerant. Under the agreement, DuPont and Honeywell will share financial and technological resources with the intent to jointly design, construct and operate a world-scale manufacturing facility for the new refrigerant, known as HFO 1234yf. The product meets European Union regulatory requirements for lower GWP refrigerants for automobile air conditioning systems. DuPont and Honeywell developed the product jointly but will market and sell it separately. ■

CDL launches online video training programme for air conditioning installers

Cool Designs Ltd launched a unique online video training programme to update the skills of air conditioning installers and service engineers. There are more than 20 titles available to date, covering topics on installation, commissioning, trouble-shooting and servicing of both indoor and outdoor units, in various models across the Toshiba range. Titles also cover how to access operational data from air conditioning systems, as an aid to performance optimisation and making energy efficiency improvements. With growing importance of minimising refrigerant leaks from equipment, there is also a training module giving an overview on the manufacturer's various options. In the event of a leak, the system can be configured to isolate a specific circuit or room while enable the rest of the system to continue functioning. Pumping down the refrigerant or stopping system, along with various alarms, are also optional. Darrel Birkett, MD, CDL, remarks, Air conditioning is obviously very much a hands-on subject, from engineer's point of view. Video training provides an excellent way of conveying knowledge and showing people how to do things properly. ■



Schneider Electric enhances Data Center Cooling Efficiency and Capacity with its InRow RC

Schneider Electric, a global specialist in energy management, introduced the second generation of the InRow RC as the latest addition to the InRow product line, expanding Schneider Electric's vast cooling portfolio to meet the evolving cooling needs



of an ever-changing data center environment. This second generation release introduces two new models that significantly improve cooling efficiency by reducing power consumption while also increasing capacity. The high temperature model, designed for optimal heat removal, leverages warmer water temperatures and outdoor ambient air temperatures to increase chiller efficiency, thus maximizing the hours of economization. "With the second generation of the InRow RC, we have taken another step in the evolution of our cooling offerings," said Nikhil Pathak, Vice President, IT Business, India & Saarc, Schneider Electric. "This product provides superior efficiency to help customers drive down ever-increasing operating costs." Part of the Schneider Electric InfraStruxure suite of solutions and created for high density applications, InRow RC reduces the distance between the heat source and heat removal, eliminating the mixture of hot and cold air streams, therefore improving overall cooling predictability. The solution also features variable speed fans that reduce energy consumption during off-peak cooling periods or when the data center is partially loaded. This decreases data center energy consumption to match the demand of the heat load, significantly impacting the overall operating costs of the data center. With a user-friendly design, InRow RC features an intuitive, 4.3-inch color touch screen display to provide fast, easy access to data. The InRow RC ACRC301S and ACRC301H models are now available for purchase. ■

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Energy Efficiency Standards for Commercial Refrigeration Equipment to cut Energy Bills & Carbon Pollution

Building on President Obama Administration's Climate Action Plan, the Energy Department announced new efficiency standards for commercial refrigeration equipment. Over the next 30 years, these standards will help cut carbon pollution by about 142 million metric tons – equivalent to the annual electricity use of 14.3 million U.S. homes – and save businesses up to \$11.7 billion on their energy bills. "In our supermarkets and grocery stores, refrigeration can use almost 40% of total energy use – contributing a large portion of these businesses' utility bills. By improving the energy efficiency of commercial refrigeration equipment – like restaurant-size fridges or the deli case at your local grocery store – we can make our businesses more competitive, reduce greenhouse gas emissions and save money," said Energy Secretary Ernest Moniz. Under the Obama Administration, the Energy Department has finalized new efficiency standards for more than 30 household and commercial products, including dishwashers, refrigerators and water heaters, which are estimated to save consumers more than \$400 billion & cut greenhouse gas emissions by 1.9 billion metric tons through 2030. To build on this success, the Administration has set a new goal: Efficiency standards for appliances and federal buildings set in the first and second terms combined will reduce carbon pollution by at least 3 billion metric tons cumulatively by 2030 – equivalent to nearly one-half of the carbon pollution from the entire U.S. energy sector for one year – while continuing to cut families' and businesses' energy bills. Commercial refrigerators, freezers and refrigerator-freezers are typically used to chill perishable products on display or in storage, including at grocery and convenience stores, restaurants and other food retail and food service establishments. Since these products must be kept cold constantly, commercial refrigeration equipment generally operates 24 hours per day, 365 days per year. A large commercial refrigerator used in grocery stores can consume up to 17,000 kwh of power per year, while a large commercial freezer can use up to 38,000 kwh of power per year. The efficiency standards established today update the Energy Department's 2009 standards and will make the average commercial refrigeration unit about 30% more efficient, compared to the current standards. ■

GEA Group concludes agreement on sale of Heat Exchangers Segment to Triton

Düsseldorf-based mechanical engineering group GEA Group announces the sale of its Heat Exchangers (HX) Segment to funds advised by Triton. The purchase agreement was signed and the sale is based on an enterprise value of approx. 1.3 billion euros. Closing of the transaction is expected by the end of the year. We are pleased that, with Triton, we have found a reputable owner for the Heat Exchangers Segment. HX has a strong foothold in the market, enjoys an outstanding market position with its products and is commercially successful. In its capacity as investor, Triton brings in the perspective of further developing the business potential of HX in the best way possible", said Jürg Oleas, Chairman of the Executive Board of GEA Group Aktiengesellschaft. Within the framework of its GEA 2020 group strategy, GEA Group had previously decided to more strongly focus its portfolio to further strengthen its position as leading system provider for the food industry and other exacting process industries. ■



ASHRAE 2014 Annual Conference: focus of Technical Program is a Track on Ground Source Heat Pumps

A new track added to the Technical Program at ASHRAE's 2014 Annual Conference speaks to the challenges engineers face when designing ground source heat pumps as compared to more traditional systems. The Conference takes place June 28-July 2, Seattle, Wash. The Technical Program kicks off June 29, with interactive programs and a networking coffee break, and concludes July 2. The program addresses broad topics in the application of technology to practice, specific applications in ground source heat pumps, operations and maintenance and indoor environmental quality, as well as new reports on research taking place worldwide. New to the Technical Program is a track on Ground Source Heat Pumps (GSHP) State of the Art: Design, Performance & Research, which addresses all aspects of design that lead to optimally performing systems in addition to avoiding common pitfalls that lead to poorly performing systems. The track was organized by ASHRAE, the National Ground Water Association (NGWA), the International Ground Source Heat Pump Association (IGSHPA) and the Geothermal Exchange Organization (GEO). "There are a number of challenges that engineers face that are different from conventional HVAC systems, such as ground coupling, working with drillers, the importance of annual heating and cooling loads to ground heat exchanger design," Jeff Spitler, an ASHRAE member who helped create the track, said. "This track addresses the entire design and installation process from site evaluation to commissioning & system operation. GSHP systems are inherently energy efficient, but poor choices in the design can compromise this inherent efficiency. 'What not to do' is also addressed in the track." Spitler said organizers have drawn in researchers from around the world to discuss new advances in the field so attendees have the opportunity to hear about both the latest research and state-of-the-art design practice. ■





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BITZER opens Green Point in Kolkata; has 4 Points of Service in India now

Refrigeration compressor company BITZER India inaugurated India's fourth Green Point in a Puja ceremony in Kolkata, making service, maintenance and training even more efficient and bringing support even closer to customers in the country. Kolkata saw the opening of the fourth Green Point in India on May 6, 2014, giving BITZER an even stronger service presence in this rising nation, which has the world's second largest population. Green Point allows BITZER to respond in the best possible way to meet the practical needs of its Indian customers. The Company started Green Points in New Delhi, Navi Mumbai and Bangalore up to 2013, in the north, west and south of the country respectively. With the addition of this latest Green Point BITZER now covers all four regions of the country providing state-of-the-art service and maintenance support for refrigeration and air conditioning technology in the east of India.

Each Green Point is equipped test equipment to check the operation of reciprocating compressors after repairs, the only facility in the country to offer this. It is also stocked with genuine (in-stock) spare parts, team of highly trained and experienced technicians and technical expertise to help address all cooling technology concerns and issues of customers in an efficient manner. The Kolkata Green Point will have expertise to support the local burgeoning Fisheries and Food Processing business that is expanding fast in the North eastern states.

Rob de Bruyn, Managing Director, BITZER Refrigeration Asia Pte Limited said, "The growing demand in the East of India gives us confidence in the investment in our latest Green Point and represents an opportunity for us to convince our customers of BITZER's quality and service support commitment to all our customers in the country, however remotely located." He adds that "opening of the fourth Green Point in Kolkata underscores BITZER's strong commitment to India and its growing presence, over the past two years, in the eastern part of the country".

BITZER customers will be able to undertake intensive training on all types of compressor fault diagnosis and repairs. A global quality standard and top-level customer support are guaranteed by the three-tier hierarchy of the Green Point Competence Centre in France, six Master Green Point branches, and the local branch offices of the Company.

The Green Point development is proof of BITZER's quality promise. By offering training courses, service and genuine spare part delivery, BITZER accompanies life-cycle of every compressor around the world, and works for its customers, providing quality and service all round. BITZER India Pvt Ltd, a 100% subsidiary of the German parent, has been operating in the country since 2007. BITZER ranks among the leading manufacturers of refrigerant compressors. BITZER in India offers superior solutions including technical design and planning support, installation and commissioning the high quality of products to its end and OEM customers. ■

Opening of the fourth Green Point in Kolkata underscores BITZER's strong commitment to India and its growing presence, over the past two years, in the eastern part of the country



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THE HEART OF FRESHNESS

Indian HVAC Market Outlook



In any developing or developed economy the growth of its Heating, Ventilation and Air Conditioning (HVAC) sector is directly correlated to the growth its domestic economy.

Now with HVAC solutions becoming an integral part of the real estate planning processes, this sector is viewed as a lead contributor to the continual growth of the economy of the land.

In Indian parlance as well, the same use case holds pertinence, where with a robust growth witnessed across the real estate, hospitality, health services and education sectors, the growth of the domestic Mechanical, Electrical & Plumbing (MEP) industry has also been on an upswing.

HVAC services which come under the purview of the Mechanical,

Electrical and Plumbing (MEP) sector, has been a greater beneficiary by the buoyancy of the Indian economy's continual growth and has seen its market capitalization increase based on pointers like the growth of Indian Real Estate sector & growing Purchasing Power of the Indian consumers. Over the past ten fiscals, the HVAC sector's growth has been directly relative to the growth in the



Kanwal Jeet Jawa,
Managing Director,
Daikin India.

Indian infrastructure sector which expected to grow at a positive growth rate of over 100% in the FY12-16E period will surely take the domestic HVAC sector together on a progressive spiral. Many industry experts deem the domestic HVAC sector to flourish based on factors like changing demand drivers, increase in project outputs and growth of domestic MEP players to capture a consolidated growth aspect of over 8% CAGR over the FY12-16E period. Major research indicate that the domestic HVAC sector will keep retaining its 15% market share in the MEP Sector which is expected to grow over the said period, thus becoming one of the major growth markers in the Indian economy.

Over the past ten years, the Indian economy has been buoyed by the emergence of various sectors like Heavy Industries, Real Estate & Infrastructure and Power which have been amongst the lead contributors to the expanding Indian economy. Out of these critical sectors, the real estate sector has been a major contributor

to development and has concurrently sustained the augmentation of the developing Indian HVAC segment. This market which is expected to reach approximately five million TR by 2015 in volume terms is today driven by variable components which are pertinent to the needs of the real estate sector like Chillers, Variable Refrigerant Volume (VRV) and Air Handling Units (AHU), which constitute the majority of HVAC product output in the India economy.

According to the recent estimates by industry standard IBEF, the Indian real estate sector, with its growing investment opportunities, is expected to post annual revenues of US\$ 180 billion by 2020 as against US\$ 66.8 billion in 2010-11, thus leading to exponential opportunities for the Indian HVAC sector. This upsurge in

cross Rs 20,000 crore mark within the next two years.

Keeping this expected growth of the domestic HVAC sector in mind, it is much important to focus on the workings of the Indian HVAC sector which has led to its continual acceptance. Major influence factors like the continual growth of the MEP sector, positive investor interest in the Indian real estate sector, along with focused government policy initiatives have had quite a significant impact on the growth of the domestic HVAC market. Other factors like growing consolidation in the market and larger awareness towards greener and energy efficient technologies have also tilted the balance towards greater acceptability of the sector as mass oriented technologies.

Today the domestic consumers



building activities will help sustain and ascertain the Indian HVAC sector as one of the mainstays of the growth of the Indian economy, and thus will help in establishing the HVAC sector as a mass oriented sector.

Considering the pace of growth in the infrastructure and real estate sector, industry analysts Indian Society of Heating, Refrigerating and Air Conditioning Engineers expect the domestic HVAC sector to witness nearly 15-20% growth y-o-y on the back of exponential growth across sectors like retail, hospitality, health-care and commercial services or special economic zones (SEZs) which all require HVAC systems, and thus

are inherently becoming more cost-conscious and are now looking for greater energy-efficient systems well within their budgets in view of the rising power costs and increasing environmental awareness. These factors along with the presence of domestic, international and unorganized market participants have made the Indian HVAC market much competitive and dynamic thus leading to greater manufacturer focus into the market.

Experts agree that the robust growth of the domestic HVAC market is well and truly on its way to expand further in the coming times, they feel that a greater focus on positive future

growth drivers can help regulate and supplement the growth of the sector's future. As discussed, the emergence of the Indian Real Estate sector which has seen major construction activities pan-India has been a major growth driver of the Indian HVAC sector wherein with the increasing demand for newly constructed residential, commercial and retail entities across the country, the demand of parallel HVAC solutions have also risen exponentially.

Today the India HVAC sector's growth has also been capitalized by the fact that key technical innovations like evolving technologies and on-the-move innovations in the international HVAC market have found general acceptance in the domestic market. This has also enabled domestic & international players in bringing cutting-edge innovations to the domestic consumers thus leading to buoyed growth of the sector. While the greater acceptance of relative HVAC appliances has in itself been one of the major keys of growth, focused governmental policies for the sector have also played a greater part in enabling a further outreach for the sector. By creating pertinent policies and regulations on focused refrigerant use, stricter eco-friendly norms and safety practices, along with issuing viewpoints on efficient use of products, services and technical know how have made the players in the market realign their strategies thus playing a greater role in creating an engaged demand in the industry.

Industry body ISHRAE believes that the domestic HVAC industry has matured and is now responding to offer value added cost-effective air-conditioning solutions to the consumers which pertinently cater to the emergent needs of the commercial and industrial customers. With the introduction of eco-friendly systems like inverter technology based air-conditioners and by phasing-out hydro chloro fluoro carbon (HCFC) gas, and introducing eco-friendly gases like HFC32 much can be done in this regard.

Imperative to study herein are the recent developments of HFC32

refrigerants and inverter technology based air-conditioning systems, which have shown a new way in making air-conditioning more cost-effective and energy-efficient. A low carbon-dioxide emitting refrigerant, HFC32 has zero ozone depletion potential and boasts of a lower global warming potential. Featuring a better life-cycle climate performance, HFC32 is very suitable for split air conditioners and heat pumps and is an excellent alternative to replace R410A in terms of performance. This makes it a pertinent investment in terms of creating greater energy efficiency and creates an enhanced 'greener' footprint. While the utilization of HFC32 refrigerant brings greater greener capabilities to the HVAC devices, the structuring of inverter AC technology helps in sustaining the domestic power needs, by integrating Reluctance DC Inverter Power Control technology with a DC Fan Motor to achieve High COP's. This helps with greater operating efficiency and makes air-conditioning a better cost-efficient investment for the mass market of India which is on an emerging path.

Some other factors like the oncoming of Inverter technology based air-conditioners which offer higher energy-efficiency ratios amongst traditional air-conditioning models, growing usage of HFC32 refrigerant based air-conditioning technologies to offer greener and environment friendly alternatives to the consumers, enhanced focus on Star labelling and greater shift towards higher Star rated air-conditioning solutions, oncoming of emergent technologies like Variable Refrigerant Flow (VRV), Ductless air-conditioning and Solar air-conditioning and a growing awareness on Green Building measures adhere to sustainable design construction standards that help in reduce the consumption of energy, water and natural resources, are some of the trends that have contributed their bit towards enabling HVAC systems in becoming a mass product and have helped increasing the scope of operation of this emergent technology.

But while growth drivers of the industry are important to talk about keeping in mind the immediate growth of the sector, a keen hawk eye also needs to be focused upon the impediments in the sector which hamper the ongoing growth of it. Many factors like the emergence of a large network of unorganized players who flood the market with sub-standard HVAC products, the negative perception driven downturn in the Indian realty market leading to faltering interest into Indian realty by international players; reluctance of local players in incorporating technological innovations into their value structures owing to spiralling input costs and the continuous power discrepancies in the country are some of the delimiters which hamper the growth of the sector. Also despite the fact that there is a greater scope in the domestic HVAC market, the lack of availability of skilled labour is a significant entry barrier for new players in the industry. Manufacturers believe that while manpower is available, the unavailability of skilled manpower is a grey area of concern for them. Thus the industry is univocal in demanding that there is a greater need for government and industry to work together to train the workforce.

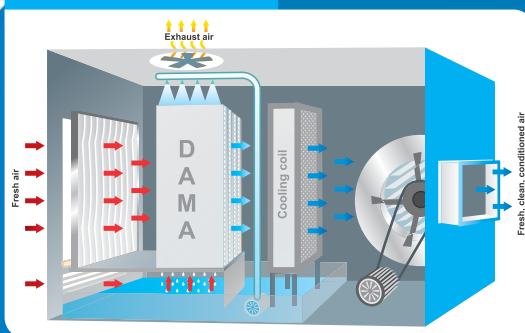
The chug forward of the Indian HVAC sector can only be positively achieved by overcoming the pertinent challenges, and post that only the domestic HVAC market can fully realise its potential and can forward critical acceleration. A positive growth in the industry will not only directly impact the growth of the Indian economy that will provide a stable growth outlook to the faltering economy, but will also encourage emerging buyers to look into HVAC as an appliance of mass consumption without the hindrances of higher energy costs or greater environmental harms. In conclusion, it would not be wrong to concur that in coming times, the Indian HVAC sector based on cumulative developmental aspects accentuating its augmentation will contribute greatly in the growth of the domestic GDP and further on the Indian economy. ■



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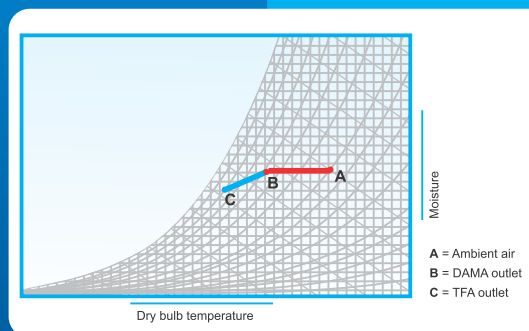
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Heaven Comfort To Helltrap

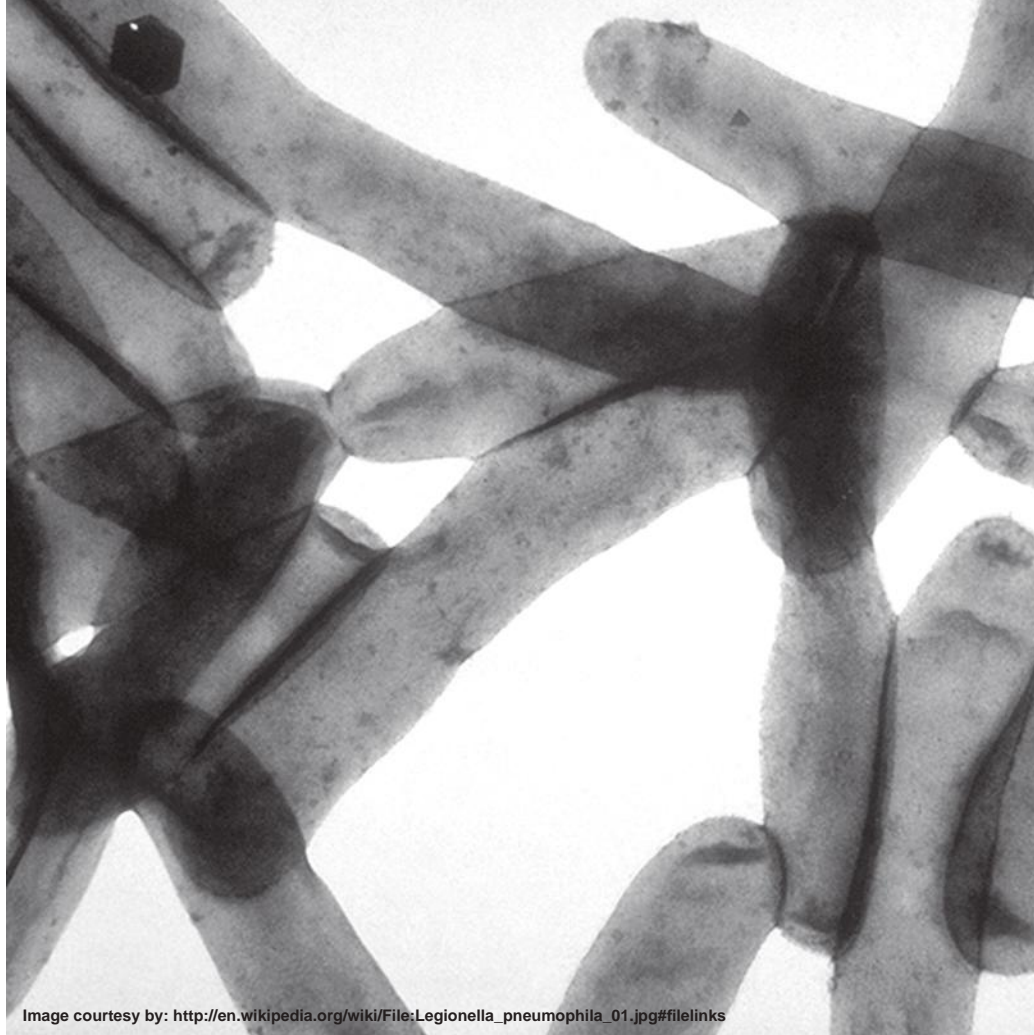


Image courtesy by: http://en.wikipedia.org/wiki/File:Legionella_pneumophila_01.jpg#filelinks

For a long time now, a widespread concern can be seen about health issues associated with indoor air quality in India. Particularly with people spending major chunk of their time in high rise centralized AC buildings with glass envelop like typical corporate offices.

Let us not take old constructions as an exception on the same, with retrofit AC systems; these are equally vulnerable to the risks without thoughtful ventilation design and maintenance.

Kindly allow me to hold play on the keyboard to convey a thanks note to one of my senior, when we discussed about the Issues and concerns in Centralized AC Buildings, which led to do a bit of work to present this article to you dear readers.

In July 1976, Bellevue-Stratford Hotel, Philadelphia Pennsylvania; The annual convention of "American Legion-

An organization for social and mutual aid comprising members from US armed forces" rattled with an outbreak of pneumonia occurred among 300 people which resulted to a death toll of 25.

The investigations and subsequent research revealed about a water borne bacteria named Legionella pneumophila and the deadly disease called Legionnaires or commonly known a legion fever.

Since 1976, almost every year legionnaires disease outbreak reported in different places across the world but 2012 & 13 were hit the most, recent comes in Sep 2013 at Warsteiner

Vivek Gupta, an engineer & post graduate in management; BEE certified Energy Manager and an accredited professional from Indian Green building council with over a decade experience in HVAC Design, Projects and Utility Operations Management with India's top automobile companies.



This bacteria is water borne it can transmit through water streams and moist air to a larger area easily. Some 43 species of LDB (legionnaires disease bacteria) have been identified, 20 of which can cause human health problems.

The prevention for such hell traps are nothing but obvious maintenance practices not only in HVAC systems but all water handling equipment specially the ones operating with low temperatures.

Here mentioned are some of the maintenance practices In HVAC ducts, Air Handling units, Cooling towers and Water handling systems which can prevent development and growth of LDBs.

HVAC (Heating, ventilation and air-conditioning systems)

- Since the bacteria can not survive without water, water less systems will gain a preference over water cooled systems
- Ensure a touch - means cleaning is the beginning of prevention and control
- Drain off the water sump in no use as in winter season in HVAC systems for comfort cooling kept switched in few regions of India
- Periodic drain, blow down from cooling towers to reduce scaling and sedimentation

- Avoid Air intake from moist areas such as one near cooling tower
- Supply of treated water to humidifiers
- Water treatment and periodic blow down in air washers, air supply plants
- Cleaning, replacement of pre-filters
- Supply air duct inspection and cleaning, specially ducts of direct evaporative cooling systems without water eliminators (keeping the ducts dry is important)
- Cleaning of AHU coils and sump
- Indirect evaporative cooling systems are preferable.

Cooling Towers and Water Handling Systems

- Cleaning of cooling towers, water tanks, water sump etc
- Water treatment chemicals to stop micro-organism growth and algae formation
- Chlorination of water
- Prevent scale deposition, sedimentation in pipelines, water handling systems
- Design improvements in piping to eliminate dead legs and reduce stagnation of water
- Pipeline joints with rubber, plastic and silicon gaskets may cause bacteria generation on joints
- Keep the water circulating
- Water systems operating below 60-70 deg C temp are more susceptible to bacteria formation. ■

beer, Germany and a nursing home in Florance, Alabama in Oct 2013. In India, officially reported cases are none but likely to grow with fast pace industrialization and increased use of industrial AC and cooling towers.

Common sources reported for the bacteria generation are Waste water systems, Air conditioning systems, Air scrubbers, Cooling towers, Hot tubs, Potable water systems, Pool among a few. Car ACs and domestic unitary ACs are not identified as a potential source.

In a statistical review, poorly maintained cooling towers & AC systems alone contribute to near 50% cases.

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Thermal Energy Storage Systems

for solar cooling (PV powered) and solar thermal (evacuated tube collector) based heating systems for Indian households



This article presents the results of thermal energy storage- both for cold storage as well as heat storage. To smoothen the parabolic nature of solar photovoltaic generation, cold thermal energy storage is required as an alternative to the very costly battery storage system. Internal ice freeze and melt systems integrated to the window size AC can be used for storage of cooling effect to be used during the off solar period.

For room heating in many parts of India, resistance electrical heaters are being attached to the fan coil units of the ACs. Room heating through resistance electrical heaters is a very costly process and a green alternative is to go in for hot thermal energy storage (HTES) using evacuated tube solar water heaters. Energy efficiency in the Indian context is achieved by sectionalizing the

building for air conditioning, using air conditioning only over limited time period & over the relevant seasons. These processes result in massive energy savings.

With increasing use of solar photovoltaic power in the grid, the need for energy storage arises for round the clock sharing of the load.

While electrical battery banks are too expensive with a charge discharge



M Siddhartha Bhatt is Additional Director and Divisional Head of Energy Efficiency & Renewable Energy Division of CPRI, Bangalore. He has published over 45 international papers in the area of energy efficiency and one book. He has developed several energy products and holds 5 patents. He has received many awards such as Award for Science and Technology, CBIP Best paper Award etc.



$$\text{Self discharge rate}(\%/h) = \frac{\frac{dQ}{dt}}{Q}$$

Quality loss factor: This is the thermodynamic loss in quality of thermal energy in terms of the discharge temperature vis-à-vis the charging temperature. For example the energy may be charged at 90°C but the maximum temperature available for use may be only 70°C.

$$\text{Quality loss factor}(\%) = \left[\frac{T_{\text{discharge}}(\text{in K})}{T_{\text{charge}}(\text{in K})} \times 100 \right]_{\text{time period}}$$

To optimize the requirements of heating and cooling in Indian conditions, the air conditioning is not provided for the whole building but for important sections of the buildings. The entire built up space is not heated or cooled. Instead certain segments of the building only are heated and cooled. For example, for residential buildings with built up area of 100-150m² only two bedrooms (15m²x2) & living room (20m²) need to be considered for heating and cooling. Thereby only 30-50% of the built up space will be taken up for air conditioning (heating and cooling). This will minimize the cooling load to 3-4 TR (electrical energy: 53-70 kWh/day) and heating load to 3.5-5 kW (thermal energy: 42-60 kWh/day). The design of the energy storage system is presented in the forgoing sections.

Ice Cooling Thermal Storage Systems (CTES)

Integration of ice based energy storage systems into air conditioning plants were under experimentation or over twenty five years but only very recently good technological success has been achieved on the hardware front even for small room ACs. The advantages of integration of conventional AC units

with cooling thermal energy storage (CTES) are reduced power (30-40%), reduced energy consumption (20-40%) and more effective cooling rates. This is especially critical in solar photovoltaic (SPV) powered plants where the plant capacity determines the maximum power and energy generation. AC with CTES referred to as AC-CTES is a means of balancing the mismatch between the load curve and the solar generation curve.

AC-CTES systems can be configured as follows:

- Direct chiller operation & ice build operation separately
- Ice build and ice melt operation only
 - External ice build & melt system
 - Internal ice build & melt system.

In an external ice build and melt system the chilled water (plus antifreeze liquid) is part of the melt system and is exchanged between (a) chiller and the ice storage system for ice build process and (b) the ice storage system and a heat exchanger for ice melt process. A secondary fluid is used to transfer the cooling effect from the heat exchanger into the air handling unit (AHU).

In the internal ice build system the chilled water (plus antifreeze liquid) is circulated between

- The chiller and ice storage system during ice build process and
- Ice storage system and the AHU during the ice melt system.

Both systems have advantage and disadvantages and overall system can built any one concept. Figure 1-3 give the give schematics of AC-CTES system with external & internal ice build systems.

SPV power is available as a parabolic output and only for 12 hours in a day. For providing electrical power in the non-sunshine period, electrical energy storage is required in the form of battery banks. The energy efficiency of electrical energy storage is 80% which calls for

efficiency of 80%, alternative options are being explored such as thermal storage [cold thermal (CTES) and hot thermal storage (HTES)], storage in car batteries (plug in hybrid vehicles), compressed air and hydrogen storage. Thermal storage is quite feasible in Indian conditions with low cost and adaptability with Indian households. Thermal energy storage saves expensive investment in battery bank storage systems and achieves the same results for room heating and cooling applications.

The basic features of a thermal energy storage system are,

Overall charge discharge efficiency: This is of the order of 70-90% depending on the time of storage as the self discharge decreases the overall efficiency as time proceeds.

$$\eta_{ov} = \frac{Q_0}{Q_1}$$

Self discharge rate: This is the rate of slow discharge of energy from the system due to non adiabatic conditions of the system. The self discharge rate can be given as a percentage per hour or drop in temperature in °C.

Fig. 1: View of a AC-CTES System

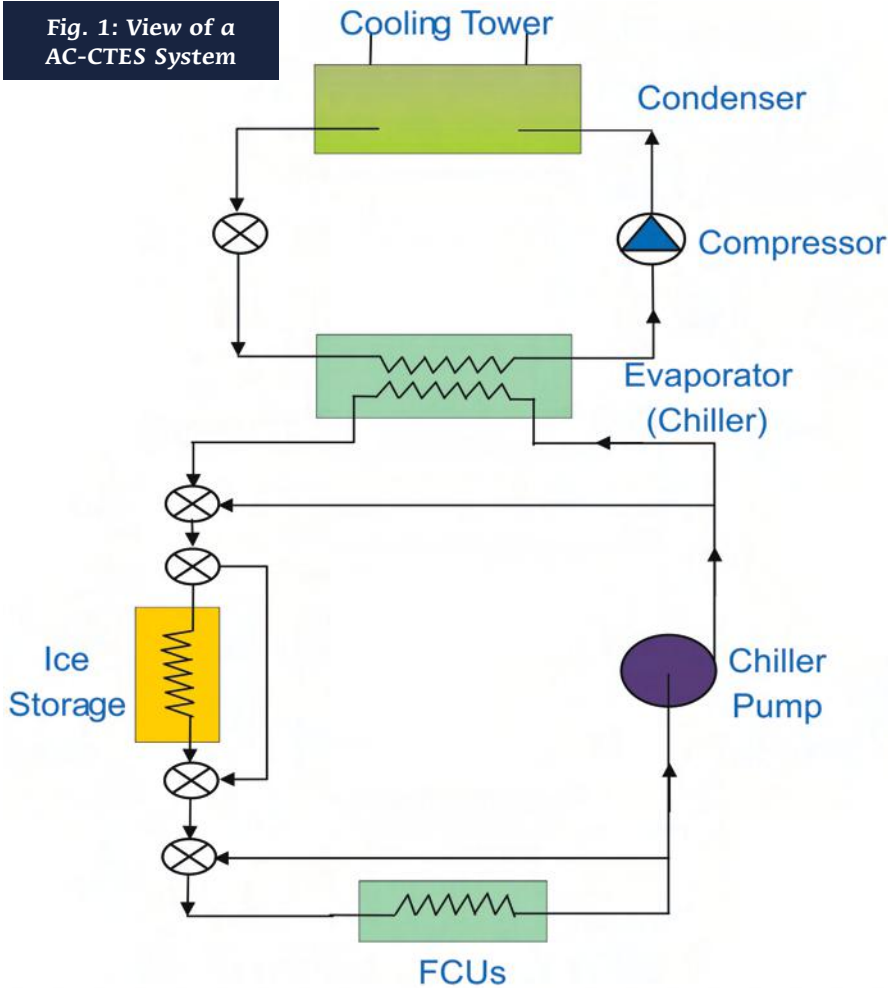
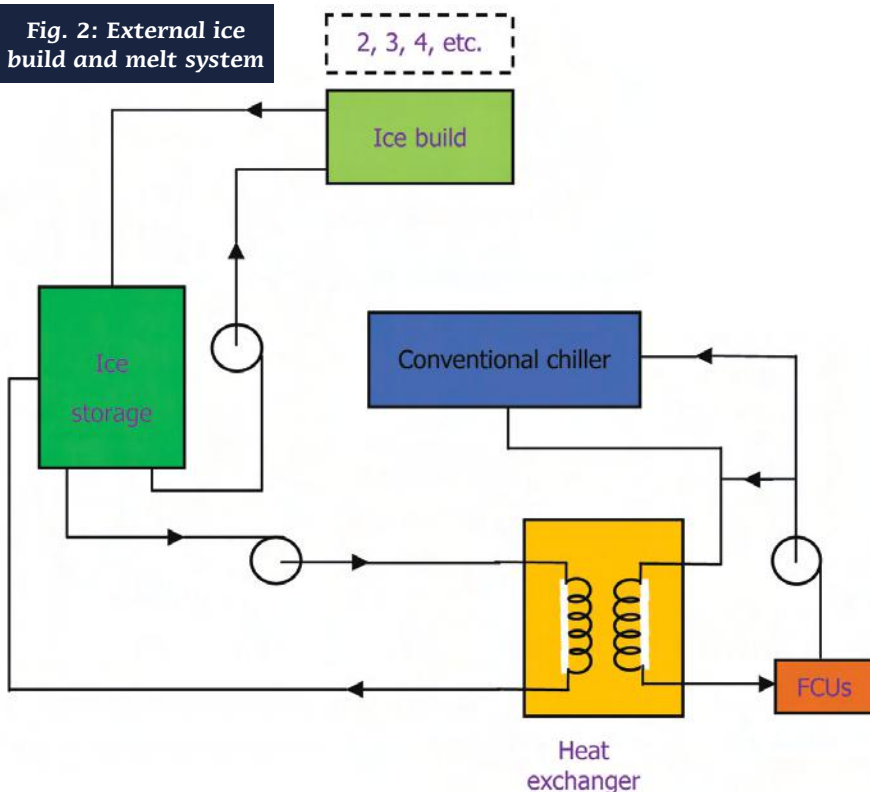


Fig. 2: External ice build and melt system



20% additional generation to meet the load. If the AC-CTES system is available, the storage of electrical energy in battery banks is totally avoided. Further during the sunshine period, the excess energy can be used for the ice freeze process. During the non-sunshine period the ice melt process will provide the cooling effect. With AC-CTES systems, the chilling (cooling effect generation) & the cooling effect utilization are de-coupled. As a result only those equipment associated with chilling are used during the ice freeze process and equipment with AHU operation will be used in the ice melt process. Thus the total power at any time of operation is much lower than the simultaneous chilling and AHU operation of conventional ACs.

The working fluid for transferring the cooling effect is a mixture of water and antifreeze agent (viz. ethylene glycol or propylene glycol) in mass fraction of 75%/25%. Methylene glycol has a specific heat of 3.77 kJ/kg°C (water: 3.77 kJ/kg°C) and viscosity of 3.2 mPas (water: 1.5 mPas).

Ice is formed and stored in a static heat exchanger vessel called as Ice storage tank which are characterized by their freeze rate (kW) and melt rate (kW). Under 100% capacity the ice storage contains 65% ice and 35% liquid. The storage efficiency is nearly 95%. The cold thermal loss is 1-5%/day. The thermal capacity of ice storage systems are 1.8-2.4 kW/m³°C. These can operated under unlimited charge-discharge thermal and deterioration of the working fluid is not an issue. In the external ice form and melt system the ice forming liquid itself (chilled water with glycol) is circulated into a heat exchanger for transferring the cooling effect and from these it is indirectly transferred to the AHU. The circulating fluid carrying up to 15% ice does not decrease the convective heat transfer coefficient. Mixtures in excess of 15% ice retard the heat transfer coefficient with any benefit in temperature difference. In the internal ice form and melt system the chilled water with glycol is circulated in the heat exchanger tubes of the ice storage tank and the ice forming mixture is always inside the tank and is not circulated.

The power plant for the ice forming

enhance comfort and energy efficiency



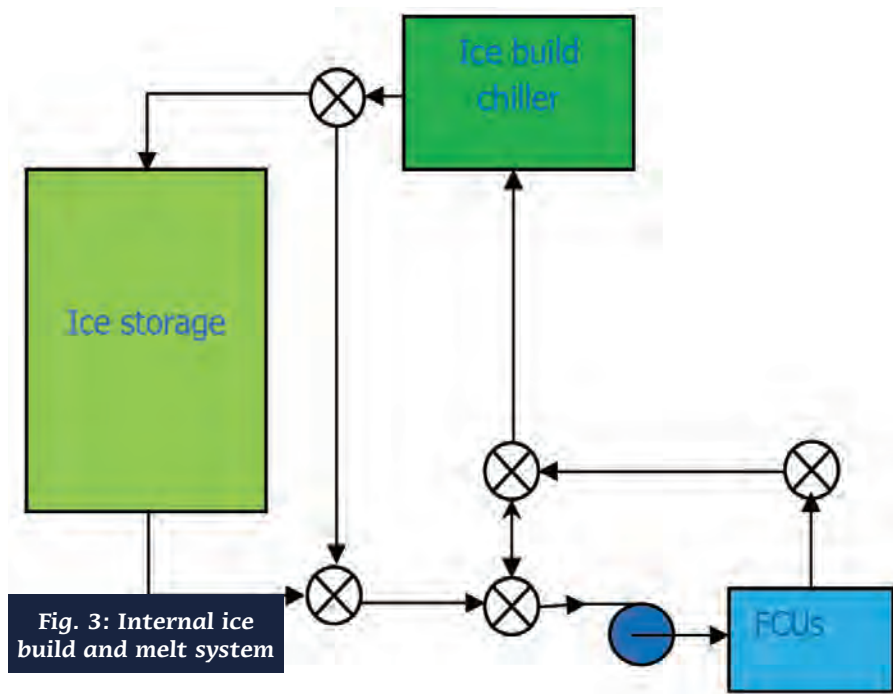
Honeywell's new Kombi 8 Series pressure independent integrated balancing control valves leverage the most innovative design and cutting edge technology, to provide comfort and convenience to customers.

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enables HVAC systems attain the highest standards of energy efficiency and cost savings. Ideal for both new installations as well as retrofits.

Their robust construction, easy-to-install design and long life make them truly next generation valves.

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SI No	Particulars	Units	Min Value	Max Value
1	Cooling load in room	TR/m ²	0.06	0.08
2	SEC (ice freeze)	kW/TR	1.15	1.15
3	SEC (ice melt)	kW/TR	0.69	0.69
4	Gross electrical load in room (ice freeze)	W/m ²	69	92
5	Gross electrical load in room (ice melt)	W/m ²	41	55
6	Average building space	m ²	100	150
7	Average bed room space	m ²	15	15
8	Two bed room	m ²	30	30
9	Living room	m ²	20	20
10	Total cooling space	m ²	50	50
11	Cooling space in building % of living space heated	%	50	33.3
12	Total building cooling load	TR	3	4
13	Total electrical load (ice freeze)	kW	3.45	4.6
14	Total electrical load (ice melt)	kW	2.07	2.76
15	Total time period of cooling (ice freeze)	h	8	8
16	Total time period of cooling (ice melt)	h	12	12
17	Total time period of cooling	h	20	20
18	Operating time	h	0800 to 0400	0800 to 0400
19	Energy Required (ice freeze)	kWh	28	37
20	Energy Required (ice melt)	kWh	25	33
21	Solar energy radiation in summer season	kWh/m ² /day	7.7	7.7
22	Efficiency of SPV system	%	14	14
23	Solar electrical energy collected in summer season	kWh/m ² /day	1.078	1.078
24	Electrical loss	%	10	10
25	Electrical energy in load end	kWh/m ² /day	0.97	0.97
26	Total electrical energy requirement	kWh/day	52.44	69.92
27	Area of solar photovoltaic panels	m ²	54	72
28	Peak solar PV capacity	m ² /kW	6.54	6.54
29	Peak solar PV capacity	kW	8.260	11.013
30	Rounded off peak capacity	kW	6	9

Table 1: Sizing of a SPV based system using internal ice melt system for

is the ice making chiller- a centrifugal chiller which is slightly different from the conventional chiller in that it has two different exit water set points. The controls are set such that the entering chilled water drops to below exit set point & operates at the maximum capacity in ice making mode. Conventional chillers respond to cooling load changes through capacity control.

Basically, with the use of AC-CTES the maximum power is reduced because of de-coupling chilling and AHU operation. In the operation of AC-CTES with SPV the power input is reduced and also the energy consumption is lower as compared to conventional AC operation. In grid power operation, the non-peak period can be used for ice free processes. The specific power is reduced from 1.84 kW/TR for a conventional system to 1.15 kW/TR during the ice freeze phase and 0.69 kW/TR during the ice melt phase.

Table 1 gives the sizing of a solar photovoltaic (SPV) based cooling system using internal ice storage. Air conditioning is generally applicable in the summer months only. In the rainy season and winter air conditioning is not normally used. This reduces the annual energy usage of the air conditioners.

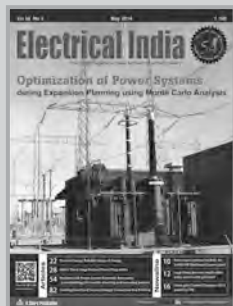
The optimal cooling load is 3-4 TR the optimal energy consumption and the energy consumption is in the range of 53-70 kWh/day for ice melt system.

Solar thermal energy storage

The thermal energy storage utilizes the solar water heaters in their usual form. The energy is stored in the hot water tank itself which are connected to the room heaters through an active circulation (SPV driven pump) hydronic system.

Figure 4 and 5 give the solar heat source and the room heating systems. Plate fin and tube heat exchangers (popularly called as radiators) are useful for room heating applications. Table 2 gives the design aspects of the room heating system. Room heating is generally applicable in the winter months only. Table 3 gives the thermal dispersion from HTES systems.

The systems in Tables are ideally suited for Indian households and the net



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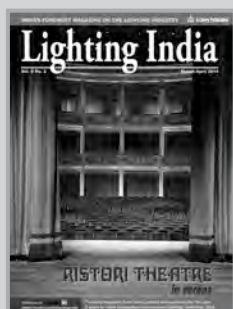
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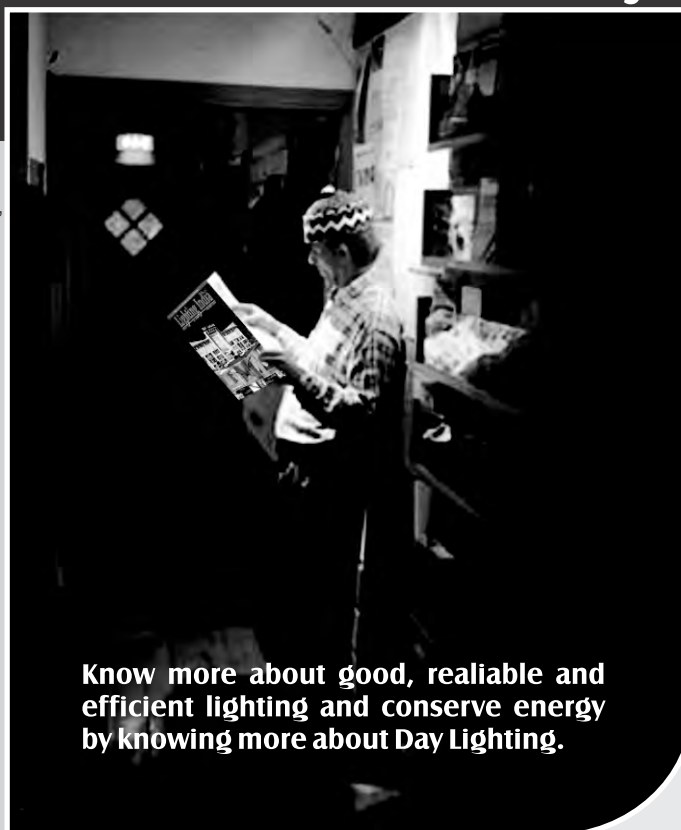
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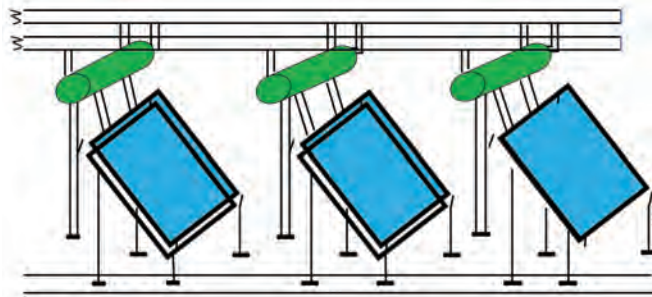


Fig. 4: View of the heat generating source in solar water heaters

SI No	Particulars	Units	Min Value	Max Value
1	Heat load in room	W/m ²	90	120
2	Lighting load	W/m ²	10	10
3	Human occupancy and miscellaneous equipment	W/m ²	10	10
4	Net heat load in the room	W/m ²	70	100
5	Average building space	m ²	100	150
6	Average bed room space	m ²	15	15
7	Two bed room	m ²	30	30
8	Living room	m ²	20	20
9	Total heating space	m ²	50	50
10	Heating space in building % of living space heated	%	50	33.3
11	Total heat load	kW	3.5	5
12	Time period of heating	h	12	12
13	Operating time	h	2000 to 0800	2000 to 0800
14	Energy Required	kWh	42	60
15	Solar energy radiation in winter season	kWh/m ² /day	7.7	7.7
16	Solar thermal energy collected in winter season	kWh/m ² /day	6.36	6.36
17	Solar tank loss	%	10	10
18	Solar tank loss	kWh/m ² /day	0.64	0.64
19	Piping loss	%	10	10
20	Piping loss	kWh/m ² /day	0.64	0.64
21	Useful solar thermal energy after tank loss and piping loss	kWh/m ² /day	5.08	5.08
22	Area of collector	m ²	8.26	11.80
23	Rounded of area	m ²	10	12

Table 2: Design of room heating system

fossil energy consumption is zero for both air conditioning as well as thermal heaters. While electric heating costs as much as Rs 5-6/kWh the heating from solar thermal systems would pay back within 6 years and thereby the energy costs are free.

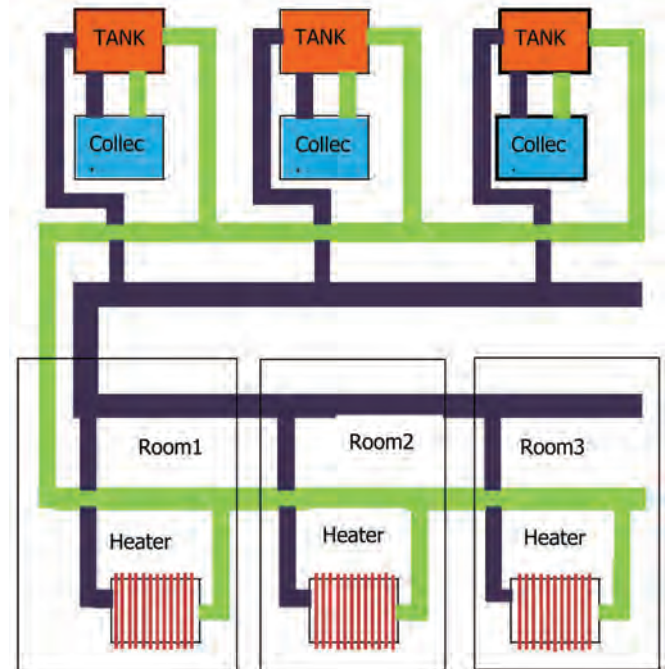


Fig. 5: The hot water circuit circulating the water from the

SI No	Particulars	Units	Best	Average	Worst
01	Day time temperature drop in storage tank	°C	4-5	6-7	8-10
02	Overnight temperature drop in storage tank	°C	2-3	4-5	7-10
03	Day time heat loss	°C	8-10	12-14	16-20
04	Overnight heat loss	°C	4-6	8-10	14-20

Table 3: Temperature drop and heat loss in storage tanks of solar water heater tanks connected to flat plate or evacuated tube collectors

Conclusion

The following are the conclusions from the study.

A number of commercial window and split AC-CTES (cold thermal energy storage) products have come into the market and the technology is matured to a reliability level for wide scale usage. The technology is applicable to both large ACs as well as window and split ACs.

AC-CTES is applicable when the source-load mismatch is present as it can get charged when there is electric power and discharge cooling effect when there is no electrical power. AC-CTES systems show definite reduction in energy consumption and maximum power and operating power by 20-40%. For SPV operation AC-CTES systems are essential for minimizing the capital costs of the source as the peak SPV array capacity is reduced to around 63% of the capacity without ice storage.

Solar water heater based hot thermal energy storage (HTES) are useful in winter for room heating. The conventional evacuated tube solar water heaters can be used for room heating by connecting them to plate and tube heat exchangers through an active circulation hydronic system. ■

Frascold has 120 compressors in basket with ASERCOM Certified performances



S S Swamy, Country Head-Sales
Frascold India Private Limited,
in an exclusive interview with **Cooling India**
says, in India Frascold India Private Ltd (FIPL)
has chalked out three major revenue pillars.

What are your views on the scope and status of cold chain industry in India?

Cold Chain Industry in Indian Market is poised to growth due to the Socio Economic factors this 12 Five year Plan, which are-

- Farming community are getting better price which encouraged their bargaining power.
- Availability of fruits and vegetables for large period of time - like Apple (for 9 months), Carrot & Lemon (for 5 to 6 months) & Onion (throughout the year)
- Diversified and improved quality of processed potato and seed potato.
- Wide variety of fruits and vegetables imported through cold chain.
- Enhancement of processing industry raw material

and life cycle costs.

- There is Big Gap between the requirement of Cold Storages in India (611.30 Lakh MT) and Present Cold Storage Capacity in India (242.98 Lakh MT). This big gap (368.22 Lakh MT) has forced the Government to earmark the Budget close to 7000 Crores (40 Lakhs MT) in 12 th Five year Plan.
- The Industry experts believe that 7000 Crores in 12th Five Year Plan will bound to shoot up to 18000 Crores (as Conservative Estimates) as per working group report. Further the sectors like Meat, Fish, Poultry, Dairy Products confectionery and pharmaceutical sectors might double the investments to approximately 40000 Crores in 12th Five Year Plan.

**Where is Frascold compressor facility located?
How many compressors and Condensing Units are produced in your facilities?**

Frascold SPA has World class Compressor manufacturing Facility in Milano, Italy, with state of art compressor calorimeter testing laboratory which can house single compressor testing with cooling capacity up to 750kw (one of the world's largest). The number of Employees working in this facility are around 180 persons with Production capacity of 1500 compressors / week.

Frascold India Private Ltd (FIPL) has a facility for Value added products and we have set up an Assembly plant in Ahmedabad, Gujarat, which has a capacity to assemble 7000 Condensing Units per annum. This facility is to sell Value Added Product not only for the Indian Market but also to Export these Value Added Products to countries like Sri Lanka, Bangladesh, Bhutan, Myanmar and Nepal.

Could you share the product range focused in Indian market? Which sector such has much more demand for your kind of products?

In India, Frascold India Private Ltd (FIPL) has chalked out three major revenue pillars.

One is the Semi Hermetic compressor sales to OEMs, Installers and End users. We import these Compressors from our Parent company (Frascold SPA -Italy) and Stock these Compressors at our facility in India. By this, We are able to give Ex-Stock delivery to the Indian customers who were earlier waiting for 8 to 10 weeks for similar compressors.

Second pillar is the Spare Parts and Service. We have stock of all Spare Parts for our Compressor Models and built the World Class Service Centre for Servicing our Frascold Semi Hermetic Compressors.

Third Pillar is to Enhance the reliability of Compressors at Customer level, we have built the Assembly Line for 'Value Added Products'. We have huge range of Value added products.

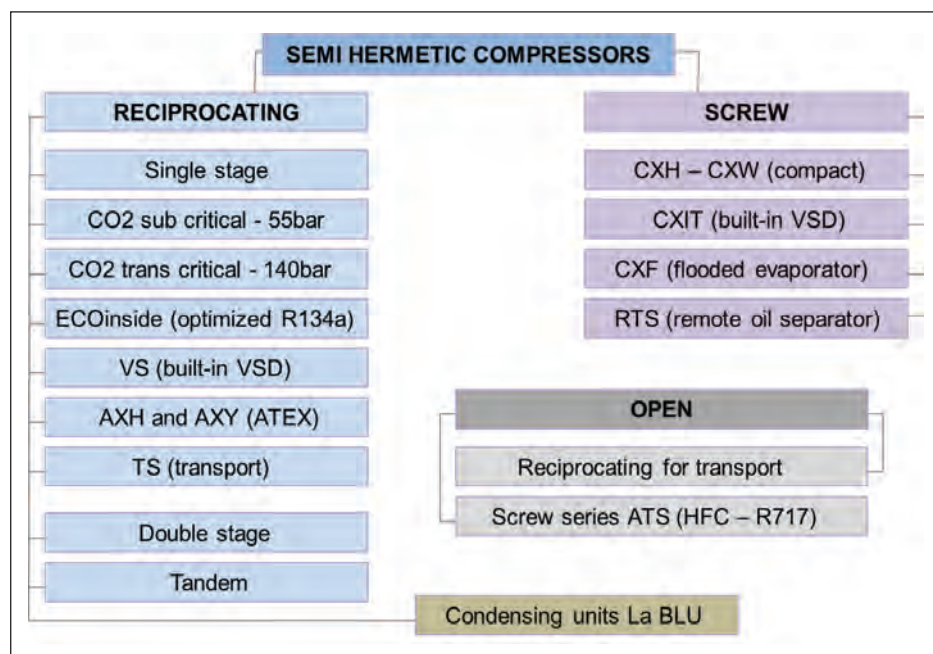
- Single Stage Air Cooled Semi Hermetic Condensing Units (0.5hp to 30 hp)
- Two Stage Air Cooled Semi Hermetic Condensing Units with Sub cooler (5hp to 30 hp)
- Single Stage Water Cooled Semi Hermetic Condensing Units (0.5hp to 80 hp)
- Two Stage Water Semi Hermetic Condensing Units with Sub cooler (5hp to 30 hp)
- Refrigeration Racks with Reciprocating compressors- Single Stage and Two Stage compressors.
- Refrigeration Racks with Screw Compressors.

The sectors like Meat, Fish, Poultry, Dairy Products, Confectionery and Pharmaceuticals has more demand for our Products.

What is the market share of your products as against products of the other companies in competition with each other domestically & globally?

At this point of time, it is quiet sensitive to speak about our Market Share in India as well as Globally. But in European Union, we are No. 2 Semi Hermetic Compressor manufacturer having a production capacity of 1500 compressors/ week.

Frascold India Pvt Ltd (FIPL) is one of the Youngest Subsidiary of Frascold SPA one of the Largest Semi Hermetic Compressor manufacturers in the World. During the First two year of operations in India, Frascold has gained substantial Market share in this Cold Chain Industry by supplying Semi Hermetic Compressors and Condensing Units to Well known OEMs in the Refrigeration Industry. Frascold India has grown more than 50% in the Indian Market compared to last year.



Whereas in India, we are selling more than 1500 compressors in last two years.

Could you share information about Quality manufacturing? How do you associate with regard to products being manufactured in accordance with Low Voltage Directive CE 93/68?

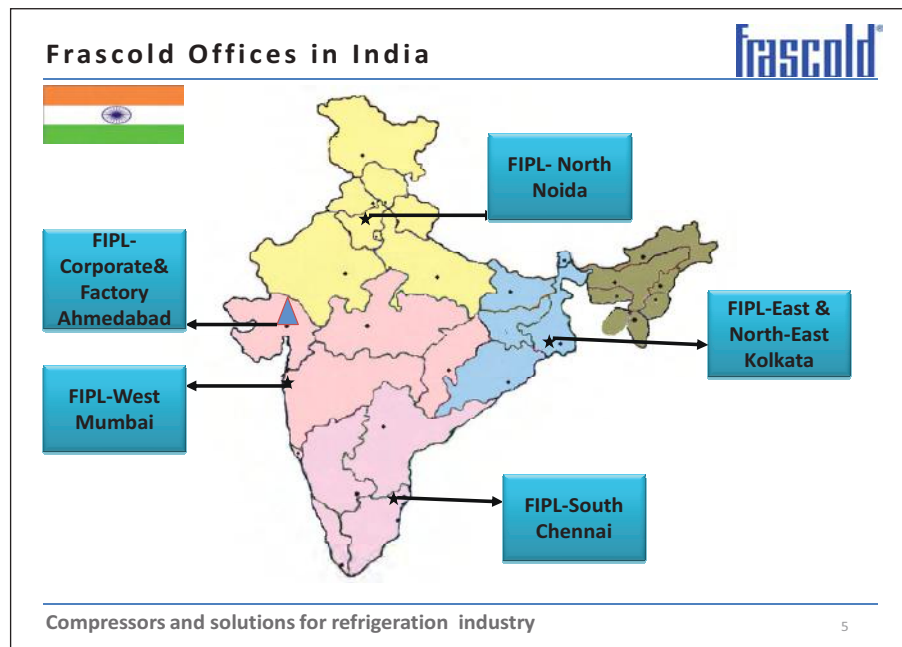
Frascold adopts high quality standards in manufacturing Semi Hermetic compressors which is achieved through the Extensive use of Best Practices in Processes and Systems and Extensive use of Best materials with strict quality tests. This quality manufacturing has made Frascold Products more reliable and more Efficient. As of today, Frascold has 120 compressors in the basket which has ASERCOM Certified performances, one of the highest number of performance certifications compared to any other Semi Hermetic Compressor manufacturers in the Industry (ASERCOM: Association of European Refrigeration compressor manufacturers).

The Low Voltage Directive is the oldest of the new Approach Directives and deals with the safety of electrical apparatus. It applies to all apparatus running on (or generating) an electrical supply in the range 50 - 1000 volts AC or between 75 and 1500 volts DC.

There are a small number of exclusions from this directive, which are generally products covered by more specific directives. Directive has both administrative & protective requirements. Administrative requirements include CE marking the product, completing a Declaration of Conformity and compiling a Technical File. Protection requirements are generally satisfied by assessing the products compliance to various standards. Compliance to the low voltage directive can be self-certified without the need for a notified body.

Could you share your views on participation in the exhibitions? Does the company earn future business benefits by responses and display of products?

Frascold India Pvt Ltd (FIPL) is start-up company with only two years in India. Although we are 78 years old company and Number 2 Semi Hermetic compressor manufacturer in



Europe. Our Brand awareness and our visibility in the Indian market needs to be increased. So participating in the exhibitions gives us more visibility and brand awareness.

What was your experience during ACREX India, Delhi as well as Sea Food Show 2014 at Chennai?

Yes. Participating in Exhibitions like Sea Food show 2014 and ACREX 2014 at Delhi has given us 'Visibility and Brand Awareness' along with inroads to some of the user levels in those markets. Once the End-user is aware of our Product and tries our Product, we are confident that our product performance and reliability "SPEAKS". After some time, the same end user, will come back to us with a repeat order.

Frascold India has build world class Service Centre with Ex stock Spare availability which is the key for Semi Hermetic Compressors. Could you elaborate on this aspect?

The Beauty of Semi Hermetic compressors is, they can be easily opened and serviced. Suppose if in case, if the parts needs to be replaced after some time due to wear and tear of the compressor, it can be done at our Service centre in Ahmedabad. By this process, we are enhancing the life of the compressor which in turn reduces the additional capital investment by the end user on his refrigeration needs.

Which geographical region/city in India has much demand of your products? And do you foresee tremendous growth of compressor market by end 2014?

Frascold India has set up Offices in Mumbai, Chennai, Delhi and Kolkata with Corporate office and facility (for Value Added Products) in Ahmedabad. The time of office set up is different in Different Regions. If we look at the trend, we are penetrating India market equally from all regions. Our Chennai office is headed by Venkata Narasimham who takes care of Southern region along with Sri Lanka. Our Delhi office is located in Noida and is headed by Shiv Kumar Gupta who takes care of Northern Market along with Nepal. Similarly, our Kolkata office is headed by Debajyoti Ghosh who takes care of East, North-East along with Bangladesh market.

Yes. If you see the trend of enquiries which are existing with us, we foresee huge demand not only for compressors but for value added products which are needed by cold chain sector.

What is your vision for the company in the next two years and in next Five Years?

In next two years, Frascold India Pvt Ltd wants to be Clear Number 2 player in Semi Hermetic compressor market with substantial market share. In next five years, we would like to be No. 1 player in Semi Hermetic Compressors in Indian market. ■

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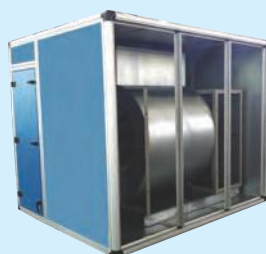
Mixed Flow



Cabinet fan



Box Fan



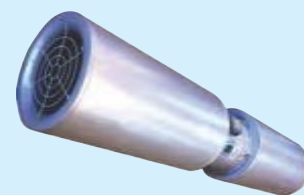
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Unspoken Truth of Indian Cold Chain



“I pick up a top-notch, branded frozen product at a national retail player’s outlet and it crushed into paste when it crashed onto the floor. Yes, we are going to unveil our minds to the truth of the so called Farm to Form / Plate” cold chain in India.

This incident brought a lot of reflection on our nation’s retail skills, cold chain skills and more importantly what sort of food safety standards do we actually depend on assuming that we are consuming safe food.

We are frequently watching cold chain enthusiasts in India ramping up the number of events, conferences, seminars, trade shows etc about cold chain. In such events there would typically be an extensive discussion about how much the country lacks in terms of infrastructure yet boasting about our food output and bursting

consumption growth over the last decade. Ceremony lamps are lit by popular personalities, a long day session on pros & cons about the industry, a few photographs, press releases and period. While such efforts and initiatives are to be much appreciated, how many of such events have actually put consumers in place? How many of such events have actually brought a change or improvement in the Indian Cold Chain? How many new technologies have been brought to light that has contributed to national savings on wastage of perishables due to lack of cold chain? We are talking

Divya Amrith, heading Marketing & Strategy for Transfreez Mobile Refrigeration, indigenous Cold-plate Reefer manufacturer has more than twelve years of experience in Refrigeration & Logistics Industry. A mechanical Engineer who possesses an MBA from SP Jain and PGD in International Business.



about bringing a revolutionary change, in other words look for a desperate need to save the amount of wastage that could feed the Brazilian population for an entire year.

How many food manufacturers in India (be it a national or multinational brand), particularly chilled/ frozen/ perishable food actually dedicate x% of sales on improving holistic Cold Chain? In other words, spend to maintain the quality of food right from the farm/factory to the consumer end. We can only seek hope with a few good food manufacturers who care about cold chain while everyone else is after EBITDA and profits.

Cold Chain

It sounds very simple, doesn't it! But is it, really! Cold Storages, Refrigerated trucks, freezers & coolers which are the heart and brain of cold chain would be useless without a healthy body to keep alive. While food manufacturer's work a lot on beautifying the body externally, in other words, the product with a variety of flavours, textures, applications carefully targeting various market segments etc. What about nurturing

and protecting the product that enables freshness, quality and longer shelf life? Without an integrated Cold Chain in place, i.e. from farm to plate, nothing much can be done than said.

Some interesting facts

Fact 1: Only 1% of Food & grocery purchases are through modern retail.

Fact 2: More than half of Indian consumer spend is dedicated to Food & grocery.

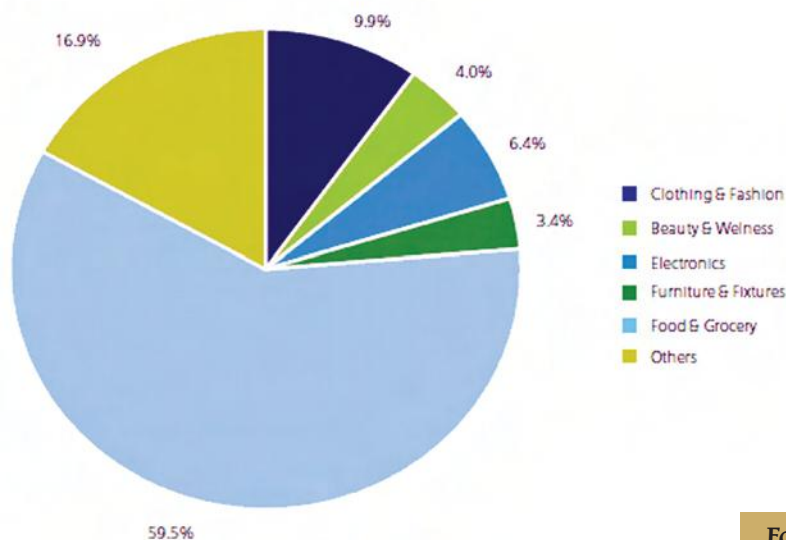
Share of Modern & Traditional retail



Source: India retail report 2009

Fact 1

India Spends On



Fact 2

S.No	Requirement	Ice Cream/ frozen Dessert/ Milk Lolly/ Ice Candy/Dried Ice Cream Mix	Cheese/ Processed	Evaporated Milk	Sweetned Condensed Milk	Butter	Butter Oil/ Butter Fat and Ghee	Yoghurt/ Dahi
1.	Total Plate Count	Not more than 2,50,000/gm	Not more than 50,000/gm	Not more than 500/gm	Not more than 500/gm	Not more than 500/gm	Not more than 500/gm	Not more than 10,00,000/gm
2.	Coliform Count	Not more than 10/gm	Absent in 0.1 gm	Absent in 0.1 gm	Absent in 0.1 gm	Not more than 5/gm	Absent in 0.1 gm	Not more than 10/gm
3.	E.Coli	Absent in 1 gm	Absent in 1 gm	Absent in 1 gm	Absent in 1 gm	Absent in 1 gm	Absent in 1 gm	Absent in 1.0 gm
4.	Salmonella	Absent in 25 gm.	Absent in 25 gm	Absent in 25 gm.	Absent in 25 gm.	Absent in 25 gm.	Absent in 25 gm.	Absent in 25 gm.
5.	Shigella	Absent in 25 gm.	Absent in 25 gm	Absent in 25 gm.	Absent in 25 gm.	Absent in 25 gm.	Absent in 25 gm.	Absent in 25 gm.
6.	Staphylococcus aureus	Absent in 1 gm	Absent in 1 gm	Not more than 100/gm	Not more than 100/gm	Absent in 1 gm	Absent in 1 gm	Not more than 100/gm
7.	Yeast and Mould Count	Absent in 1 gm	Absent in 1 gm	Absent in 1 gm	Not more than 10/gm	Not more than 20/gm	Absent in 1 gm	Not more than 100/gm
8.	Anaerobic Spore Count	Absent in 1 gm	Absent in 1 gm	Not more than 5/gm	Absent in 1 gm	Absent in 1 gm	Absent in 1 gm	Absent in 1 gm
9.	Listeria monocytogenes	Absent in 1 gm	Cheese aother than hard cheese: Absent in 25 gm	Absent in 1 gm	Absent in 1 gm	Absent in 1 gm	Absent in 1 gm	Absent in 1 gm

Product	(2-4 °C)	Freezer (-18 °C)
Pasteurized Fresh Whole or Skimmed Milk	1 to 5 days beyond "sell-by" date	3 months. Freezing may result in change in texture. Thaw in refrigerator.
Butter	2 weeks	Butter made from pasteurized cream: 6 to 9 months.
Ice Cream	-	2-3 weeks (Opened) 2 months (Unopened)
Yogurt	7-10 days	Do not freeze.
Cultured Buttermilk	2 weeks	Do not freeze.
Homogenized, Reconstituted Dry Non-fat and Skimmed Milk	1 week	Do not freeze.
Sweet and Regular Cream	1 to 5 days beyond "sell-by" date	Do not freeze. (Change of texture, body appearance. Separation of fat emulsion.)

Well, the point to wonder now is that: Coming back to our first point of discussion, if a modern retailer cannot take the necessary initiative to provide optimal cold chain for perishables such as dairy, dairy products, ice cream, frozen food, pastry, meat & poultry, fruits, vegetables etc, how much would a Kirana store or our neighbourhood retailer really care about?

Let us take a look at the Food safety Standards set for Dairy Products in

India - the microbial requirement of food products.

This may look Greek and Latin to a consumer, but the point to note is that there definitely standards set in our country by FSSAI for health safety, but how much of it is being practised? The real question is how safe is the food we consume?

How many of us know that some pathogens that can survive in food even at low (negative) temperature

include *Salmonella* spp., *Listeria monocytogenes*, *Campylobacter* spp. and *Yersinia* spp. We are even talking about ice cream and frozen food.

Cold Chain in milk

Refrigeration is the single most important factor in maintaining the safety of milk. By law, Grade A milk must be maintained at a temperature of 7°C or below. Bacteria in milk will grow minimally below 7°C. However, temperatures well below 4°C are

necessary to protect the milk's quality. It is critical that these temperatures be maintained through warehousing, distribution, delivery and storage. The cooler refrigerated milk is kept, the longer it lasts and the safer it is. As the product is allowed to warm, the bacteria grow more rapidly.

Infants, pregnant women, the elderly and the chronically ill (such as those undergoing cancer treatments and individuals with AIDS, diabetes or kidney disease) are most at risk from serious illness due to consuming any unsafe food.

We are not really certain if the milk available in the market is Grade A at par with global food standards or not, but it is definitely evident that the Milk we buy from the retail store has not been transported nor stored at point of sale at 4°C. How so! Most of the Cold Chain experts know that milk dispatched from the factories is transported in Insulated containers and not refrigerated ones.

Even worse, when it comes to retail, last mile delivery, we can only see closed body containers – not even insulated ones. The reason? Well, it is not all that hot in the morning when milk is distributed to retail stores. We cannot blame the distributors who are mere transporters who remain as unaware as the consumers when it comes to cold chain.

Do consumers know, how much would such lack of cold chain imply in terms of food safety!

According to Food safety standards Authority of India (FSSAI) the milk & milk products order (1992) makes it very clear that Milk Manufacturers "shall endeavour to maintain a cold chain from the place of milk procurement up to the final stage of sale of the milk or milk product to the end consumer and every holder of the registration certificate shall observe such procedures and practices that may be approved by the Advisory Board for clean milk production, collection, transportation and distribution of milk and milk product"

Optimal Storage Temperature for Dairy & Ice cream Product – to which every consumer can be made conscious.

We are not only focusing on critical primary food such as Dairy. The plight is pretty much the same for fruits & vegetables, pastry, seafood, meat & poultry and many more.

The only hope to enabling an effective food safety bill is when the government and food manufacturers work hand in hand to deliver fresh, hygienic and safe food through efficient cold chain – that would start right from farm to fork. Until then, perhaps every Indian consumer would continue to compromise by throwing away the bad food and opening a new pouch/pack instead of demanding the retailer to compensate for the bad quality and health safety breach. ■



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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 Δt ,
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,
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Amin Gauravkumar, Sales Director,
Kaal Flex Pvt Ltd,
(KAALFLEX - Flexible Air Duct),
in an exclusive interview with **Cooling India**
says, we follow the UL standard, UL-181.

What is your perception about HVAC/R industry in India?

It is growing at a very high speed; we are way behind with the world in this industry.

What is the scope of flexible duct product market domestically and globally?

Domestically the growth is phenomenal. In 2008 there were very few manufacturers of flexible duct in India and after 6 yrs today in 2014 there are over 12 manufacturers and few other importer of flexible duct. Believe the growth rate is 2% to 3% in USA.

Could you detail about product range of Kaalflex?

We can manufacture with Insulation sizes - from 4" to 12", with R value 4.2 & 6. We do Non-Insulated Flexible Duct from 4" to 18".

What are the advantages of Kaalflex ducts? Could you describe the features of Insulated as well as non-

insulated Flexible Air duct?

- Reduction in cost & time of installation – (fast & economical installation)
- Meets UL 181 & NFPA 90A-90B Fire Codes
- Superior Insulation & Thermal Performance
- Unique moisture resistant core construction will not unravel when cut, eliminates waste of materials
- Easily shaped to fit over all inlets and quickly connects to fast fittings
- Tough Reinforced Metallized Polyester Jacket - Tear & Puncture Resistant/Low Maintenance
- Light Weight Compact Packaging - Reduces Warehousing & Jobsite Handling Costs.

Could you share details about the manufacturing facilities and quality standards being adhered to as well as production turnover?

We follow the UL standard, UL-181. Continuous lab tests performed on the product from each machine, every two hours. Over 39,000 Sq ft of

manufacturing facility, with 4,000 Sq ft. of office, with Revenues around 4 Crore.

Which of the product range is best suited for Indian market and what is its sales demand?

The best suited market for our product is R-6. But most consumers look for cheapest and thus R 4.2 is mainly used in current market.

Kaal Flex is a UL approved vendor and a supplier to "Thermaflex" in USA. Could you share details about technology collaboration?

We do manufacture as per UL guidance under "Thermaflex" USA.

What cutting edge do you have over other competitive products in the same line of manufacturing ducts?

It is our high volume capacity to produce as compared to others. We being 100% EOU & export major of our production to USA market we have very high quality control & are very conscious on every detail – to keep up with exports markets.

What is your vision in the next two years?

Even due to slow down in construction industry; I believe since we are way behind with the world in HVAC/R, we will have a steady growth. ■

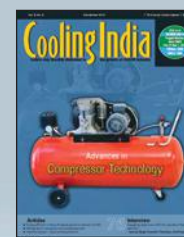
KaalFlex Pvt Ltd, is a "Flexible Duct Manufacturing company" with a modern and state of the art plant located in Vadodara, Gujarat. In India, KaalFlex is exclusively the only manufacturer with the technology collaboration with U.S. based Flexible Technologies and brand rights to market "Thermaflex".

Kaalflex is furthermore a UL approved vendor and a supplier to "Thermaflex" in USA. With a world recognized name of the most reliable and durable products in the residential & commercial HVAC industry and years of experience in the global market, we now intend to introduce this world class product into the expanding Indian domestic main stream market, with our most popular Insulated Flexible Air Ducts & Non Insulated Flexible Air Ducts.

Cooling India

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Brief History of Air-cooled Coal-fired Power and its Rapid Adoption in China



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Globally, the water consumption from coal-fired power plants is becoming an increasing concern. Some are arguing that, countries like India and China lack water resources for the cooling needs of their coal-fired power plants.

The arguments mostly overlook the facts that air cooling technologies, which eliminate the need for cooling water, have been successfully used in hundreds of coal-fired power plants (mostly in China) and have become a mainstream technology for power generation. In this article, I will introduce the history of air-cooled coal-fired power technology and its rapid adoption in recent years.

There are three main periods (1930s~1970, 1970s~1990s, and after 2000) in the history of air cooling technologies. The earliest development

started in Germany in the late 1930s. From the late 1930s to the 1970s, (primitive) direct air cooling was the dominant technology.

From the 1970s to mid-1990s, indirect air cooling was more popular than direct air cooling. The sizes of air-cooled power generators during this period were mostly 100~300 MW.

The recent large-scale commercialization began in the early 2000s when a new generation of direct air cooling became popular. The rapid expansion of China's coal-fired power sector and the policy mandate for air



Dr Chi-Jen Yang, research scientist at Duke University, focuses on energy technology and environmental policy. His comments are often quoted in major media, including New York Times, WSJ, USA Today, Washington Post, Al Jazeera, IEEE Spectrum, and Time Magazine.

cooling provided the demand for such technologically advanced, air-cooled condensers. Direct air-cooled, coal-fired power plants with large capacities (300~1000 MW) have since then become very common in China.

Early development of air-cooled coal-fired power technology

Although the German company GEA developed a small, 1.5 Megawatt (MW) air-cooled power generator as early as the late 1930s, the application of air-cooling in power generation remained rare until the 1960s. The first commercial air-cooling steam power generators were also relatively small, as a description of air-cooled power plants in the world demonstrates for this early time period (Table 1).

Most of the earliest systems directly cooled the exhaust steam with air. The volume of exhaust steam is rather limited and the heat-carrying capacity of air is relatively small. In order to facilitate heat transfer, a designer needed to maximize the surface area between limited amounts of steam

Location	Rating (MW)	Type of Dry Tower	Year Commissioned
Germany	1.5	Direct	1939
Luxemburg	13	Direct	1956
Rome, Italy	2x30	Direct	1957
Cologne, Germany	28	Direct	1958
Bavaria	40	Direct	1960
Dunaújváros, Hungary	16	Indirect	1961
Sindelfingen, Germany	11&15	Direct	1960-61
Rugeley, England	120	Indirect	1962
Wyodak, Wyoming, USA	3	Direct	1962
Worms, Germany	5	Direct	1962
Chile	3.6	Direct	1963
Eilenburg, Germany	5.3	Indirect	1964
Quetta, West Pakistan	7.5	Direct	1964
Ludwigshafen, Germany	38	Direct	1966
Ibbenbüren, Germany	150	Indirect	1967
Gyongyos, Hungary	2x100	Indirect	1969
Wyodak, Wyoming, USA	22	Direct	1969
Switzerland	4.3	Direct	1969
Utrillas, Spain	160	Direct	1970
Grootvlei, South Africa	200	Indirect	1971
Windhok, South Africa	3x30	Direct	1971
Wolfsburg, Germany	3x50	Direct	1961-67

Table 1: Earliest air-cooled power plants

and air, a technical challenge. Due to the limited efficiency in heat exchange, these early direct air-cooling systems could only be used for relatively small power generators (typically <100 MW). Since the late 1950s, however, several companies began to develop indirect air cooling, which uses closed-loop cooling water as the medium for heat transfer. An indirect air cooling system has two heat exchanges: first between steam and the cooling water and then between cooling water and the air. Because the volume of cooling water is much larger than the volume of exhaust steam, the designs of both heat exchangers are easier to construct than for a direct air-cooling system.

Dr. László Heller presented the earliest indirect air-cooling design (now known as the Heller system) in 1956. In Heller's design, exhaust steam comes directly into contact with cooling water in closed loops that are subsequently cooled by air. The direct mixing of steam and cooling water provide high efficiency heat exchange but causes some technical difficulties. The boiler/steam engine and the cooling tower are made of different materials and operate under very different temperatures and pressures. In addition, the preferred water quality parameters for preventing corrosion are quite different for steam and for cooling water. For instance, anti-scaling and anti-freezing are desirable

features for the coolant, but scale inhibitors and anti-freezing agents are often corrosive or heat sensitive in the conditions of the boiler and engine. The Heller design is typically only used in smaller (<300 MW) power plants.

In the late 1970s, a few indirect air cooling towers were built with surface condensers, which eliminated any contact between the exhaust steam and cooling water. This improved design of indirect air cooling using a surface condenser is known in China as the Hamon system, likely because China acquired this design through a technology transfer agreement with the Belgium company Hamon-Sobelco. The world's largest surface-type indirect air cooling system is found in South Africa's 680 MW Kendal Plant.

The speed of development and deployment of dry-cooling technology increased significantly beginning in the 1980s, when more large units were installed. Table 2 lists some of the major air-cooled power plants built globally from 1970 to the early 1990s. Note in particular the substantial increase in capacity compared to the earlier direct air cooling plants (Table 1).

Dry-cooled condensers are also

widely used in the United States, but mostly not for coal-fired power. According to the U.S. Energy Information Administration's EIA-860 power plant database, there are 53 power plants (with 142 generators) equipped with dry-cooled condensers in the United States. Most of them are combined-cycle gas-fired power, and only five of them are coal-fired power plants. The size of air-cooled combined-cycle gas-fired power plants in the United States is primarily in the range of 100–300 MW.

The Wyodak power plant in Wyoming had been the world largest air-cooled, coal-fired power plant for nearly a decade until it was surpassed by three South African stations built in the late 1980s. After Wyodak was commissioned in 1978, no air-cooled, coal-fired project was built in the United States for three decades, until the 116-MW Wygen III plant in Wyoming and 857-MW Comanche plant in Colorado were completed in 2010.

China's technology acquisition, development, & deployment of air cooling

China's earliest air-cooled condenser for power generation was conducted

in the Harbin Institute of Technology in the 1960s. The research project built and tested a 1.5 MW direct air-cooled power unit that was never commercialized. It took 20 more years for the first commercial scale air-cooled coal-fired power generator to be built in China in 1987, when the Shanxi Datong power station installed two 200 MW coal-fired power generators with indirect air-cooled condensers. The systems were designed by the Hungarian company EGI and used key components imported from German GEA. Subsequently, the Chinese company Harbin Air Conditioning licensed the technology from EGI and built air-cooled condensers for two 200 MW coal-fired power generators in Inner Mongolia, completed in 1993. The German GEA and Shanxi electric power corporation set up a joint venture—GEA Shanxi, which built two air-cooled condensers for the Taiyuan Second Thermal Power Plant (completed in 1994). These earliest commercial scale projects all adopted the indirect air-cooling design, in which the exhaust steam is cooled by water subsequently cooled in a dry cooling tower.

The Shanxi provincial power company originally initiated the introduction of air-cooled condensers in the 1980s. An engineer at Shanxi Electric Power Equipment Factory proposed and eventually convinced national policymakers to include air cooling technology in the key technology development program in China's 8th (1991–1995) five-year plan. Subsequently, the 9th (1996–2000) five-year plan included a program to develop key components for 600 MW-scale coal-fired power using air cooling. Although China's central government provided research grants and granted approvals for air-cooling projects, the technology acquisition and indigenisation were largely local and private-sector activities.

From 1994 to 2003, the Chinese market for air-cooled condensers for coal-fired electricity was put on hold. The hiatus may have been a result of relatively stagnant demand growth for electricity during this period. Unsatisfactory performance of these early projects and low awareness of water scarcity issues may also have

Name	Country	MW	Type	Year Commissioned
Gyongyos	Hungary	2x100 2x220	Indirect	1969-72
Razdan	USSR (Armenia)	3x220	Indirect	1970-72
Mátra (Gagarin)	Hungary	2x220	Indirect	1972
Wyodak	USA	1x360	Direct	1978
Isfahan	Iran	4x210	Indirect	1984
Schmchauven	Germany	1x300	Indirect	1985
Touss	Iran	4x150	Indirect	1987
Candiota	Brazil	2x160	Indirect	1987
Matimba	South Africa	6x665	Direct	1987
Datong	China	2x200	Indirect	1987
Kendal	South Africa	6x680	Indirect	1988
Shahr	Iran	1x260	Direct	1989
Majuba	South Africa	3x657	Direct	1991
Uran	India	1x240	Direct	1991
Shahid Rajai	Iran	8x250	Indirect	1992
Fengzhen	China	4x200	Indirect	1993
Teshrin	Syria	2x200	Indirect	1993

Table 2: Large air-cooled power projects from 1970s to 1990s (4)

Location/Name	Province	Rating (MW)	Year	Type	Equipment Provider
Datong/Second	Shanxi	2x200	1987-88	Indirect	GEA
Ulanqab/Fezheng	Inner Mongolia	4x200	1993-95	Indirect	Harbin Air Conditioning license from GEA-EGI
Taiyuan/Second	Shanxi	2x200	1994	Indirect	GEA Shanxi
Datong/Pingwang	Shanxi	2x200	2003	Direct	GEA Shanxi
Taiyuan/Second	Shanxi	1x200	2003	Indirect	GEA Shanxi
Changzhi/Zhangshan	Shanxi	2x300	2004	Direct	SPX, Harbin Air Conditioning
Jinzhong/Huaneng Yushe	Shanxi	2x300	2004	Direct	SPX
Shuozhou/Pingshuo Gangue	Shanxi	2x50	2004	Direct	SPX
Datong/Second	Shanxi	2x600	2005	Direct	GEA
Hohhot/Datong Togtoh #3	Inner Mongolia	2x600	2005	Direct	GEA
Hejin/Chalco Shanxi Huaze aluminum & power	Shanxi	2x300	2005	Direct	SPX
Taiyuan/Gujiao	Shanxi	2x300	2005	Direct	SPX
Shuozhou/Pingshuo Gangue	Shanxi	2x50	2005	Direct	SPX
Huozhou/Second	Shanxi	2x300	2005	Direct	SPX
Zhouzi/Huadian #1	Inner Mongolia	4x200	2005	Indirect	Harbin Air Conditioning
Taiyuan/Xishan	Shanxi	3x50	2005-6	Direct	SPX

Table 3: Earliest air-cooled coal-fired power plants in China

contributed to the lack of progress at that time. The early systems encountered technical problems, including freezing in winter, tubes cracking and leaking, significantly lower generation capacity on hot summer days, and instability in some windy conditions. Some Chinese researchers even argued against indirect air-cooling designs and called for introducing direct air-cooling instead. Table 3 lists the earliest air-cooled, coal-fired power plants in China.

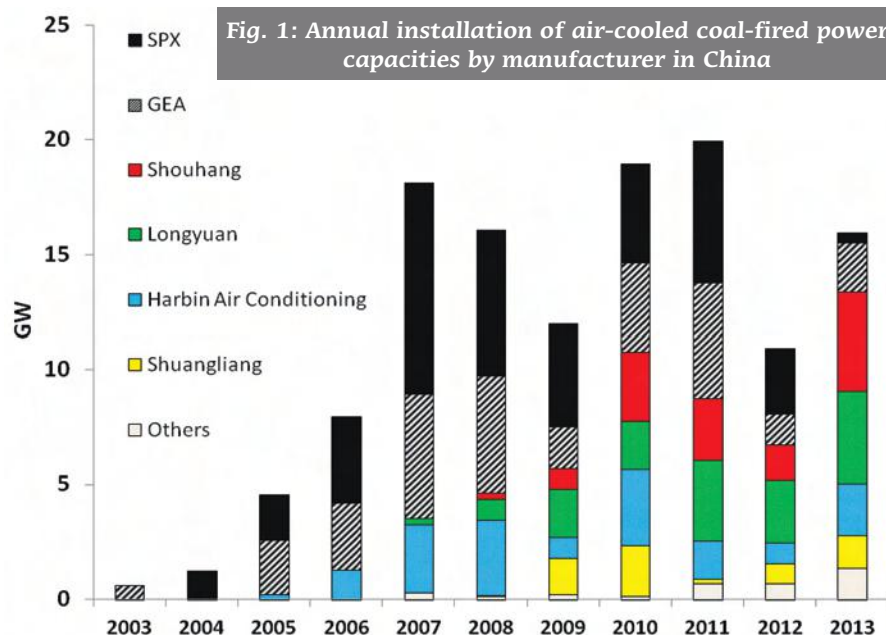
When Shanxi imported equipment and built its first indirect air cooling tower with direct-contact (Heller-type) condensers, such a design was already outdated compared to the improved indirect air-cooling at the Kendal project and the direct air cooling used at the Matimba project in South Africa constructed during the same period (1987–88). When Harbin Air Conditioning licensed the GEA-EGI technology to build China's subsequent commercial indirect air-cooling tower with direct-contact condenser in Fengzhen, Inner Mongolia, the technology provider was already developing and perfecting more advanced direct air cooling technology for large-scale application. Foreign

companies (German GEA and U.S. SPX), with advanced technologies, have continued to dominate the Chinese market for air-cooling towers.

In 2003, the Datang YunGang thermal power corporation built China's first direct air-cooling power system at Pingwang power plant in Datong, Shanxi. The plant employed

key components such as finned tubes from the Shanxi GEA. The success of this project encouraged further deployment of even larger direct air-cooling systems.

In 2004, the National Development and Reform Commission (China's national economic planning authority) announced a policy that mandated all coal-fired power plants in arid regions



in northern China to adopt large-scale air-cooled condensers. This policy mandate fundamentally transformed the air cooling condensers for coal-fired power from being rare and exotic to a mainstream standard.

Since 2004, the market for air-cooled coal-fired power in China has expanded rapidly. Two foreign companies (GEA and SPX) initially dominated the market, but Chinese equipment suppliers have become increasingly competitive. By 2013, Chinese suppliers have taken over most of the air-cooled condenser market in China. Intense competition and rapid technical innovations have suppliers contributed to rapid cost reductions of air cooling technologies. The Chinese government's demonstration projects also supported technology indigenisation and domestic manufacturing capacities. Most notably,

the Huadian Ningxia Lingwu 1-GW ultra supercritical air-cooled coal-fired power demonstration, currently the world's largest and most advanced air cooling system, has adopted Chinese indigenous design and equipment from domestic suppliers. Figure 1 shows the annual installation of air-cooled coal-fired power in China since 2004. By the end of 2013, China had installed over 127 Gigawatt (GW) of air-cooled coal-fired power. In recent years, air-cooled systems have accounted for nearly one third of China's new thermal power installation. Direct air cooling is the dominating choice, which account for 86% of all installed air-cooled coal-fired power capacities in China.

Conclusion

The rapid development of dry cooling technologies in China testifies

to the aphorism that necessity breeds innovation. In addition to the mandate on dry cooling, the Chinese government's aggressive policy in decommissioning existing, relatively inefficient capacities also accelerates capital renewal and creates markets for newer, more efficient technologies. In the past decade, the development and adoption of air cooling technologies have revolutionised China's coal-fired power sector. India can certainly take advantages of this innovation in conserving its water resources.

The author thanks Rongguo Sun for his tremendous effort in data collection, and the SPX Cooling Technologies for the permission to use their image and for sharing their knowledge on the air-cooling business. ■

Industry first for Toshiba as Estia heat pumps gain triple approvals

The advanced Estia heat pump range from Toshiba Air Conditioning (a division of Toshiba Carrier UK Limited) is believed to be the first to achieve full approval under three key industry certification bodies, namely the MCS, British Kitemark and NFPAC approval schemes.

The most recently awarded NFPAC mark certifies compliance with energy performance and sound power levels in accordance with European standards.

The three approvals apply to the full Estia range, including Toshiba's latest 4 Series, spanning heat pumps from 8 kW to 14 kW heating capacity.

Following the achievement, Estia heat pumps have been specified for use on a very large residential development currently being rolled out.

David Dunn, Toshiba Air Conditioning UK general manager says, "The triple approval for Estia is, we believe, an industry first and gives complete reassurance to customers and end users that the product complies with the very latest



standards. It also enables clients to gain financial assistance through the MCS/RHI scheme."

He added, "Estia units combine efficiency, low noise and high quality manufacture, all obviously highly desirable. When you add cost-effectiveness and a shortened pay-back, the Estia range offers an unbeatable package that puts Estia ahead of the pack."

As energy prices continue to rise and heat pumps are increasingly seen as a mainstream solution, Toshiba has plans to extend the Estia range in the near future to meet anticipated growth in demand for heat pumps. ■

ECT launches 7th Edition of The Emerson Cup

Emerson Climate Technologies (India) Ltd, a business of Emerson, launched 7th edition of The Emerson Cup 2014. The Emerson Cup, an annual competition instituted by Emerson Climate Technologies, recognizes outstanding designs and innovations for projects in the Air-conditioning & Refrigeration categories in India. As one of the most influential competitions in the industry, The Emerson Cup receives a large number of outstanding projects from all over India and follows a rigorous selection process for winning entries by an independent jury panel.

Committed to promote energy efficient technologies, exploring outstanding environmentally responsible products and solutions, and awarding enterprises and professionals who have made great contributions, The Emerson Cup's latest edition has made several changes this year, including the addition of 'Cold Chain design application' as an award category, to support the current growth of cold storage and food preservation industry in the country.

Speaking on the occasion, Sridar Narayanswami – Vice President & Managing Director, Emerson Climate Technologies (India) Ltd, said, "It is heartening to see the momentum this competition has gained over the last six years of its existence in India. The Emerson Cup provides a valuable platform for showcasing the emerging trends and practices amongst industry professionals, combined with the availability of high quality technology today." He further added, "We have specifically introduced 'Cold Chain application' as a category this year recognizing the huge growth this sector is bound to see in India given the current scale of fruits and vegetables wastage. With this step we are aiming to encourage design and innovation in high quality cold storage infrastructure development.

The competition has, for the first time, also introduced a two stage application process with the aim of encouraging more entries. In the first stage, the applicant has to just submit the nomination form along with a 500



word design intent on his/her project. It is only after the Jury's preliminary selection that the complete application will need to be submitted.

The Emerson Cup 2014 once again has a distinguished panel of judges consisting of industry experts in the fields of green building, energy efficiency, engineering, HVAC designs and architecture. The competition will accept nominations for energy efficient and innovative projects from India across the field of Air-conditioning & Cold Chain technologies.

Participation in The Emerson Cup competition is open to engineers, architects, consultants, developers, institutional owners and end-users. The award categories for 2014 are-

- New Project
- Retrofit Project
- Cold Chain Project
- Project with Emerson Technologies.

Each award category has two winners – one for a project from metropolitan cities and another one from emerging markets. Metropolitan cities include Ahmedabad, Bangalore, Chennai, Delhi (NCR), Hyderabad, Kolkata, Mumbai (Navi Mumbai) and Pune. All other cities across India fall under 'Emerging Markets' category. Each of these awards carry a monetary prize of Rs One Lakh.

The Emerson Cup 2014 nominations are being accepted now and will remain open until 15th June. Successful applications will be informed individually and asked to submit their complete entry by July 21, 2014.

Connect with them online to know more about The Emerson Cup on Facebook, Twitter, LinkedIn, Slideshare and Youtube.

Committed to energy & environment responsibility, The Emerson Cup 2014 recognizes the role of technology and system design in India. ■

*A Competition that Recognizes
Innovative HVACR Solutions
for Empowering The Future.*



Solar Energy for Buildings

Clean Energies Utilisation
and Development

The move towards a de-carbonised world, driven partly by climate science and partly by the business opportunities it offers, will need the promotion of environmentally friendly alternatives, if an acceptable stabilisation level of atmospheric carbon dioxide is to be achieved.

The move requires the harnessing and use of natural resources that produce no air pollution or greenhouse gases & provides comfortable coexistence of human, livestock, and plants. This article presents a comprehensive review of energy sources, and the development of sustainable technologies to explore these energy sources. It also includes potential renewable energy technologies, efficient energy systems, energy savings techniques and other mitigation measures necessary to reduce

climate changes. The article concludes with the technical status of the ground source heat pumps (GSHP) technologies.

Over millions of years ago, the plants have covered the earth converting the energy of sunlight into living plants and animals, some of which were buried in the depths of the earth to produce deposits of coal, oil and natural gas. The past few decades, however, have experienced many valuable uses for these complex chemical substances and manufacturing from them plastics, textiles, fertilisers and the various end



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products of the petrochemical industry. Indeed, each decade seeks increasing uses for these products. Coal, oil and gas, which will certainly be of great value to future generations, as they are to ours, are however non-renewable natural resources. The rapid depletion of these non-renewable fossil resources need not continue. This is particularly true now as it is, or soon will be, technically and economically feasible to supply all of man's needs from the most abundant energy source (the sun). The sunlight is not only inexhaustible, but, moreover, it is the only energy source, which is completely non-polluting.

One way of reducing building energy consumption is to design buildings, which are more efficient in their use of energy for heating, lighting, cooling, ventilation and hot water supply. Passive measures, particularly natural or hybrid ventilation rather than air-conditioning, can dramatically reduce primary energy consumption. Exploitation of renewable energy in buildings and agricultural greenhouses can, also, significantly contribute towards reducing dependency on fossil

fuels. Therefore, promoting innovative renewable applications, particularly the ground source energy will contribute to the preservation of the ecosystem by reducing emissions at local and global levels. This will in turn contribute to the amelioration of environmental conditions by replacing conventional fuels with renewable energies that produce no air pollution or greenhouse gases. Therefore, an approach is needed to integrate renewable energies in a way to meet high building performance. However, the renewable energy sources are stochastic and geographically diffuse. Also, their ability to match demand is determined either by the utilisation of a greater capture area than that occupied by the community to be supplied or the reduction of the community's energy demands to a level commensurate with the locally available renewable resources.

Materials and Methods

Energy sources and their use

Scientifically, it is difficult to predict the relationship between global temperature and greenhouse gas (GHG) concentrations. The climate system contains many processes that will change if warming occurs. Critical processes include heat transfer by winds and tides, the hydrological cycle involving evaporation, precipitation, runoff and groundwater and the formation of clouds, snow, and ice, all of which displaying enormous natural variability. The equipment and infrastructure for energy supply and use are designed with long life-times, and the premature turnover of capital stock involves significant costs. Economic benefits occur if capital stock is replaced with more efficient equipment in step with its normal replacement cycle. Likewise, if opportunities to reduce future emissions are taken in a timely manner, they should

be less costly. Such a flexible approach would allow society to take account of evolving scientific and technological knowledge, while gaining experience in designing policies to address climate change.

Overview of alternative energy sources

Utilised renewable resources currently account for about 9%-10% of the energy consumed in the world; most of this is from hydropower and traditional biomass sources. Wind, solar, biomass and geothermal technologies are already cost-effective today in an increasing number of markets and are making important steps to broaden commercialisation. The present situation is best characterised as one of very rapid growth for wind and solar technologies and of significant promise for biomass and geothermal technologies. Each of the renewable energy technologies is in a different stage of research, development and commercialisation and all have differences in current and future expected costs, current industrial base, resource availability and potential impact on energy supply chain.

Technology need/justification

Geothermal energy is the natural heat that exists within the earth and that can be absorbed by fluids occurring within, or introduced into, the crystal rocks. Although, geographically, this energy has local concentrations, its distribution globally is widespread. The amount of heat that is, theoretically, available between the earth's surface and a depth of 5 km is around 140×10^{24} joules per day. Only a fraction of this (5×10^{21} joules) can be regarded as having economic prospects, and only about 10% of this is likely to be exploited by the year 2020. Three main techniques are used to exploit the heat available: geothermal aquifers, hot dry rocks and ground source heat pumps. However,

only the ground source heat pumps are considered in this study because the other previous two are expensive.

Goals

The purpose of this study is to establish the suitability of ground source heat pumps (GSHPs) for heating and cooling and to develop a design tool and document the necessary design parameters, and the savings in energy use and demand that GSHPs may reasonably be expected to achieve. This design tool will be verified using measured data. The main objective of this study is to stimulate the uptake of the GSHPs. The GSHPs are well suited to space heating and cooling, and can produce significant reduction in carbon emissions. The tools that are currently available to design a GSHP system require the use of key site-specific parameters such as temperature and the thermal and geotechnical properties of the local area. This study deals with the modelling of vertical closed-loop and hybrid, ground source heat pump systems. The challenges associated with the design of these systems are discussed herein.

Results and Discussions

Role of efficient energy systems

The prospects for development in power engineering are, at present, closely related to ecological problems. Power engineering has harmful effects on the environment, as it discharges toxic gases into atmosphere and also oil-contaminated and saline waters into rivers, as well as polluting the soil with ash and slag and having adverse effects on living organisms taking into account of electromagnetic fields and so on. Thus there is an urgent need for new approaches to provide an ecologically safe strategy. Substantial economic and ecological effects for thermal power projects (TPPs) can be achieved by improvement, upgrading the efficiency of the existing equipment, reduction of electricity loss, saving of fuel, and optimisation of its operating conditions and service life leading to improved access for rural and urban low-income areas in developing countries through energy efficiency & renewable energies.

Renewable energy technologies

Sustainable energy is the energy

that, in its production or consumption, has minimal negative impacts on human health and the healthy functioning of vital ecological systems, including the global environment. It is an accepted fact that renewable energy is a sustainable form of energy, which has attracted more attention during recent years. Increasing environmental interest, as well as economic consideration of fossil fuel consumption and high emphasis of sustainable development for the future helped to bring the great potential of renewable energy into focus. Nearly a fifth of all global power is generated by renewable energy sources, according to a new book published by the OECD/IEA, (2004). This book entitled "Renewables for power generation: status and prospects" claims that, at approximately 20%, renewables are the second largest power source after coal (39%) and ahead of nuclear (17%), natural gas (17%) and oil (8%) respectively. From 1973-2000 renewables grew at 9.3% a year and it was predicted that this would increase by 10.4% a year to 2015. Therefore, promoting innovative renewable applications and reinforcing the renewable energy technologies market will contribute to preservation of the ecosystem by reducing emissions at local and global levels. Wind power grew fastest at 52% and should be multiply seven times by 2015, overtaking biopower and hence helping reducing green house gases, GHGs, emissions to the environment. This will also contribute to the amelioration of environmental conditions by replacing conventional fuels with renewable energies that produce no air pollution or greenhouse gases (during their use).

Energy use in buildings

Buildings consume energy mainly for cooling, heating and lighting. The energy consumption was based on the assumption that the building operates within ASHRAE-thermal comfort zone during the cooling and heating periods. Most of the buildings incorporate energy efficient passive cooling, solar control, photovoltaic, lighting and day lighting, and integrated energy systems. It is well known that thermal mass with night ventilation can reduce the maximum indoor temperature in buildings in

summer. Hence, comfort temperatures may be achieved by proper application of passive cooling systems. However, energy can also be saved if an air conditioning unit is used. The reason for this is that in summer, heavy external walls delay the heat transfer from the outside into the inside spaces. Moreover, if the building has a lot of internal mass the increase in the air temperature is slow. This is because the penetrating heat raises the air temperature as well as the temperature of the heavy thermal mass. The result is a slow heating of the building in summer as the maximal inside temperature is reached only during the late hours when the outside air temperature is already low. The heat flowing from the inside heavy walls could be reduced with good ventilation in the evening and night. The capacity to store energy also helps in winter, since energy can be stored in walls from one sunny winter day to the next cloudy one. However, the admission of daylight into buildings alone does not guarantee that the design will be energy efficient in terms of lighting. In fact, the design for increased daylight can often raise concerns relating to visual comfort (glare) and thermal comfort (increased solar gain in the summer and heat losses in the winter from larger apertures). Such issues will clearly need to be addressed in the design of the window openings, blinds, shading devices, heating system, etc. In order for a building to benefit from daylight energy terms, it is a prerequisite that lights are switched off when sufficient daylight is available. The nature of the switching regime; manual or automated, centralised or local, switched, stepped or dimmed, will determine the energy performance. Simple techniques can be implemented to increase the probability that lights are switched off. These include:

- Making switches conspicuous and switching banks of lights independently.
- Loading switches appropriately in relation to the lights.
- Switching banks of lights parallel to the main window wall.

There are also a number of methods, which help reduce the lighting energy use, which, in turn, relate to the type of

occupancy pattern of the building. The light switching options include:

- Centralised timed off (or stepped)/ manual on.
- Photoelectric off (or stepped)/ manual on.
- Photoelectric and on (or stepped), photoelectric dimming.
- Occupant sensor (stepped) on/off (movement or noise sensor).

Likewise, energy savings from the avoidance of air conditioning can be very substantial. Whilst day-lighting strategies need to be integrated with artificial lighting systems in order to become beneficial in terms of energy use, reductions in overall energy consumption levels by employment of a sustained programme of energy consumption strategies and measures would have considerable benefits within the buildings sector. It would perhaps be better to support a climate sensitive design approach that encompasses some elements of the pure conservation strategy together with strategies, which work with the local ambient conditions making use of energy technology systems, such as solar energy, where feasible. In practice, low energy environments are achieved through a combination of measures that include:

- The application of environmental regulations and policy.
- The application of environmental science and best practice.
- Mathematical modelling and simulation.
- Environmental design & engineering.
- Construction and commissioning.
- Management and modifications of environments in use.

Recommendations

- Launching of public awareness campaigns among local investors particularly small-scale entrepreneurs and end users of RET to highlight the importance and benefits of renewable, particularly solar, wind, and biomass energies.
- Amendment of the encouragement of investment act, to include further concessions, facilities, tax holidays, & preferential treatment to attract national and foreign capital investment.

- Allocation of a specific percentage of soft loans and grants obtained by governments to augment budgets of R and D related to manufacturing and commercialisation of RET.
- Governments should give incentives to encourage the household sector to use renewable energy instead of conventional energy. Execute joint investments between the private sector and the financing entities to disseminate the renewable information and literature with technical support from the research and development entities.
- Availing of training opportunities to personnel at different levels in donor countries and other developing countries to make use of their wide experience in application and commercialisation of RET particularly renewable energy.
- The governments should play a leading role in adopting renewable energy devices in public institutions e.g., schools, hospitals, government departments, police stations etc. for lighting, water pumping, water heating, communication and refrigeration.
- Encouraging the private sector to assemble, install, repair and manufacture renewable energy devices via investment encouragement and more flexible licensing procedures.

Conclusion

There is strong scientific evidence that the average temperature of the earth's surface is rising. This is a result of the increased concentration of carbon dioxide and other GHGs in the atmosphere as released by burning fossil fuels. This global warming will eventually lead to substantial changes in the world's climate, which will, in turn, have a major impact on human life and the built environment. Therefore, effort has to be made to reduce fossil energy use and to promote green energy, particularly in the building sector. Energy use reductions can be achieved by minimising the energy demand, rational energy use, recovering heat and the use of more green energy. This study was a step towards achieving this goal.

The adoption of green or sustainable approaches to the way in which society is run is seen as an important strategy in finding a solution to the energy problem. The key factors to reducing and controlling CO₂, which is the major contributor to global warming, are the use of alternative approaches to energy generation and the exploration of how these alternatives are used today and may be used in the future as green energy sources. Even with modest assumptions about the availability of land, comprehensive fuel-wood farming programmes offer significant energy, economic and environmental benefits. These benefits would be dispersed in rural areas where they are greatly needed and can serve as linkages for further rural economic development. However, by adopting coherent strategy for alternative clean sustainable energy sources, the world as a whole would benefit from savings in foreign exchange, improved energy security, and socio-economic improvements. With a nine-fold increase in forest – plantation cover, every nation's resource base would be greatly improved while the international community would benefit from pollution reduction, climate mitigation, and the increased trading opportunities that arise from new income sources. The non-technical issues related to clean energy, which have recently gained attention, include:

- Environmental and ecological factors e.g., carbon sequestration, reforestation and revegetation.
- Renewables as a CO₂ neutral replacement for fossil fuels.
- Greater recognition of the importance of renewable energy, particularly modern biomass energy carriers, at the policy and planning levels.
- Greater recognition of the difficulties of gathering good and reliable renewable energy data, and efforts to improve it.
- Studies on the detrimental health effects of biomass energy particularly from traditional energy users.

The present study is one effort in touching all these aspects. ■

These waves can also pass through material substances. The perfect transmitter of radiant heat is a vacuum; the ability of matter, whether solid or fluid, to transmit the wave motion tends to increase with the transparency of the material body. The intensity of the radiation emitted by the matter, and its distribution among the different wavelengths (λ) depends on the nature and temperature of the matter.

Radiation from a heated body may extend over a wide range of wavelengths,

similar too. The only difference is in their wavelengths. The wave length of visible rays ranges from 0.4 to 0.8 microns and that of heat rays ranges from 0.8 to 100 microns. The wavelength of ultraviolet rays ranges from 0.1 to 0.4 microns.

The total radiant energy emitted per unit time per unit area from the body is defined as the total emissive power and is denoted by E . It is the quantity which is directly proportional to the fourth power of the absolute temperature. In view of the complexity of the phenomenon of radiation, the fact that the overall effect can be simply represented as a absolute temperature, stands as one of the wonders of nature.

As stated above, the amount of energy emitted by body generally varies with wavelength of frequency in the manner shown in fig. This variation can be described by defining a monochromatic emissive power E_λ , such that the amount of energy emitted per unit time per unit area in the spectral range λ to $\lambda + d\lambda$ is given by $E_\lambda \cdot d\lambda$. Thus, total rate of energy emission at any temperature is given by area under the curve for that temperature, i.e.

$$E = \int_0^{\infty} E_\lambda \cdot d\lambda$$

Reflection, Absorption & Transmission of Radiation

Radiation is the property of all substances, and each continuously emits energy. In general, radiation falling on a body is partially reflected (scattered) at the surface. Those waves which are not reflected penetrate into the material and are progressively absorbed with depth, thereby producing heat. The remainder are transmitted through the body. This is illustrated in Figure, next page.

For any given wave length λ , the portion reflected at the surface depends on the material, the surface finish, and the angle of incidence.

For any given body and surface finish, the portion reflected also differs for different wave lengths. Out of the radiation penetrating the surface, the amount absorbed depends on the material and the wavelength.

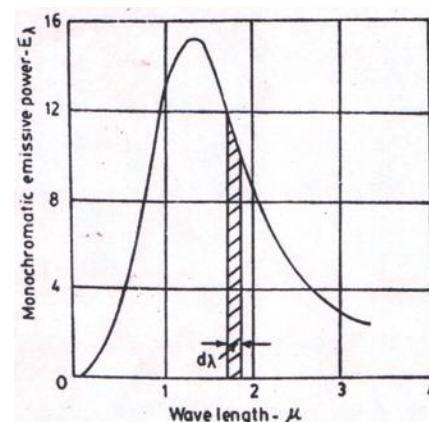
For example, when thermal radiation

Thermal Radiation

When heat exchange between any two bodies, situated at a distance apart, takes place even when no material substance fills the space between them, is called heat transfer by radiation. This transfer of heat takes place with the help of electromagnetic waves.

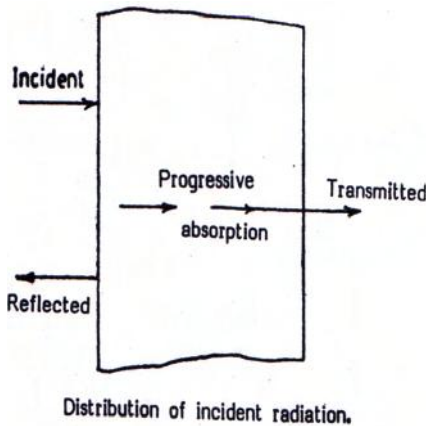
from short ultraviolet, through the visible range and into the long infrared heat rays. The properties of these rays are different. We are interested most in rays which are absorbed by substances and energy of which turns into heat energy in the course of absorption. Visible light rays and infrared rays (0.8 to 100 microns) possess such properties in the greatest measure. These rays are known as heat rays and the process of their propagation as thermal radiation or radiation.

Since, the nature of heat and visible light rays is one and the same. Their physical properties are essentially





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from an electric fire (comprising of red light waves, λ_1 and infrared heat waves, λ_2) fall on a slab of glass, the light waves are transmitted virtually undiminished while the heat waves are largely absorbed. Thus, reflection and absorption are selective as regards wavelengths.

Now, in general the reflected energy impinges upon other (surrounding) bodies and forms the part of incident radiation energy transmitted through the body. Thus, after a series of absorptions, radiant energy is fully distributed among the surrounding bodies. Hence, each body not only emits radiant energy continuously but also absorbs it continuously.

The Process of radiant heat exchange is the result of these phenomena linked with the double reciprocal transformation of energy (thermal radiant – thermal). The amount of heat lost or absorbed is determined by stance. This difference is not zero if the bodies participating in the interchange of radiant energy are at different temperatures.

At equal temperature the entire system is in the so-called mobile thermal equilibrium. In this case, all the bodies in the system also emit and absorb, but the amount of energy absorbed is equal to that emitted in each given case.

Thus, when radiant energy falls on a body, part may be absorbed, part reflected, and the remainder transmitted through the body. In mathematical form,

$$\alpha + \rho + \gamma = 1$$

Where, α = absorptivity or the fraction of the incident radiant energy absorbed,

ρ = reflectivity or the fraction of the incident radiant energy reflected, and

γ = transmissivity or the fraction of the incident radiant energy transmitted through the body.

Above fractions are dimensionless & vary from 0 to 1. If $\alpha = 1$, then $\rho = 0$ & $\gamma = 0$, which means that incident energy is entirely absorbed by the body. Such a body is defined as a black body. In practice, most solid bodies are such strong absorbers of the thermal radiation penetrating the surface, that none of the original radiation is transmitted. This is so narrow region near the surface. For good conductors of electricity this is of the order of 1 micron (10^{-6} m). In electrical insulators, this thickness may be as much as thousand microns. However, this is still such a short distance that, in all cases, practically $\gamma = 0$. Such bodies are called opaque bodies.

Thus, for opaque bodies

$$\alpha + \rho = 1$$

If $\rho = 1$, $\alpha = 0$, and $\gamma = 0$; this means that all the incident radiant energy is reflected e.g. in case of a mirror, and the body is called white body.

If $\gamma = 1$, $\alpha = 0$ and $\rho = 0$; which means that entire incident radiant energy passes through the body e.g. in case of glass. Such bodies are called transparent or diathermanous.

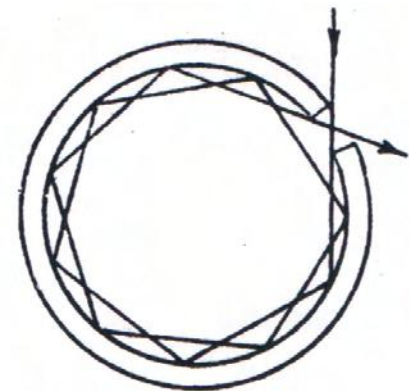
There are no absolutely black ($\alpha = 1$), white ($\rho = 1$) and transparent ($\gamma = 1$) bodies in nature, and these conceptions are conditional when applied to real bodies.

Concept of a Black Body

A black body is one which absorbs all radiation incident upon it, whatever be the wave length λ . The implication is that a black body is perfectly non-reflecting and non-transmitting at all wave lengths. Actually no material with $\alpha = 1$ & $\rho = \gamma = 0$ exists. Even the blackest of the surfaces occurring in nature have reflectivity of about 1 per cent ($\rho = 0.01$).

Thus, although a black body must be black in colour, this is not a sufficient condition. Kirchhoff, however, conceived the following possibility of making a practically perfect black body: If a hollow body is provided with only one very small opening and is held at uniform temperature, then any beam of radiation

entering by the hole is partly absorbed, and partly reflected inside. The reflected radiation will not find the outlet, but will fall again on the inner wall. There again, it will be partly absorbed and partly reflected and so on. By such a sequence of reflection, the entering radiation will be almost completely absorbed by the body, and none will be able to come out though the opening. Thus, a small opening provided in a hollow body of any shape acts as a black body as shown in Figure below.

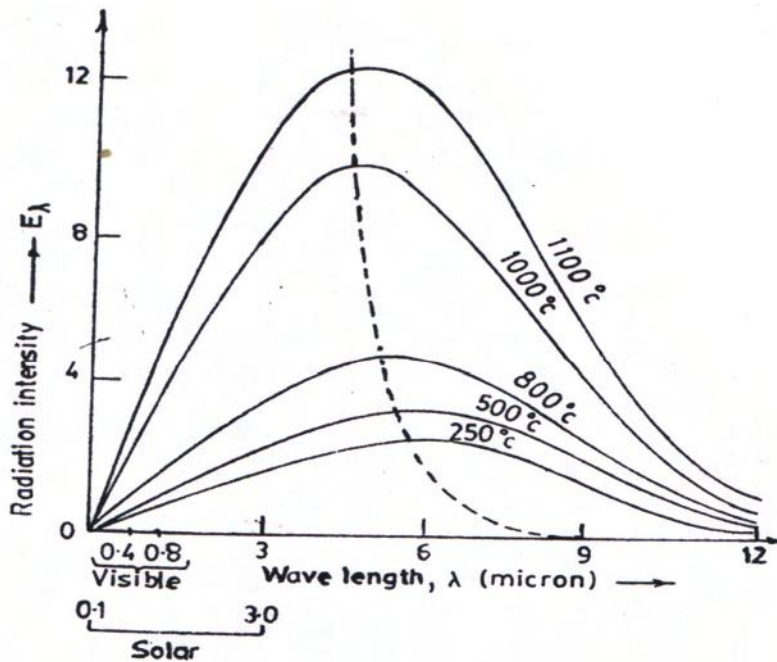


Black body concept

All substances emit radiation, the quality and quantity depending upon the absolute temperature and the properties of the material composing the radiating body. It may be shown that, at a given temperature, good absorber of any particular wave length is also the good emitter of that wave length. Thus, since by definition a black body is a complete absorber of radiations at all wave lengths, it is also the best possible emitter of thermal radiation, i.e. it is a perfect radiator.

Planck's Law of Emission of Radiant Heat

Planck formulated a law regarding emission of radiation for black bodies which states that the total heat loss by



Intensity of solar radiation for black body at various temperatures

radiation from a black body depends only on the absolute temperature. The distribution of radiation energy among the different wave lengths varies with temperature as shown in fig.

According to Planck's Law, the magnitude of intensity of radiation depends on the temperature of the radiating surface & the wave length of radiation. The peak wave length, λ_m (i.e. that most strongly emitted) becomes shorter with increase in temperature. This is indicated by the dotted curve passing through the peak of all curves.

Vien's Law relates T and λ_m by the following expression:

$$\lambda_m T = 2.898 \text{ mm} - ^\circ\text{K}$$

Planck introduced the quantum theory, which enabled him to express the following relationship between $E\lambda$ and λ for a black body in such a manner that it satisfactorily fits the experimental results:

$$E\lambda = \frac{C_1 \lambda^{-5}}{C_2 / \lambda T}$$

Where, λ = wave length, m,
 T = absolute temperature of body, $^\circ\text{K}$
 C_1 = constant = $3.74 \times 10^{-16} \text{ W/m}^2$,
 C_2 = constant = $1.4388 \times 10^{-2} \text{ m}^\circ\text{K}$, and
 $E\lambda$ = monochromatic emissive power, W/m^3 .

Planck's formula has been checked

experimentally & theoretically and is accepted as an exact relationship for black body radiation.

When the right hand term of eqn. is multiplied by $d\lambda$ and integrated between limits $\lambda = 0$ and $\lambda = \infty$, it yields the Stefan-Boltzmann law.

Stefan - Boltzmann's Law of Total Radiation

In 1879, Stefan concluded from experimental data that the total radiation by the black body per unit area per unit time is proportional to the fourth power of the absolute temperature of the body. Few years later Boltzmann derived the same law from a thermodynamical reasoning. It, likewise, can be derived from Planck's law of radiation of black body as suggested earlier. For a black body the total energy E , radiated per unit surface area per unit time is represented by areas under curves of fig. These areas vary as fourth power of absolute temperature, T^4 . In honour of its discoverers, the law has been called the Stefan - Boltzmann Law. The law is expressed as

$$E = \sigma T^4$$

Where, E = heat energy radiated per unit time per unit area in W/m^2 ,
 T = absolute temperature in $^\circ\text{K}$, and
 σ = Stefan - Boltzmann's constant = $5.68 \times 10^{-8} \text{ W/m}^2\text{K}^4$

The value of the constant arrived at by using Stefan's experimental results.

For convenience eqn. may be written as,

$$E = 5.67 \left(\frac{T}{100} \right)^4 \text{ W/m}^2$$

Equations hold good for black surfaces only.

Radiation from Non - Black Bodies

For non- black bodies (i.e. those which either reflect or transmit part of the incident radiation), the amount of radiation emitted, when heated, falls short of that given by the Stefan - Boltzmann Law. For such bodies Kirchhoff's Law states that,

Emissive power of a

body at a given temperature

and at a given wave length

Emissive power of a similar

black body at the same temperature

and at the same wave length

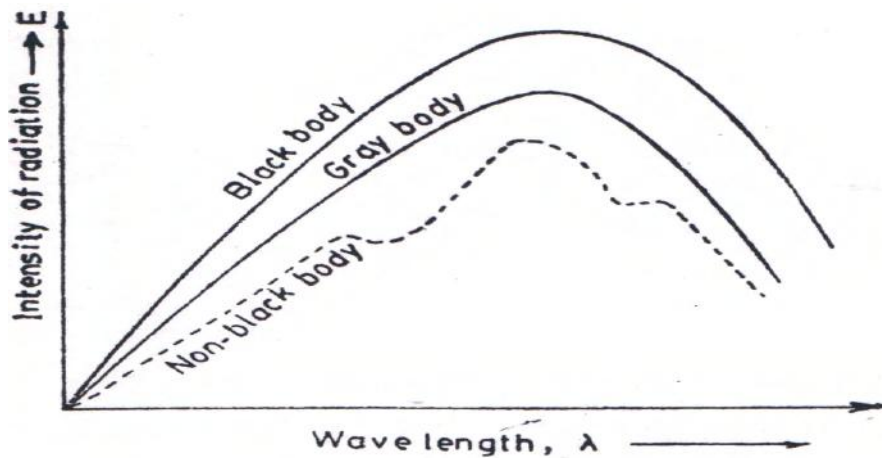
Where, ϵ = emissivity of non-black body for particular temperature and wave length.

The emissivity of a body has importance in radiation similar to that of conductivity in conduction. Generally, it is difficult, if not impossible, to estimate the emissivity of a surface with sufficient accuracy of a few percent because the emissivity depends to some extent on the behavior of the surface, particularly as far as metallic surfaces are concerned. Since perfectly non-black surfaces are not attainable in engineering practice, the equation established for black body radiation must be multiplied by the fraction ϵ known as emissivity, for non-black bodies.

Hence, for a non-black body, the radiation intensity curve for a given temperature falls below that for a black body, and in addition, is distorted as shown in Figure next page.

Concept of Gray Body

A gray body is defined as one in which radiation spectrum is continuous and radiation spectrum curve is similar to the corresponding curve of a black body at the same temperature, i.e.



Comparison of radiation intensity curves for black, gray and non black bodies at same temperature.

the ratio of emissive power of a gray body to that of black body at a given temperature is constant for all wave lengths, that is, its intensity curves will be identical in form with those of fig., but to a reduced vertical of curve for black body and gray body give emissivity. Experiments reveal that most technical materials are gray bodies.

Thus, for a gray body, the total loss by radiation is given $E = \epsilon \sigma T^4$.

Emissive Power of Non – Black Bodies

For practical purposes eqn. may be used for bodies not truly gray, but in such cases ϵ is the mean value of the emissivity which varies with the wave length at the temperature considered. This mean emissivity varies some what with temperature.

The emissivity ϵ of non – metallic bodies does not vary much at ordinary temperatures. Some approximate values of emissivity ϵ are given in Table 1 – 2.

Materials	Emissivity
Carbon, Oil, Iron Oxide	0.8
Rubber, Wood Paper	0.85 to 0.9
Roofing Paper, Enamel,	0.91 to
Porcelain Brick (Red, Rough),	0.94
Marble, Glass	
Asbestos Slate, Lamp Black, Ice	0.95 to
Water Glass Compound	0.99

Table 1 – 2: Emissivity ϵ of Non – Metallic Bodies

Metallic smooth surfaces emit very little radiation at ordinary temperatures and the emissivity increases moderately

at higher temperatures. A few values are given in Table 1 – 3.

Materials	Emissivity ϵ at different temperatures		
	50°C	250°C	500°C
Aluminum	0.04	0.05	0.08
Copper	0.04	0.05	0.08
Gold	0.02	0.02	0.03
Silver	0.01	0.02	0.03
Steel	0.07	0.10	0.14

Table 1 – 3: Emissivity ϵ of Polished Metallic Surfaces

Kirchhoff's Law

Gustav Kirchhoff in 1895, established the relationship between the emissivity and absorptivity of a body. Consider radiant interchange between two surfaces, one gray and the other absolutely black as shown in

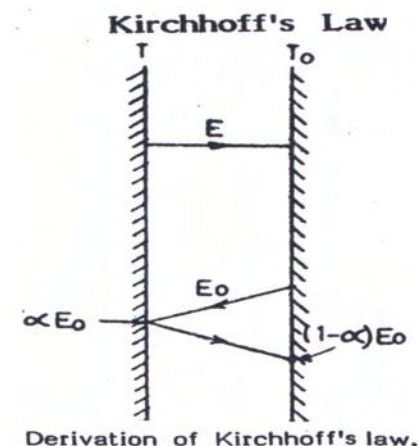


fig. The surfaces, are arranged parallel to each other and as close that the

radiation of one falls on the other. Let the temperature, emissive power and absorptivity of the gray and black surfaces be respectively, T, E, α and $T_0, E_0, \alpha_0 = 1$ and $T > T_0$ is assumed here.

The energy emitted, ($E \text{ W/m}^2$) by gray surface is fully absorbed by the black surface. In turn the black surface emits $E_0 \text{ (W/m}^2\text{)}$. A portion αE_0 of this energy is absorbed by the gray body and the remaining portion $(1 - \alpha) E_0$ is reflected and fully absorbed by the black surface. Thus, radiant interchange between the two surface is,

$$H = E - \alpha E_0 \text{ W/m}^2$$

This is the amount of energy lost by gray surface & gained by black surface. Radiant interchange between two surfaces also takes place when $T = T_0$. In this case, the system is in dynamic thermal equilibrium and $H = 0$,

i.e.

$$E = \alpha E_0 \text{ or } \frac{E}{\alpha} = E_0 = \frac{E_0}{\alpha_0} \text{ as } \alpha_0 = 1$$

The above relationship can be extended by considering different surfaces in turn, as follows:

$$\frac{E_1}{\alpha_1} = \frac{E_2}{\alpha_2} = \frac{E_3}{\alpha_3} = \dots = \frac{E_0}{\alpha_0} = E = \alpha T^4$$

Thus, for all bodies, the ratio of the emissive power to absorptivity is the same and is equal to the emissive power of a black body at the same temperature.

Now, according to eqn., $E = \epsilon \sigma T^4$ for gray bodies. Thus,

$$E_1 = \epsilon_1 \sigma T_0^4, E_2 = \epsilon_2 \sigma T_0^4, \text{ etc. for } T_1 = T_2 = \dots = T_0.$$

Substituting above values in eqn. and simplifying, we get,

$$\frac{\epsilon_1}{\alpha_1} = \frac{\epsilon_2}{\alpha_2} = \frac{\epsilon_3}{\alpha_3} = \dots = \frac{\epsilon_0}{\alpha_0} = 1$$

Thus, the emissive power of bodies increases along with their absorptivity. If the absorptivity α of a body is low, its emissive power ϵ is low. Therefore, good reflectors are poor emitter; for instance, the emissive power of an absolutely white body is zero. Further, good emitters are good absorbers. Kirchhoff's law expressed by eqn. is applicable to integrated or total radiation, but it may also be used for monochromatic radiation. Thus, for radiation at the same wavelength and temperature the ratio of the emissive power to the absorptivity is the same for all bodies. ■

Energy Saving opportunities in Outdoor Unit



Simple measures like regular cleaning of Air conditioning system not only enhance its durability and life but it also lead to energy savings. Outdoor unit of Air conditioning system consisting of fan and condensing coils/fins is used to condense the high pressure refrigerant vapour from Compressor.

Outdoor unit being outside is likely to get affected from dust and other contaminants in the environment. Efficiency of Condenser decreases due to the deposition of dust, fibrous material, scaling, and corrosion etc. on condensing fins/coils. Because of this, condensing temperature and pressure of refrigerant increases & hence work done by compressor increases resulting in excess power consumption.

In one of the studies done to evaluate the performance of air conditioning for one of our clients, fins

of the outdoor units were choked up with dust.

Due to choking of fins, the specific energy consumption of the installed units was measured to be at 1.6 kW/TR as against rated 1.2 kW/TR. The measurement and analysis for one of the unit is given in Table 1.

Measures to Improve Specific energy consumption Regular Maintenance

With regular maintenance of these outdoor units, the Specific Energy consumption of the system can be



easily maintained at 1.3 kW/TR. The scenario would be as in Table 2.

Using Evaporative Pre-Cooler

Evaporative Pre-Cooler is installed to cool the hot ambient dry air by humidifying it. The air temperature, when humidified, shall reach closer to coincident Wet bulb temperature of air. These Pre-cooler will cool ambient air by addition of water in it before it goes to condenser in Outdoor

Rajesh Deshpande
Managing Director of
Energetic Consulting Pvt Ltd (ECPL),
is BTech Chemical Engineering.



Sr. No.	Designed capacity TR	Load TR	Compressor Power, kW	Specific Energy Consumption, kW/TR
1	22	12.8	21	1.64
2	22	9.7	14	1.46
3	22	10.9	15.5	1.42
4	22	9.5	14	1.49

Table 1

Sr. No.	Designed capacity TR	Load TR	Compressor Power, kW	Specific Energy Consumption, kW/TR	Reduction in Energy Consumption (%)
1	22	12.8	16.7	1.3	20
2	22	9.7	12.6	1.3	11
3	22	10.9	14.2	1.3	8
4	22	9.5	12.3	1.3	13

Table 2

Sr. No.	Designed capacity TR	Load TR	Compressor Power, kW	Specific Energy Consumption, kW/TR	Reduction in Energy Consumption (%)
1	22	12.8	12.8	1	39
2	22	9.71	9.7	1	31
3	22	10.9	10.9	1	30
4	22	9.5	9.5	1	33

Table 3

unit. Pre-cooling of air shall reduce to 1.0 kW/TR. The Scenario would the specific energy consumption be as in Table 3. ■

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Application of Renewable Energies in HVAC Systems



In India, the energy demands are increasing gradually due to booming industries, information and technology and new buildings. With rapid growth in these economic sectors results into high energy consumptions for operation of heating, ventilation and air-conditioning (HVAC) to maintain the thermal comfort within the buildings.

The countrywide electricity consumption in commercial buildings since 2003 has gone up by 13% annually. This poses a challenge to the overall energy supply and on the environment. Furthermore, the energy efficiency should be an integral part of architecture, engineering and the construction phase.

The present article reviews that the possible applications of renewable energy, different technologies/

approaches and demonstrates their capability to improve the performance of HVAC systems in order to reduce energy consumption. Energy efficient HVAC systems can be created by re-configuring traditional systems to make more strategic use of existing system parts. Recent research has demonstrated that a combination of existing air conditioning technologies can offer effective solutions for energy conservation and thermal comfort.



Praveen Babu, Senior Research Fellow, IIT Delhi, PhD Full Time – pursuing, ME has professional affiliations with national and international level, such as, life member from Indian Aerosol Science and Technology Association (IASTA), India; Student member ISHRAE, New Delhi Chapter, and ISIAQ, USA. He has published papers and received awards also.



Dr Mukesh Khare serving as Professor at Indian Institute of Technology Delhi, India, did PhD in Faculty of Engineering (Specialization: Air Quality) from UK. He has published more than 50 refereed research articles, more than 45 articles in refereed conferences/seminars, 03 books He is also serving as reviewer to many journals and publishing houses.

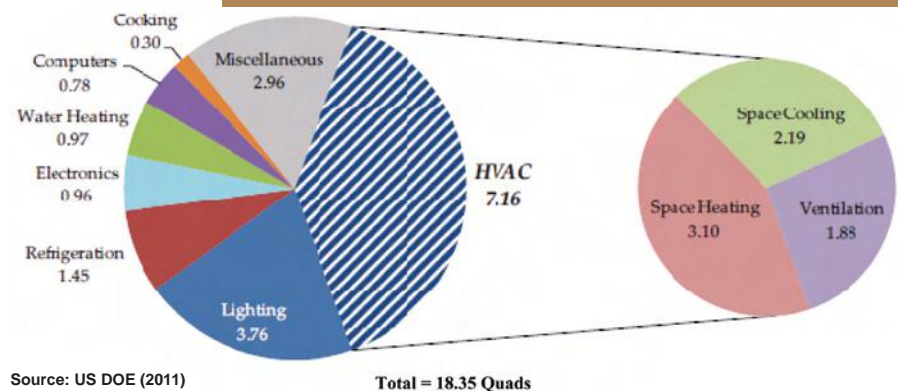


Radha Goyal Fellow Scientist at National Environmental Engineering Research Institute (NEERI), Delhi Zonal Centre. She is an Environmental Scientist. Currently she is engaged in various research projects and has published 8 articles in journals. She has also contributed 3 chapters in international books by well known publishers.



The renewable energy could have a significant role in reducing the emissions and increasing the energy efficiency of the global economy. With modern technologies, instrumentations and visualization tools offered by renewable energy could allow to optimise the use of existing physical resources taking into account the many factors that influence the energy demand. In 2002, Department of Energy (DOE) – Building Technology Program (BT) commissioned a study to characterize and assess opportunities for energy savings in commercial building HVAC systems with a specific focus on select technology options and its technical energy savings potential and barriers to wide adoption (Roth, et al., 2002). Furthermore, there is an increased level of consumer awareness of climate change and interest in energy efficiency options. According to Building Energy Data Book, the U.S. commercial building sector consumed 18.35 quadrillion BTU's (Quads) of primary energy in 2010 (US DOE, 2011). Energy consumption associated with HVAC equipment (i.e., space heating, space cooling and ventilation) accounts for nearly 40% of

Fig. 1: US commercial building sector primary energy consumption for the year 2010



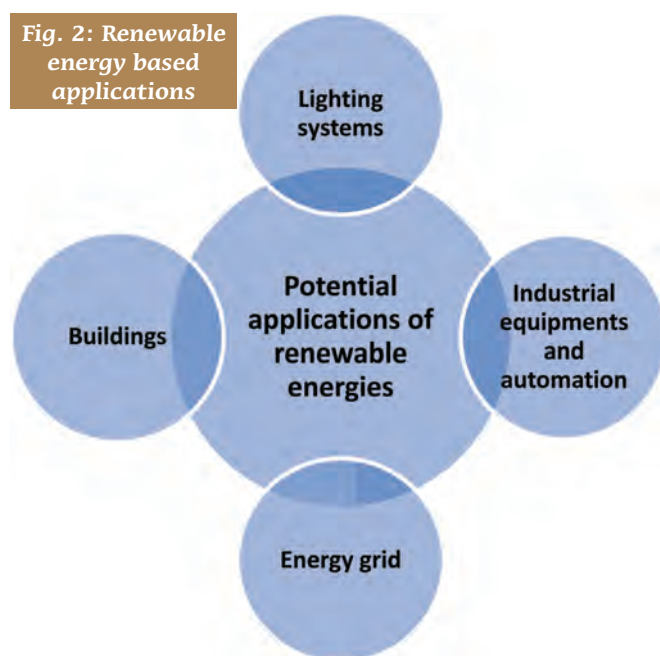
the total energy consumption at 7.16 Quads (Fig. 1).

- Buildings: The HVAC systems are analysed considering the potential energy efficiency gains (e.g. temperature monitoring and heating control, switchable vacuum insulated panels, switchable mirror film on windows, integrated cooling equipment, integrated control of clean room conditions).
- Lighting systems: The increased energy efficiency of lighting systems through integrated communication based lighting technologies

(e.g. LED) and control systems is analysed (e.g. occupancy and daylight sensors).

- Industrial equipment's and automation: Energy efficient technologies based on information and communication technologies are applied to electrical drivers (motors, pumps, and fans).
- Energy grid: Smart metering and smart grids represent important means to maximise energy savings in buildings, for the widespread deployment of electric vehicles, and for efficient energy supply and

Fig. 2: Renewable energy based applications



distribution and for integrating renewable energy sources.

Energy and economy: Indian context

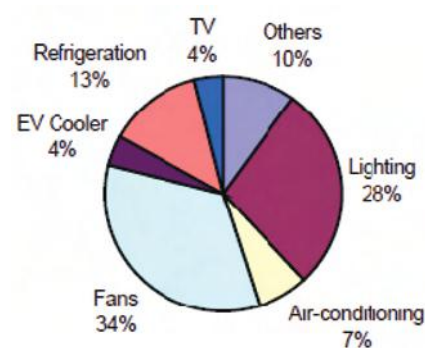
India ranks sixth in the world in terms of energy demand accounting for 3.5% of world commercial energy demand in 2001. With a gross domestic product (GDP) growth rate of 8% set for the Tenth Five Year Plan (2001 – 2006), the energy demand is expected to grow at 5.2%. Still, at 479 kg of oil equivalent (kgoe), annual per capita energy consumption is low even compared to other developing countries. The country has seen an expansion in total energy use during the last five decades, with a shift from non-commercial to commercial sources of energy. Accordingly, the production of commercial sources of energy has increased significantly. Table 1 indicates the trends in production of various primary commercial energy resources.

Since the upheaval of the first oil crisis, the supply and demand trajectories of the Indian energy sector have

undergone changes in response to economic, demographic, and technological factors. While technological innovations increased market opportunities and suitable policy reforms have boosted the country's energy supply potential, a rise in the national income, population, and enhanced economic activities have led to an even more strongly escalating demand for energy. The need of developing countries to improve living standards and reduce poverty is well understood and energy is the prime resource for development. Though, the total energy use, which one of the major sources of emissions is increasing in developing countries, their per capita energy consumption still remains far below then that of developed countries.

Electricity use in Indian building sector

During the last decade, in the residential and commercial sector, there has been a rapid increase in the consumption of electricity at a rate of about 13.2%. Growing electrification



Source: CMIE (2001)

Fig. 3a: Residential building sector Annual consumption = 116 TWh

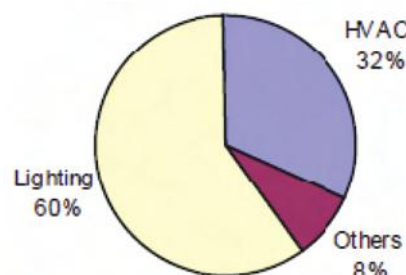


Fig. 3b: Commercial building sector Annual consumption = 33 TWh

Item	Units	Production					
		1960-61	1970-71	1980-81	1990-91	2001-02	2006-07
Coal	mt	55.67	72.95	114.01	211.73	325.65	405.00
Lignite	mt	0.05	3.39	4.80	14.07	24.30	55.96
Crude Oil	mt	0.45	6.82	10.51	33.02	32.03	33.97
Natural Gas	BCM	-	1.44	2.35	1.79	29.69	37.62
Hydro Power	BkWh	7.84	25.25	46.54	71.66	82.80	103.49
Nuclear Power	BkWh	-	2.42	3.00	6.14	16.92	19.30
Wind Power	BkWh	-	-	-	0.03	1.70	4.00

Table 1: Trends in commercial energy production in India
Source: Planning Commission (2002)

and more comfortable style of living have been the main causes of this increase. The electricity consumption in this sector is essentially in buildings and building establishments for various uses; the distribution is illustrated in Fig. 3 (a&b).

Energy efficiency policies in India

Due to the increase in economic activity and the concurrent increase in energy intensity, energy supply could not follow energy demand particularly in the electricity sector. After the Government's measures in the second half of 1990's aimed at restoring the financial viability of state owned power utilities were unsuccessful, a new Electricity Act was passed in June 2003. Moreover the Energy Conservation Act has provided a framework for promoting energy efficiency in the country. The Bureau of Energy Efficiency (BEE) has been setup to facilitate

implementation of the provision of the Act. Launching the BEE action plan for promoting energy efficiency in the country all the Government Organizations should bring down their energy consumption by 30% & Private Organizations by 20% over a period of 5 years. Improvement in the building sector is one of the agenda in the BEE's Action Plan.

Renewable energy sources

Solar energy

Solar energy mainly refers to the use of solar radiation for practical ends. However, all renewable energies, other than geothermal & tidal, derive their energy from the sun. Solar technologies are broadly characterized as either passive or active depending on the way they capture, convert and distribute sunlight. Active solar techniques use photovoltaic panels, pumps, and fans to convert sunlight into useful outputs. Passive solar techniques include selecting materials with favorable thermal properties, designing spaces that naturally circulate air, and referencing the position of a building to the Sun. Active solar technologies increase the supply of energy and are considered supply side technologies, while passive solar technologies reduce the need for alternate resources and are generally considered demand side technologies.

Wind energy

Wind power is the conversion of wind energy into a useful form of energy, such as using wind turbines to make electricity, wind mills for mechanical power, wind pumps for pumping water or drainage, or sails to propel ships. At the end of 2009, worldwide nameplate capacity of wind-powered generators was 159.2 GW. A wind turbine installation consists of the necessary systems needed to capture the wind's energy, point the turbine into the wind, convert mechanical rotation into electrical power, & other systems to start, stop, & control the turbine. The Betz's law represents the theoretical maximum coefficient of power for any wind turbine: no more than 59.3% of the kinetic energy of the wind can be

converted into mechanical one turning a rotor. To assess the frequency of wind speeds at a particular location, a probability distribution function is often fit to the observed data. Different locations will have different wind speed distributions. The Weibull model closely follows the actual distribution of hourly wind speeds at many locations.

Hydro energy

- Tide energy: Tidal stream energy is one of the alternative energy sources that are renewable and green. With the constantly increasing effort in promoting alternative energy, tidal streams have become one of the more promising energy sources due to their continuous, predictable and spatially-concentrated characteristics.
- Wave energy: It is a form of

Active solar technologies increase the supply of energy and are considered supply side technologies, while passive solar technologies reduce the need for alternate resources and are generally considered demand side technologies.

renewable energy that can be harnessed from the motion of the waves and this energy is captured directly from surface waves or from pressure below the surface. Waves are caused by the wind blowing over the surface of the ocean. This also technologies mainly differ in their orientation to the waves with which they are interacting and in the waves into other energy form, usually electricity (Stallo C. et al., 2010).

- Rain energy: Some Researchers have developed a technique that harvests energy from rain and converts it into electricity. The technology could work in industrial air conditioning systems, where water condenses and drops like rain. It could also be used in combination with solar power to capture as much energy from the

environment as possible, or to power wireless sensors designed to monitor environmental conditions.

Geothermal energy

Geothermal power is extracted from heat stored in the earth. This geothermal energy originates from the original formation of the planet, from radioactive decay of minerals, and from solar energy absorbed at the surface. Almost everywhere, the shallow ground or upper 3m of the Earth's surface maintains a nearly constant temperature between 10°C & 20°C. Geothermal heat pumps can tap into this resource to heat and cool buildings. A geothermal heat pump system consists of a heat pump, an air delivery system (ductwork), and a heat exchanger a system of pipes buried in the shallow ground near the building. In the winter, the heat pump removes heat from the heat exchanger & pumps it into the indoor air delivery system. In the summer, the process is reversed, & the heat pump moves heat from the indoor air into the heat exchanger. The heat removed from the indoor air during the summer can also be used to provide a free source of hot water.

HVAC energy resources

Building services are end-users of energy, or stated in another way 'final energy is consumed' by buildings. This energy flow could be simply referred as final energy use. If we knew the processes and conversions that energy resources have undergone from extraction to consumption, the final energy use could be translated to primary energy. Similarly, the environmental impact of energy use could also be estimated in terms of greenhouse gas emissions in the extraction to consumption path. As for HVAC systems, energy consumption is necessary to operate end-use conversion devices, mainly thermal generators and fluid movers. Electrical power, natural gas, oil derivatives, coal and renewable sources are the most widely used energy carriers in HVAC systems.

Measures to reduce building energy use

The change in energy use over time is driven by a combination of

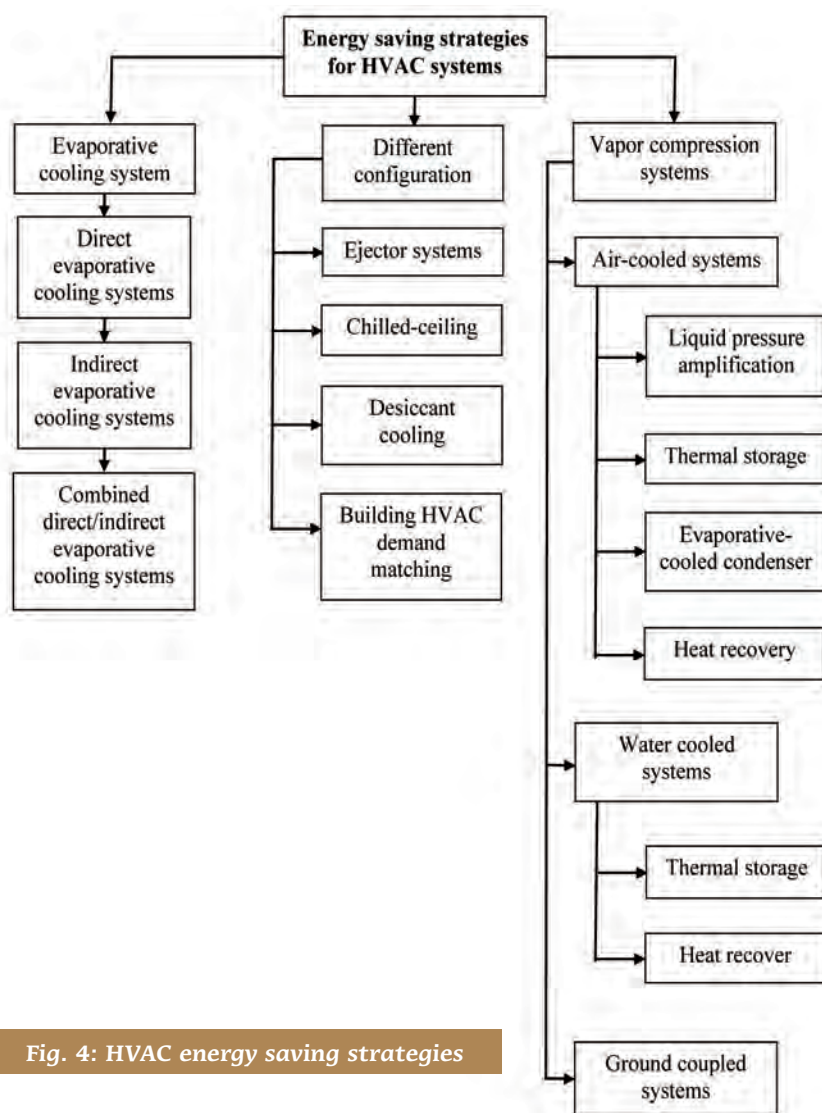


Fig. 4: HVAC energy saving strategies

Source: Vakiliari V., et al. (2014)

efficiency, weather, behavioral, and structural effects that may be only partially separable and may differ among energy services. Therefore, the task of measuring and assessing energy efficiency and its change over time consists of the followings are,

- Deciding which effects should be considered as inherent in efficiency measurement and which are due to weather, behavioral, and structural changes to be eliminated or, at least, recognized in the measurements. This is particularly important for the assessment of baseline emissions.
- Creating an appropriate categorization of energy services that provides the best possible starting point to assess efficiency measures.

The following measures can be considered:

- Reducing the energy demand in air-conditioned buildings while maintaining comfortable living conditions.
- Reducing the electricity consumption in non-airconditioned buildings through natural cooling (ventilation and earth air tunnel systems) and energy efficient fans.
- Reducing the lighting energy demand through energy efficient light systems.
- Switching to solar and other renewable sources of energy.

Conclusion

Energy efficient HVAC system designs depend on new configurations of traditional systems that make better

use of existing parts. One effective way of achieving energy efficiency is in the design of HVAC system configurations that combine a range of different traditional HVAC system components. Recent research has demonstrated that a combination of existing air conditioning technologies can offer effective solutions for energy conservation and thermal comfort. Each HVAC discipline have specific design requirements and each presents opportunities for energy savings. It must be understood, however, that different configurations in one area may augment or diminish savings in another. Another issue that drastically increases the energy usage of HVAC systems is the requirement for fresh air in the buildings they cool. The amount of fresh air for a building is dependent on the type of activities taking place in the building. However, in the case that a building needs more fresh air to produce positive pressure inside the space, using a heat recovery system is the best option. For buildings with lower fresh air level quotas, controlling and adjusting the fresh air flow rates based on design criteria is a more efficient method. Thermal storage systems are appropriate when maximum cooling load is significantly higher than average load. Therefore, these systems are normally used for commercial and industrial buildings but have fewer benefits in residential buildings. Among the buildings most suited to thermal storage systems are buildings with high cooling, short duration demands. Although capital costs for this sort of systems tend to be higher than a conventional system, but smaller ducting system for the thermal storage system can compensation that additional cost. While this system have higher upfront costs, its reduced energy usage will result in significant long-term savings as a result of lower energy bills. A ground-source heat pump takes advantage of more benign climates below ground, limiting the efficacy of this sort of system for above ground installations. Furthermore, other factors such as maintenance and cost of repairs would cost more compared to other HVAC systems. ■

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Philips addresses issue of health problems due to poor indoor air quality

As part of Philips' commitment to deliver meaningful innovation in personal health and well-being, Philips introduced a new category in its Consumer Lifestyle portfolio – Air – with the launch of three variants of Air Purifiers designed to manage indoor air quality. These products can help to improve the lives of those suffering from allergies or respiratory problems - good indoor air quality can help prevent such issues from occurring or worsening.

A. Krishna Kumar, Vice Chairman and Managing Director, Philips India said, "The air we breathe is pivotal to our health and well-being, especially for children and people with respiratory problems. At Philips, we want to empower people to take control of the quality of air they breathe, providing advanced solutions that remove contaminants such as

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harmful gases, fine-dust and pollen and also general germs, bacteria and viruses."

The World Health Organization's (WHO) Global Action Plan for the prevention and control of noncommunicable diseases¹ (NCDs), includes external air quality as one of the contributors to chronic respiratory diseases. According to other international studies indoor air across the world is between 10-30 times more polluted than outdoor Air, and 80% of the world's population breathes polluted air that exceeds the WHO prescribed level of Particulate Matter (PM). In India alone, the level of PM in indoor air is approximately three times higher than the WHO standard. In the national Capital of New Delhi, this level is up to

ten times higher than the WHO standard.

"Controlling external air pollution is the task of multiple stakeholders, including government, industry and individuals, but Philips Air Purifiers can help consumers to take action to improve the air they breathe inside homes and offices," adds Jayati Singh, Business Head – Air, Philips India.

The Philips Air Purifiers, with a unique VitaShield Technology, purify the air through a 4-stage filtration process removing 99.7% airborne particles. Philips VitaShield IPS also has a number of special new filters designed for specific environments like new homes. These filters are complemented with the Smart Sensor and light indicators that measure and show the air quality in a room. The Healthy Air Protect and Healthy Air Lock warn the user when the filter requires replacement. ■

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Commissioning of Cooling Towers

Beyond the Scope of
Switching “ON”

Cooling Towers locate their usage & application everywhere in HVAC&R facility. They play a special role for Water Cooled Chiller units. A Cooling Tower is a heat rejection device that extracts heat from HVAC&R system and throws into atmosphere by means of evaporation.

Like other equipment used in HVAC&R system, Cooling towers are also available and classified in various categories like Natural Cooling Tower, Induced type Cooling Tower, Forced Draft type Cooling Tower, Cross flow type, Counter flow type etc. Although Cooling towers may be available in various types but the basic underlying principle for commissioning of Cooling towers remain the same.

Commissioning has always been a part of the project for HVAC&R system. But a perfect commissioning has never been the ideology since ever. To

accomplish a perfect commissioning requires a complete and a thorough knowledge about the function of equipment and its associated system. In this article efforts have been taken to present some useful information pertaining to Cooling towers used for HVAC&R application.

This is my ever green statement and my conventional quote that the scope of Commissioning HVAC&R system or unit is never limited up to switching “On” the equipment by pressing its button and making it operational. The objective of commissioning is to establish the



correctness and the realistic working of the system/equipment which has been supplied and installed for the beneficial usage to the end user.

Autonomous Cooling Tower System

In thermal power plants and in other manufacturing plants, there is a peak demand for Cooling towers not only limited to serve for HVAC&R system but its core purpose is for plant application. In such projects, the range of the Cooling towers selected and installed is far dissimilar to the range that is required to run HVAC&R system. Just for the sake of grabbing a project order, if the Sales Engineer accepts Client's proposal on utilizing the same Cooling tower for multiple applications including HVAC&R facility in order to save a little amount then, the problems will start rooting by this much undisciplined step. The Cooling towers installed at client's premises may be oversized and designed to meet their plant requirement and hence may work with odd range of Inlet water temperatures and outlet water temperatures which may not be suitable

Y S Rao is a Mechanical Engineer and Certified Energy Manager by BEE. He has also worked abroad (in Bahrain) for a short period. Presently he is working with one of the leading MEP contracting company in India. He is accredited with the Certificate of Completion for "Refrigerant Usage Certification Prep under EPA Section 608". He is also a member of ISHRAE Nagpur Chapter.



for the smooth operation of Chiller units.

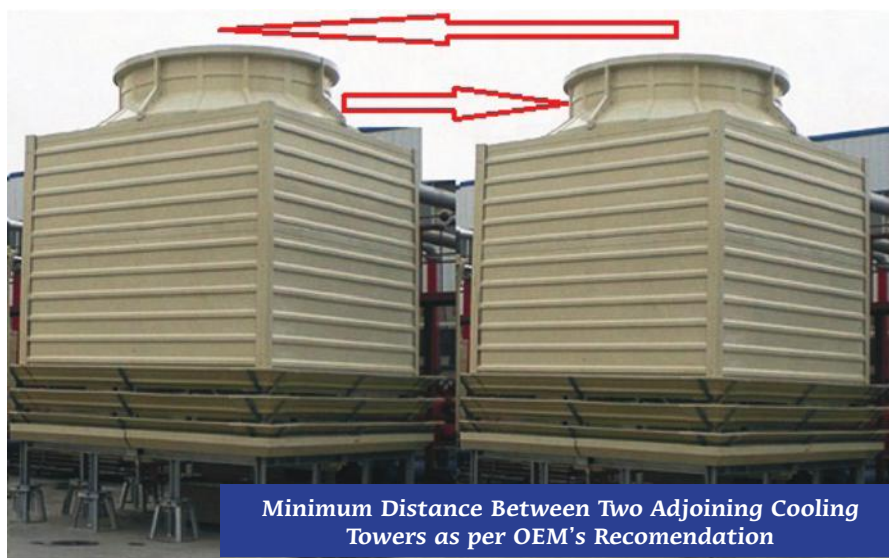
This concept can be explained and understood very well by screening a unique study. If the Cooling towers installed at client's premises are designed to work at a range of 95°F to 75°F to meet their plant requirement and if the same Cooling towers are brought into use for the Chiller units (especially with Screw type compressors or Centrifugal type compressors) whose operating range of condenser is 90°F to 100°F, then in such cases, the condenser will get water at 75°F at its inlet which is far below its operating range and will lower down the discharge temperature. In case of Chiller units designed to work with Screw type compressors, lowering of discharge temperature will lower down the discharge pressure as well as oil pressure which will cause the Chiller units to trip "off" frequently. While on the other hand, for Chiller units designed to work with Centrifugal type compressors, lowering of discharge temperature will lower down the discharge pressure & results in frequent tripping "off" due to Low Discharge Superheat. Such a helpless situation calls for an independent network of Cooling

towers which shall be designed to work autonomously for HVAC&R system only.

Adequate Clearance for Free Air Flow

Prior to Commissioning, an Engineer must ensure that the Cooling towers are installed at site as per manufacturer's guidelines. In other simple words, it should be checked that the clearance from all sides of the Cooling towers and the distance between two adjoining Cooling towers is maintained as per manufacturer's instruction only. Otherwise short cycling of air will occur.

Short cycling of air near the Cooling towers is an unhealthy sign which will have a severe impact on the performance of the Cooling towers. The hot and humid discharge air from the Cooling towers when gets short cycled, will effect on the performance of neighbouring Cooling towers as well. To understand this concept, one has to be very much clear about the evaporative cooling principle of a Cooling tower. In a Cooling tower, the evaporative heat transfer occurs because a part of water gets evaporated in the cold ambient air thus lowering down the



Minimum Distance Between Two Adjoining Cooling Towers as per OEM's Recommendation

water temperature. Evaporation occurs if the Wet bulb temperature of air is lower than the Dry Bulb temperature of air. Higher the difference between Dry Bulb temperature of air and the Wet bulb temperature of air, lower will be the relative humidity and drier will be the air. The lower relative humidity indicates about the greater capacity of air to absorb water and lower down the temperature of water more efficiently. In case of short cycling, the discharge air from the neighbouring Cooling towers which is already saturated and cannot process further more evaporation, may not be able to lower down the water temperature as desired. This results in poor effectiveness of the Cooling tower. So prior to Commissioning of Cooling towers, an Engineer must always focus on the availability of sufficient clearance on all sides for the free flow of air.

Water Quality Analysis

Prior to commissioning of a Cooling tower, lab analysis for sump/basin water as well as for make-up water is mandatory and hence it has to be carried out without fail. A Cooling tower can perform more effectively and efficiently only if the available water is suitable and fit enough for its smooth operation. There are various salts and dissolved solids present in the water. Increase in the concentration of these salts and dissolved solids in water will sheath the fills of Cooling tower thus

making it vulnerable and unfit for usage. A detailed summary of water parameter requirement to suit for Cooling tower operation is given for your ready reference.

Necessary action must be taken to maintain the water parameters. Although operators working in the field of HVAC&R prefer to adapt a conventional method to maintain water quality by frequent blowing down of Cooling tower water but this is neither desirable nor worth enough. Apart from the above water parameters it should be ensured that water available to the Cooling tower is filtered and is free from filth and wastes.

Cleaning of Strainer

Usually all the Cooling towers are provided with Strainers (especially Pot type strainers) on their outlet water pipe line in order to filter the contaminants and solid particles present in water. During the ongoing stage of the project, there is always a threat for civil dust and debris to make its pathway through some or the other source/medium and getting deposited & accumulated inside the strainer. The foreign particles like civil dust and debris will not only block the strainer from inside to restrict the proper flow of water in the circuit, but also may cause damage to the perforated sheet provided inside the strainer for filtration purpose. Restriction of water flow will have an adverse

effect on the entire HVAC&R system by reflecting it's symptoms in the form of erratic performance and wobbling parameters. The Chiller unit may trip at high discharge pressure due to restricted water flow through the condenser coil. So to attain a good commissioning, it is highly recommended to get the strainer cleaned thoroughly prior to commissioning.

Leak-free Sump/Basin

A Basin is a storage tank for Cooling tower where water is accumulated for instant operation. Any minor leakage in the basin will lead to continuous loss of water from the system. Once a Cooling tower is commissioned and put into operation it becomes uneasy for the end user or the operator to attend and rectify water leakages in the sump/basin as it requires lot of down time. To avoid such awful situation, it is better to follow the rule "A Stitch in Time, Saves in Nine". If the leakage in the sump/basin is traced out at the very initial stage of commissioning and is rectified then itself, will prevent the leakage from taking a gigantic shape. This proactive pre-commissioning step will reduce the down time as well.

Cleaning of Sump/Basin

One of the major resources for the cause of contamination in a Cooling tower network is its basin. If a basin/sump of the Cooling tower is not cleaned thoroughly prior to commissioning then the sludge settled in the basin will start circulating with the water and will get deposited at various locations in the system. The sludge may sometimes eventually damage the whole system by depositing in the tubes of condenser coil or by chocking up the strainers or else, it may even jam up the impeller of condenser water pump. Although cleaning of sump/basin is regular and periodic maintenance activity after commissioning but its significance is more if it is done properly and thoroughly prior to Commissioning.

Uniform Distribution of water over the fills

Every Cooling tower has its own arrangement for spraying/sprinkling

Water Quality Parameters			
Test Items	Make-up Water Quality Std.	Cooling Tower Water Quality Std.	Chilled Water Quality Std.
Ph	6.0 - 8.0	7.2 - 6.5	7.2 - 8.5
Total Hardness (CACO ₃) ppm	Max. 50	Less than 200	Max. 80
Total Alkanity (CACO ₃) ppm	Less than 80	Less than 100	Less than 100
Chloride Ion (ppm)*	Less than 50	Less than 200	Less than 50
Total Ion (Fe) ppm	Less than 0.3	Less than 1.0	Less than 0.3
Silica (SiO ₂)	Less than 30	Less than 50	Less than 30
Ammonium Ion ppm	Less than 0.2	Less than 1.0	Less than 0.2
TDS ppm	Max. 250	Max. 1500	Max. 1200
For more details as the type of water treatment refer to ASHRAE Handbook 1999, Chapter 47			

water over the fills. Fills are the basic medium that increases the surface area of water and thus makes it easier to evaporate thereby cooling the water. If the water distribution is not proper or un-uniform, then it may ultimately result in low cooling of the water. So an Engineer must make sure that the water distribution over and through the fills shall be uniform.

Proper Functioning of Float Valve

Maintaining correct quantity of circulating water is one of the concerned issues in a Cooling tower operation. Water in a Cooling tower loses continuously by evaporation and by drift losses during its operation. These water losses have to be compensated through some external sources by adding water to the basin as and when required. Otherwise the water level in the basin will reduce down and over a period of time, the water level becomes too low that the pumps start sucking in air. In most Cooling towers, a float valve is provided to maintain a certain water level. Float valves are automatic valves that operate, based on the water level in the basin, typically in open position, allowing water to enter into the basin. As soon as the desired water level in the basin reaches, the make-up water tap gets closed by the float valve. Prior to commissioning of Cooling towers, an Engineer has to check for proper functioning of float valves otherwise their malfunctioning may either lead to the scanty of water or may lead to the overflow of water from the basin of the Cooling towers.

Drain Line and Overflow line of Cooling Towers

Cooling towers shall be provided with drain line to drain out water from its sump/basin during the course of their maintenance and blow down. Similarly Overflow line shall also be provided to drain out excess basin water to prevent overflow and spill over of water from the basin. This is a common practice that both drain lines and overflow lines are connected to a common pipe line. An Engineer must check for unrestricted water flow through both drain line and

overflow line prior to commissioning. If any requirement for the modification in pipe routing is identified to enable for free flow of water through these two pipe lines, then the same corrective action has to be taken-up prior to commissioning of Cooling towers.

Make-Up Water Tank

Generally all the Cooling towers associated with HVAC&R system are provided with make-up water tank as an immediate source to refill water whenever there is a demand in the Cooling tower network. The make-up water tank connected to the Cooling tower network must always be positioned at an elevated location with reference to the level of Cooling towers so as to ease the delivery of water to the Cooling tower's basin by the action of gravity. Make-up water tank must be filled up with filtered and recommended quality of water prior to commissioning. At the same time it must also be ensured for correct functioning of quick fill valve to deliver water into the basin instantly as per requirement.

Equaliser Line

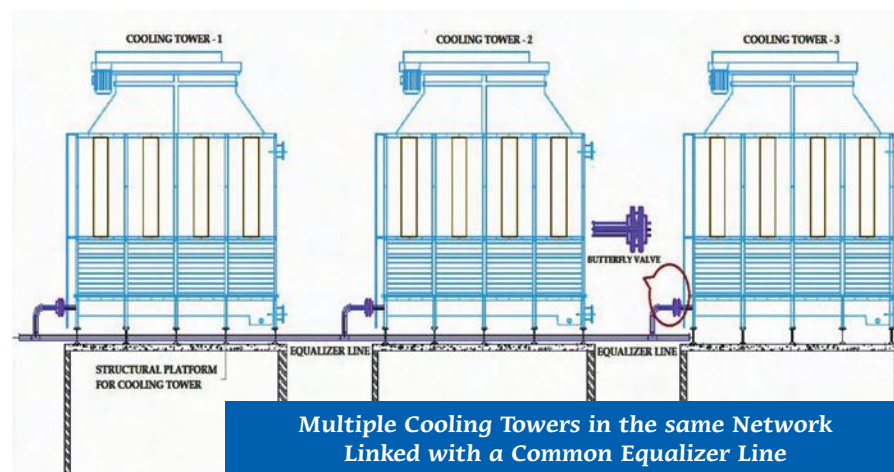
When two or more Cooling towers are installed in the same network to serve for a common HVAC&R system, then all the Cooling towers shall be interlinked to each other by a common equaliser line. The purpose of interlinking by a common equaliser line is to maintain equal volumes of water in the sump/basin of all Cooling towers installed in the same network. Prior to commissioning of Cooling towers an Engineer must check

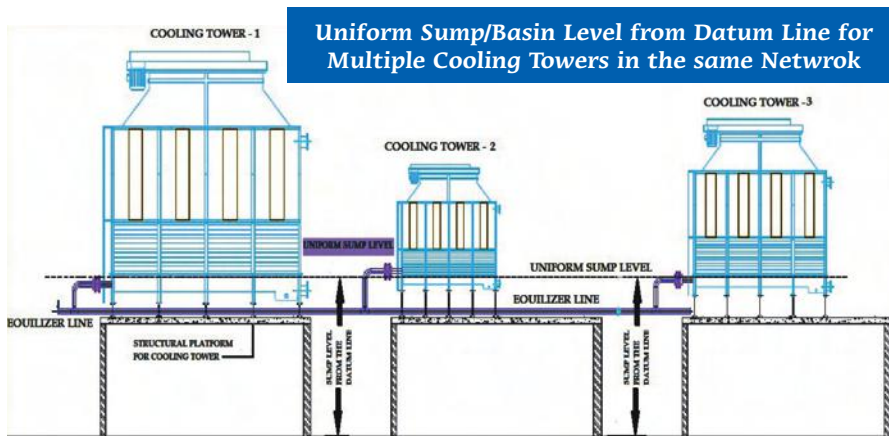
and verify the proper functionality of the Equalizer line. This shall be done by filling up water in the sump/basin of any one of Cooling towers in the common loop and then allowing the water to get equally distributed amongst all the Cooling towers.

If the entire water gets equally distributed among all the Cooling towers interlinked in the common loop, then no further movement of water will take place between them. Physical verification of equal amount of water in all the Cooling towers shall be done to ensure for the free flow and correct distribution of water among sumps/basins of all the Cooling towers in the common loop. If in any case, unequal volumes of water is measured in any of the Cooling towers in the loop then the tight spot has to be traced and sorted out immediately. Equalizer line is a very essential element in the Cooling tower network and its importance can be realised during emergency shutdown for carrying maintenance activities. Its correct functioning will make the life of a Maintenance Engineer easier and smoother.

Elevation of Cooling Towers

When multiple Cooling towers are installed in a common network for HVAC&R system, then great care has to be taken and attention has to be focussed on the level of water maintained in the basin of Cooling towers. Although equalizer line is equally important but the correct functioning of an equalizer line can be achieved only if all the Cooling towers in the same network





above Cooling tower then the above stated problem will come about. Since the proposal for relocation of Chiller unit or the Cooling tower will never be entertained nor accepted at the commissioning stage by any working authority on the project, so some innovative idea has to be applied to overcome such a cumbersome problem. There are various techniques which can over-ride such problem. One of such technique is re-modification and re-routing of the water pipe line which is

are installed at a correct elevation. If all the Cooling towers are of same size and equal dimensions, then it should be checked that all of them are at equal levels from the line of datum.

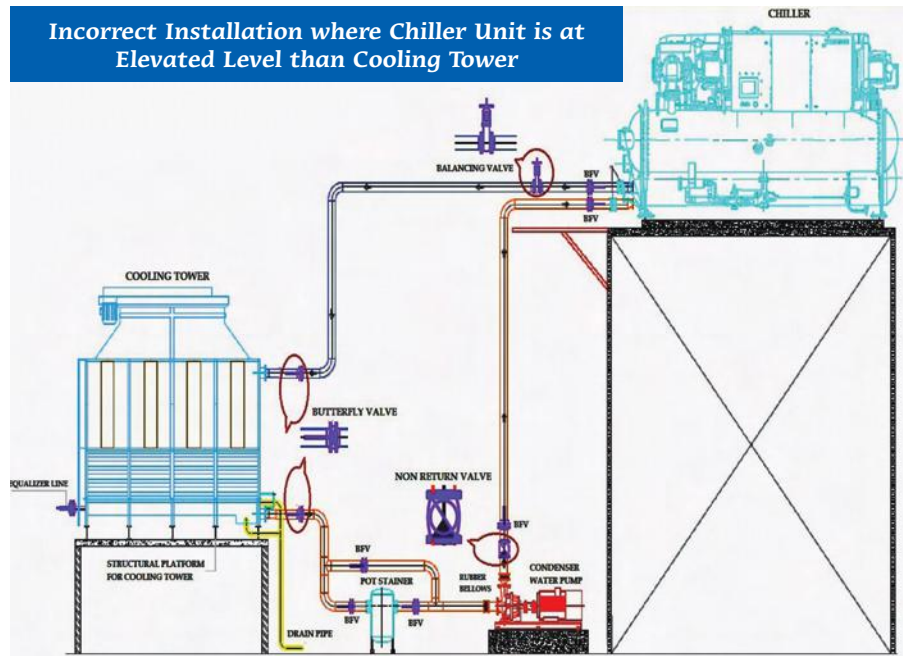
But if multiple Cooling towers of different capacities, different sizes and different dimensions are installed, then the problem solving becomes tricky. Such situations must be tackled and attended ingeniously. Under such circumstance, the Cooling towers must be installed in such a way that either the top surface level of the sump/basin or the overflow level of water must be at the same/equal/uniform level. Otherwise problems like overflow of water from the basin during pump shut "off" & shortfall of water in the basin during operation will be experienced.

Erroneous Installation

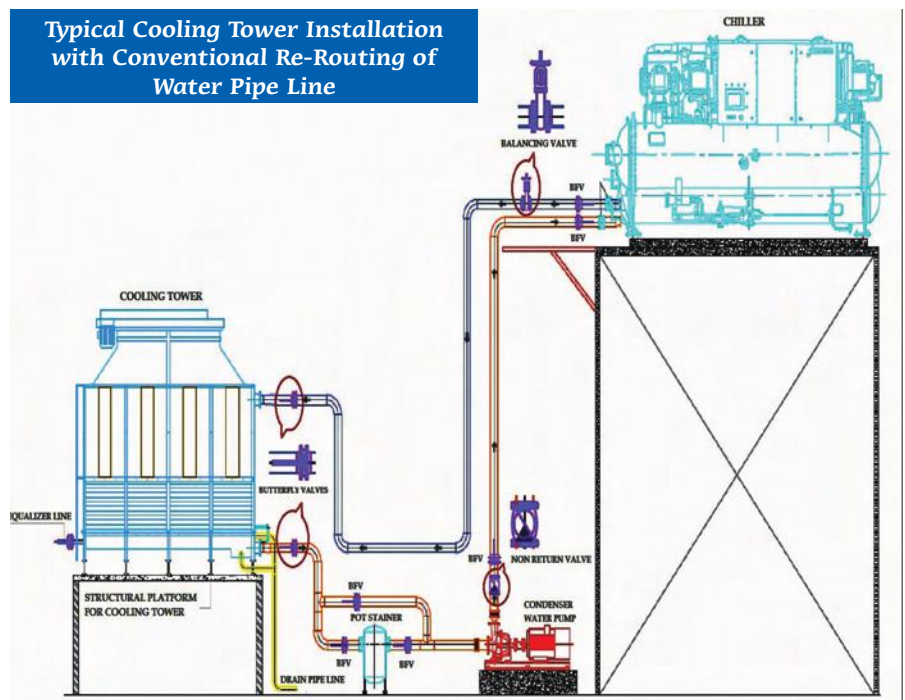
There is a standard and predefined installation technique which intellectual Engineers always speak about i.e. Cooling towers must be installed either at the same level or at an elevated level above the Chiller unit. Cooling towers are generally avoided to be installed below the level of Chiller unit. The reason is that, if the Chiller unit is installed at an elevated level above Cooling tower, then the Cooling tower Inlet water pipe line will be evacuated during pump shut "off" due to gravity and the water in the sump/basin will start overflowing due to back pressure from the suction side of condenser pump.

If under any such condition, either due to site constraint or else due to the unawareness & negligence of uneducated site Engineer, if the Chiller unit is installed at an elevated level

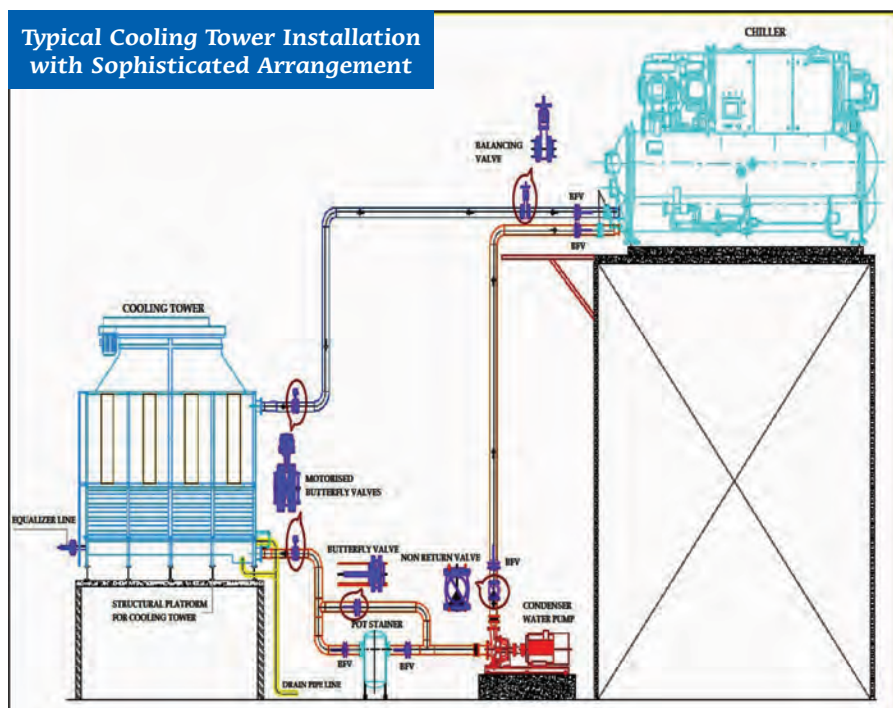
Incorrect Installation where Chiller Unit is at Elevated Level than Cooling Tower



Typical Cooling Tower Installation with Conventional Re-Routing of Water Pipe Line



Typical Cooling Tower Installation with Sophisticated Arrangement



a time consuming and an expensive activity as well. Re-routing of the water pipe line is a conventional technique that can solve such kind of stated problem.

The other best way to come out of the stated problem is to apply modern technique of electro-mechanics. This technique can sort out the problem only by installing two motorised butterfly valves which shall be interlocked with condenser water pump operation. As soon as the condenser water pump will be shut "off", both the motorised butterfly valves installed at the inlet and outlet of Cooling Tower shall be closed instantaneously and fully without any further delay of more than 5 seconds. This operation will prevent the flooding of the Cooling tower basin water due back pressure developed by condenser water pump and also will prevent the evacuation of water in the Cooling tower Inlet pipe line due to gravity during pump shut "off".

If Engineers happen to face any such kind of situation, then proper techniques shall be explored to overcome the problem & do a successful commissioning.

Parameter Recording and Analysis

Commsioning of a Cooling tower is basically done in two phases. The first

phase is done prior to the commissioning of Chiller unit from where it has to draw the heat. The second phase is done at a later stage after commissioning of Chiller unit. There are a series of parameters which have to be recorded for analytical purpose while commissioning of Cooling Tower. CTI (Cooling Technology Institue) defines the commissioning of a Cooling tower in a very broader spectrum and emphasis on certain parameters which are quite inevitable for decalring a successful commissioning of Cooling tower.

In the first phase of commissioning, the following parameters are crucial-

Air Flow Rate of a Cooling tower is a key parameter that influences other parameters too. Although the measurement of air flow in a Cooling tower is a hectic and tedious task yet unavoidable too. It is commonly found that propeller fans are used in induced draft type Cooling Towers and both propeller and centrifugal fans are used in forced draft Cooling towers. Controlling and balancing of air flow in a Cooling tower is managed well by the most conventional method of adjusting the pitch/blade angle of the propeller fans or else the optional method left is by a Variable Frequency Drive.

Water Flow Rate of a Cooling tower is another key parameter that sets an

impact on other parameters. Water flow measurement in a Cooling tower is generally done by using a calibrated ultrasonic digital flow meter. Controlling and balancing of water flow in a Cooling tower network is done by balancing valves provided in the hydronic circuit. Water flow adjustment/balancing must be done perfectly to obtain a correct operating range. Perfect water balancing is imperative for multiple Cooling towers that are interconnected in the common network to ensure apposite water flow through the system and thus shun the situation from overflow and underflow of water.

Electrical Parameters shall be recorded at both the phases. In the first phase, measurement of Voltage, Current, Power (KW) of the Cooling tower fan motor shall be recorded. If the fan is coupled with dual speed motor, then all the electrical parameters shall be recorded at both speeds. And if the fan is coupled with single speed motor with VFD then electrical parameters shall be recorded only @ 50 Hz set frequency in the first phase.

In the second phase electrical parameters shall be recorded after the commissioning of Chiller unit. These include measurement of Voltage, Current, Power (KW) of the Cooling tower fan motor when running under load operation. If the Fan is coupled with dual speed motor then all the electrical parameters shall be recorded at both speeds. And if the fan is coupled with single speed motor with VFD then electrical parameters shall be recorded at that running frequency.

Range of a Cooling tower can be defined as the difference between Cooling tower inlet water temperature and Cooling tower outlet water temperature. Mathematically

Range = Cooling Tower Inlet water temperature - Cooling Tower Outlet water temperature

Range of a Cooling tower shall be measured and recorded in the second phase after the Chiller unit is commissioned and put into operation.

Approach of a Cooling tower is the difference between Cooling tower outlet water temperature and the ambient Wet bulb temperature. Ideally a Cooling

tower must be capable enough to drop down the water temperature as much as close to ambient Wet bulb temperature. But practically, Cooling tower outlet water temperature never reaches to ambient Wet bulb temperature and thus Approach declares the gap between the Cooling tower outlet water temperature and the ambient Wet bulb temperature. This parameter shall be measured & recorded during the second phase of commissioning.

Mathematically,

Approach = Cooling Tower Outlet water temperature – Ambient Wet Bulb temperature

Enthalpy of Air is a must calculation for evaluating the performance of a Cooling tower. Enthalpy of air is derived by plotting Dry bulb temperature and Wet bulb temperature of air on a psychrometric chart. While calculating the total Enthalpy of Cooling tower, an Engineer must always consider measuring Enthalpy at three different locations i.e. Enthalpy of Cooling tower Outlet air, Enthalpy of Cooling tower Inlet air, Enthalpy of free ambient air. Emergent Engineers generally carry a bogus & fraudulent theory that the Enthalpy of Cooling tower Inlet air is the same as Enthalpy of ambient air. Theoretically and ideally this is true but practically far and wide it is not the case. If the value of Cooling tower Inlet air Enthalpy lies more or less between the values of Cooling tower outlet air Enthalpy and the value of ambient air Enthalpy, then it's a sign of short cycling of Cooling tower outlet air which might be due to the influence of various factors. It may be due to fan's weak performance or it may be due to insufficient clearance between two neighbouring Cooling towers or it may be also due to restricted air flow caused by nearest high rise structures. Such a restricted flow of air results in the poor performance of the Cooling towers.

Cooling Tower Capacity calculation shall be done individually for each of the Cooling towers in the common network with out fail. Calculation of Cooling tower capacity shall be carried out on air side as well as on water side at 100% load operation of Chiller unit.

Enthalpy of Air is a must calculation for evaluating the performance of a Cooling tower. Enthalpy of air is derived by plotting Dry bulb temperature and Wet bulb temperature of air on a psychrometric chart.

It should be noted that under any circumstance, Cooling tower's capacity shall never be calculated collectively or in a permutation-combination. For example, if two numbers of Cooling towers are installed for two numbers of Chiller units of 200 TR each, then the evaluation of capacity for each Cooling tower shall be carried out individually by running a single Chiller unit of 200 TR at Full load or 100% Load operation.

Mathematically,

Load of Cooling Tower on water side(BTU/Hr.) = 500 x USGPM x (T1-T2)

Where USGPM = Water Flow rate of Cooling Tower

T1 = Cooling Tower Inlet water temperature

T2 = Cooling Tower Outlet water temperature

Load of Cooling Tower on air side(BTU/Hr.) = 4.5 x CFM x (H2-H1)

Where CFM = Air Flow rate of Cooling Tower

H1 = Cooling Tower Inlet air Enthalpy.

H2 = Cooling Tower Outlet air Enthalpy.

L/G Ratio is a unique parameter that is purely based on the principles of thermodynamics. Ideally the whole heat extracted by water from the condenser of Chiller unit has to be transferred to the atmospheric air which never happens practically. This parameter gives a clear view about the amount of heat extracted by the water of the Cooling tower and the amount of heat transferred to the surrounding air. This parameter has its own significance. Mathematically,

$L/G = (H2-H1)/(T1-T2)$

Where, H1 = Enthalpy of Cooling Tower Inlet air

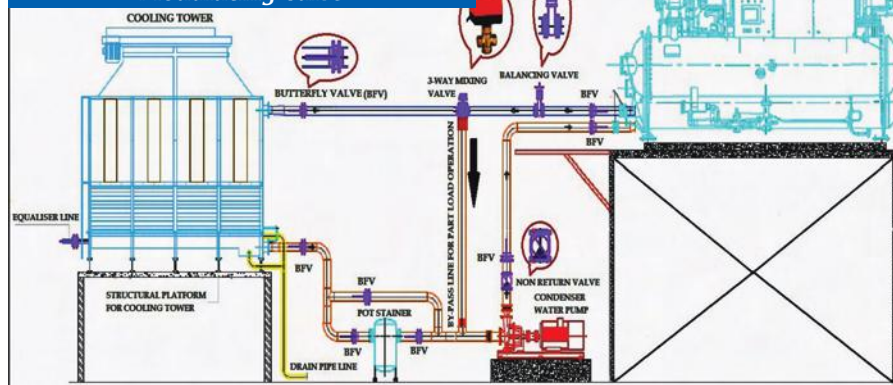
H2 = Enthalpy of Cooling Tower Outlet air

T1 = Cooling Tower Inlet water temperature

T2 = Cooling Tower Outlet water temperature.

Part Load Operation of Cooling Towers: While selecting Cooling towers for HVAC&R system, special consideration shall be given towards part load operation of Chiller units and the extreme geographical climatic conditions of that location. Even for procurement of Cooling towers, an Engineer has to specify the requirement which shall include the extreme geographical climatic conditions like Wet bulb temperature, Capacity of the Chiller unit and the desired working Range of the Cooling towers. Based on the requirement, the manufacturers design and select the Cooling towers and declare the minimum approach. If any incorrect input is given to the manufacturer, then an unsuited & mismatched capacity of Cooling towers will be delivered by the manufacturer. Under such unfavourable situation, the Cooling towers shall not be discarded; rather an Engineer must extend expertise to draw out a solution at its best. To be more illustrative, let's consider a special case where a Cooling tower is selected for a Chiller unit with screw compressor of capacity 200 TR for a location where the Wet bulb temperature during monsoon reaches to 83°F. The desired range of Cooling tower was specified to be 10°F. The Cooling tower Inlet water temperature considered is 100°F and the Cooling tower outlet water temperature considered is 90°F. But no attention was given towards odd winter conditions for that geographical location where the Dry bulb temperature drops down to as low as 59°F and the Wet bulb temperature also drops down to 53.6°F. Although the Cooling tower is designed to work with Variable Frequency Drive which shall vary the fan speed with reference to the Cooling tower outlet water temperature. During the extreme peak winter season when the Dry bulb temperature of that location falls down to 59.0°F, the Chiller Unit shall be operational at part load. By considering approach into account, the Cooling tower's minimum achievable outlet water temperature under such ambient conditions shall be 60.6°F.

Cooling Tower Installation with a by-Pass Line & 3-Way Mixing cum Modulating Valve



While the desired Condenser Inlet water temperature shall not fall below 80.0°F by any means otherwise the operation of Chiller unit will get interrupted. Under such staggering situation, the Variable frequency drive will tend to limit down the fan speed of the Cooling tower and in extreme condition it will cut "off" the fan operation thereby restricting the flow of air. But if the problem still persists then the indecent option left, is to control the flow of water in the Cooling tower which shall never be thought of, because this may cause damage to the entire system.

The best solution which has been practically proven in such critical cases

is to simply introduce a By-pass Line in the Cooling tower hydronic circuit with a three way mixing cum modulating valve. A three way mixing cum modulating valve shall be operated by an actuator and shall modulate with reference to the Cooling tower outlet water temperature. As soon as the Cooling tower outlet water temperature reaches 80°F, the three way mixing cum modulating valve will start to open the By-pass line and starts to throttle down the inflow of water to the Cooling tower. However the pump shall receive the same volume of water at its suction. The hot water from the condenser

outlet of the Chiller unit mixes up with the cold water of the Cooling tower in a definite proportion and thus the inlet water temperature to the condenser of Chiller unit shall be maintained up to the desired level without sacrificing the flow of water in the circuit. Sizing of By-pass pipe line and calculation of the water flow rate through the modified By-pass pipe line to maintain a desired temperature at the Condenser Inlet of the Chiller unit shall be the scope of designing.

Since almost all the Contracting companies in India usually procure almost all the major and capital equipments from the market (may be from OEMs or Traders) and sell it to the client. A perfect commissioning of the system discloses whether the equipment procured from the market is right enough to justify its cost and at the same time it also gives the privilege to the end user to get the optimum and the best out of it. An erroneous commissioning will not only squeeze the money of the contractor but also will tail off the confidence of the end user/client on the contractor. So it's the choice of the contractor to opt for and take the decision shrewdly. ■

Clasimat optimises warehouse space and reduces storage costs

The Clasimat® Vertical Lift Module (VLM) from Mecalux, a completely enclosed space-saving vertical automated storage system, is marketed, sold and serviced in southern Africa by APC Storage Solutions SA. It is designed to maximise warehouse storage capacity by optimising storage space through extendable heights in a compact manner which can drive down warehouse costs by up to as much as 30%.

This unique storage system uses compartments within the VLM which can reach heights of 15.4 m. As the VLM is a sealed unit, controlled via the Mecalux EasyWMS software, security and safety are enhanced beyond conventional storage. In addition, limited human interaction decreases any possible security issues as only one machine operator is required. This means the goods stored inside are protected from possible accidental impact and improper



handling. The door, which opens only when merchandise is picked or delivered, consists of two downward sliding panels preventing access to the shuttle from the front.

Fred Albrecht, APC Storage Solutions SA Managing Director

points out, "The totally sealable unit also prevents stored items from gathering dust and grime." The Clasimat can be used for storing all types of products generally stored in boxes, such as tools and electric components. Its high security value also makes it ideal for valuable or risky items including jewellery, pharmaceutical drugs, optical items and valuable documents, for example. "The Clasimat location is determined by the clients," Albrecht adds. ■

Mechanical Room Efficiency and Optimisation



Victaulic - suction diffuser

"A suction diffuser enables pipework to be connected closer to the pump, permitting a smaller mechanical room footprint."

Grooved-end mechanical piping systems reduce the mechanical room footprint, enhance system performance and save time and cost on installation, says Andy Carter, Product Engineer at Victaulic.

Controlling costs & compressing schedules without sacrificing quality are key concerns for contractors responsible for mechanical room installations. Clients are looking for on-time, on-budget delivery of high-quality systems that work well and are easy to maintain. Alongside these drivers, space is becoming a critical factor.

The high cost of commercial and industrial building space and its scarcity has led to a growing trend to squeeze the size of mechanical rooms. Ever tighter

architectural designs for new builds are putting pressure on consulting engineers and contractors to deliver reliable, cost-effective HVAC solutions that keep the mechanical room footprint to a minimum. Similar demands are being made for mechanical room retrofits within the structural constraints of older buildings.

Grooved-end mechanical piping systems address all these issues. The lighter weight, smaller size yet higher integral strength of grooved components compared with welded

Andy Carter is Product Engineer at Victaulic, the world leader in mechanical pipe joining systems, and is an affiliate member of the Chartered Institution of Building Services Engineers. He has a degree in mechanical and electrical engineering and 23 years' experience of providing technical support for a range of products.



or flanged systems, make them ideal for projects that are tight on space or where mechanical rooms are located on higher-level floors. Their ease and speed of installation offer savings on total installed costs and they also deliver improved performance and reliability.

Eliminating rubber bellows

Victaulic grooved couplings are designed with an elastomeric gasket contained inside the internal cavity of a ductile iron or stainless steel housing and secured by two nuts and bolts to create a leak-tight joint. This unique design gives the couplings noise and vibration reducing properties superior to those of traditional devices.

In traditional mechanical room set-ups rubber bellows or compensators are placed in the piping system at either side of the pump to reduce noise and vibration and are sometimes used to correct misalignment between welded pipe and equipment, placing the rubber under intense stress in a certain plane. Not only do they take up valuable plantroom space, but rubber bellows are considered the weakest point of an

installation and the first component that is likely to fail, as general wear and tear, along with exposure to UV light in the mechanical room, causes the rubber to erode.

They also require ongoing maintenance: as bolts gradually slacken and the system starts to weep, the bolts need to be tightened regularly. With a best life expectancy of 10 years, rubber bellows may need to be replaced several times within the life of the system - which involves system downtime plus the cost of a new unit. Failure of the rubber bellows can be sudden and unpredictable, causing serious health and safety risks if, for example, the rubber splits and water escapes.

Installing three Victaulic grooved flexible couplings on each side of a pump solves these problems. It eliminates the need for costly, bulky flanged units and avoids the use of rubber bellows. The coupling construction enables the gasket to seal against the pipe, while the metal housing provides both space for the resilient elastomeric material to flex, and containment to prevent over stretching.

This creates a discontinuity similar to that of a rubber compensator. Additionally, ductile iron and stainless steel both have their own vibration dampening qualities, so the external housing also serves to absorb sound, thereby protecting equipment and enhancing the life time of the system.

A further advantage is removing the need for tie rods or the type of bracketry required to support pipework on top of and beneath bellows which increases time, labour and material costs. Special bracketry must either be prefabricated or fabricated on site and can account for around two thirds of the cost of installing a metre of pipe. Installations with flexible grooved couplings avoid these issues as they only require conventional brackets.

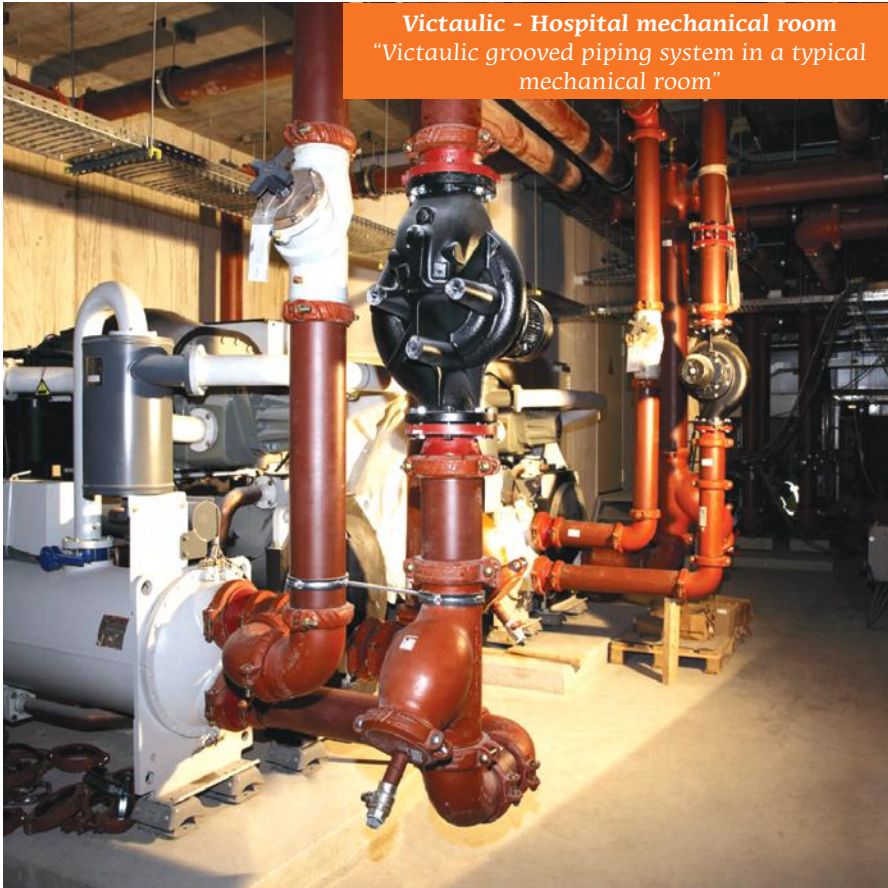
Three Victaulic flexible couplings can be used not only with pumps but also with chiller units, cooling towers and any equipment with an engine that causes vibration. The use of additional grooved couplings - whether flexible or rigid - in the distribution lines will further reduce the transmission of vibration. By combining versatility with durability, the method provides a low-maintenance solution that saves space and delivers both practical and commercial benefits throughout the life of the system.

Avoiding misalignment

In addition to noise and vibration attenuation, Victaulic grooved couplings allow for alignment ease in a pump installation. The pipe and system components can be fully rotated before tightening, without creating stress on the pump flange or equipment connection. Flexible couplings also help to accommodate slight deviation that might be caused if pipework has not been prefabricated to exact dimensions - something which is more difficult to achieve with a welded or flanged system.

Improving pump efficiency

Cavitation is a problem frequently experienced, especially where space is limited. When turbulent water enters a pump chamber and the suction eye of a pump impeller, the degree of turbulence has a direct correlation with lower pump efficiency and greater hydraulic noise within the pump casing. To reduce the effects of turbulence before the water enters the centrifugal action of the pump impeller, suction pipes are typically kept as long and straight as possible before the connection onto the pump flange. Yet creating long lengths of pipe does not sit well with modern design trends which aim to keep mechanical rooms simple and compact.



Victaulic - Hospital mechanical room
 "Victaulic grooved piping system in a typical mechanical room"

Where a bend is connected directly onto the pump suction, the water flow may spin in opposite directions within the eye of the impeller. Pump energy then has to be spent correcting this action before producing the expected performance. Inevitably, both flow and pressure measurements will be less than those expected at the design stage. A simple alternative is to fit a type of strainer called a suction diffuser. A suction diffuser straightens out the spinning fluid created by the change in direction (bend) and enables pipework to be connected closer to the pump at a 90-degree angle. Eliminating long pipe runs, elbows and reducers makes for a smaller mechanical room footprint and optimum pump performance.

Designing mechanical rooms with grooved valves achieves similar space savings. Traditionally, check valves and butterfly valves need a spool piece between them to avoid damage to the valves. Having grooved check valves, close-coupled to grooved butterfly valves, eliminates the use of flanged spool pieces on the pump dressings and cuts out the need for flange adapters.

Again, this reduces the mechanical room footprint. But space saving is not the only advantage: there are cost benefits too. When it comes to installation, avoiding an extra spool between valves means the job is completed more quickly so labour costs are reduced.

Cutting labour risk

Driving down costs is a key objective for contractors. Whilst material costs are relatively easy to fix, labour costs are more volatile, leaving contractors open to significant labour risk on project costings. The grooved mechanical system reduces that risk by a large factor and competes favourably on total installed costs because a larger proportion of the total costs is fixed. When other joining methods are used, typically 70% of costs are subject to variation making it difficult to estimate, which means a greater risk to the project budget. A grooved mechanical system with a quick and simple joining method and no need for jobsite preparation offers considerable cost-saving opportunities on installation.

Time spent on the jobsite is a critical

cost factor, leading contractors to prefabricate as much as possible offsite. Prefabrication offers major productivity gains and labour efficiencies – especially when there is limited space on site. Creating a controlled working environment enables the optimum organization of work and utilization of skills, facilitating the highest standard of workmanship and reducing material waste.

The Victaulic grooved system lends itself to prefabrication, since pipes can be cut and grooved offsite and valves fitted to pump assemblies ready for final assembly in the field as needed. Working in such a way avoids the risk of loss or damage to components on the jobsite, whilst reduced material handling lowers the potential for accidents.

Time savings

Ease and speed of installation are key benefits of grooved mechanical room installations, since just two nuts and bolts are needed to form a secure joint. Compared with the multiple nuts and bolts on a flanged strainer, depending on size, suction diffusers are up to three times faster to install. Once installed, the grooved system provides for quality control through visual confirmation of proper installation. Metal-to-metal bolt pad connection indicates that the joint is properly made and avoids time-consuming X-ray tests.

A system that uses grooved pipe-joining technology can be flushed out and cleaned in a fraction of the time needed for a system joined by other methods. When pieces of equipment need to be disconnected from the system – for instance to avoid flushing dirty water through a chiller – this can be done quickly and simply. A temporary by-pass around a chiller that might take several days on a welded system can be avoided with the grooved system and the task completed in a few hours.

When it comes to cleaning filters and strainers after flushing, access is much quicker and easier through the loosening of two nuts and bolts and the way the filter is positioned in the strainer makes it easy to extract. Modifications to pipework which may be required at any stage during the project can be



Victaulic - filters and strainers
"Access to filters and strainers is faster and easier with a mechanical grooved system."

completed with similar ease. Tasks such as changing out a filter or replacing a pump can be done in minutes rather than hours.

Conclusion

Switching from welded and flanged specifications to the grooved method for mechanical room installations can make a big difference to the success of a project. And its

Get into the Groove

Grooved-end pipe joining, or the "grooved" concept as it is known today, was invented in 1919 when the company now known as Victaulic designed the first mechanical pipe joint. Since being made commercially available it has become a preferred joining method on many piping applications.

A mechanical joint is comprised of four elements: grooved pipe, a gasket, a coupling housing, and nuts and bolts. The pipe groove is made by cold forming or machining a groove into the end of a pipe. The key section of the coupling housing engages the groove and the bolts and nuts are tightened with a socket wrench or impact wrench and hold the housing segments together. In the installed state, the coupling housing segments encase the gasket and engage the grooves around the circumference of the pipe to create a leak-tight seal in a self-restrained pipe joint.

Couplings provide the convenience of a union at every joint and fall into two categories: flexible and rigid. Both provide the security of full circumferential engagement of the coupling into the groove for high pressure and end load performance. Rigidity is achieved with rigid couplings. The unique angled pad design provides positive clamping of the pipe to resist torsional and flexural loads.

Flexible couplings allow controlled angular, linear and rotational movement, which accommodates pipeline deflection as well as thermal expansion and contraction.

use is becoming more widespread. Because manufacturers of pumps and some other types of equipment have come to realize the advantages of grooved technology, many now offer a grooved outlet as a standard option. Not only does it make for easier product testing in the factory, but manufacturers know that having a grooved connection reduces the likelihood of additional forces on the equipment that could damage it.

Engineers, contractors and owners all stand to gain from Victaulic grooved systems. Design engineers can realize space savings; contractors can make time and cost savings to achieve on-time, on-budget hand-over to the client; owners get an efficient, reliable system which is easy to maintain. ■



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Frigo'sco flash defrost system wins international clean-tech Award at Monaco

Frigesco's pioneering flash defrost system for cold rooms and refrigerated cabinets has won a prestigious international award at Clean Equity Monaco 2014.



The patented technology can reduce annual running costs for refrigeration systems by up to 25 per cent, plus extend the life of plant, safeguard food hygiene, and improve health and safety for store employees.

The innovation has been developed by a team headed by Professor Tom Davies. It beat 22 rival entries from 11 countries to win the top accolade for Excellence in the field of Environmental Technology Development.

David Walter, managing director of Frigo'sco, was presented with the award by His Serene Highness Prince Albert II of Monaco.

The international accolade is the latest in a string of endorsements for Frigo'sco's pioneering flash defrost technology. The company was awarded a Department of Energy and Climate Change (DECC) grant last year, and invited to participate

in Cleantech Innovate, the leading UK green technology event, backed by DECC and the Institution of Mechanical Engineers. Its presence there led to an invitation to present the innovation in Monaco.

David Walter said: "It's a huge honour to receive this international award and reflects a lot of hard work, creativity and commitment on the part of the Frigo'sco team. We believe the Frigo'sco flash defrost system is a world beater, and will become a mainstream technology throughout the refrigeration industry."

If supermarkets adopted the system worldwide, it would save an estimated £1.6bn in energy costs. "With energy prices increasingly sharply, pay-back times are getting shorter and the scale of potential energy savings increasing," said David Walter.

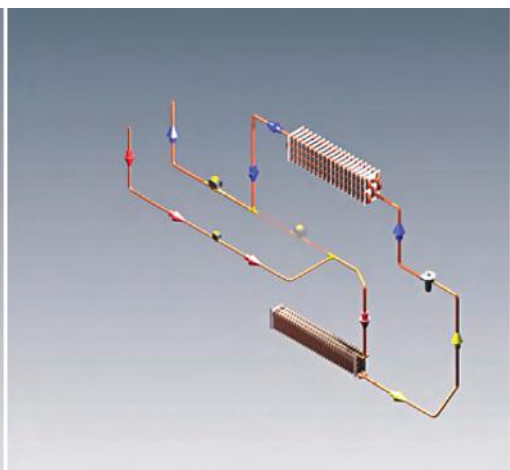
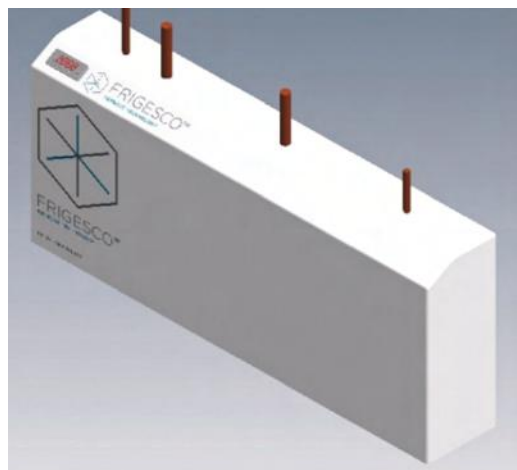
Traditional methods of defrosting refrigeration systems require electric heaters, or "hot gas" from the system, which makes the refrigeration plant less efficient. The additional energy required for melting frost build-up can cost a store thousands of pounds a year.

Frigo'sco's system uses a special phase-change material to store heat energy generated by the refrigeration system in the course of normal operation. It uses this heat to defrost evaporators, without the need for additional energy.

As the phase-change material absorbs and removes heat from the refrigeration system, it makes it more efficient and adds a sub-cooling effect, improving performance again and yielding further energy savings.

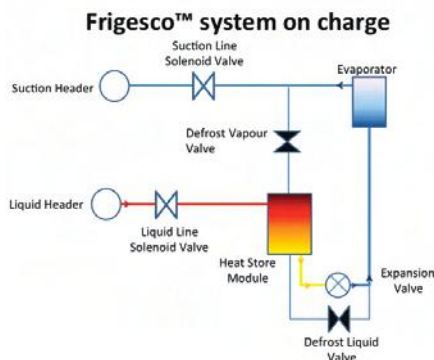
Although the main benefit is a

Frigo'sco's system uses a special phase-change material to store heat energy generated by the refrigeration system in the course of normal operation.



reduction in energy use and lower running costs, the Frigesco system delivers other attractive benefits for retailers. These include:

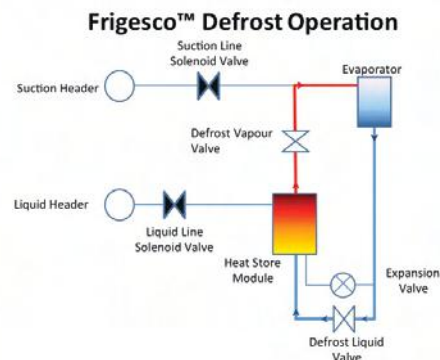
- Improved food hygiene and safety due to more effective defrosts, and more stable temperatures in the refrigerated space;
- Increased working life and fewer breakdowns for refrigeration plant, due to more complete defrosts and improved equipment operation;
- Potential reductions in equipment capital 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.

Having proven the technology in test conditions, Frigesco is now working with a number of major UK food retailers on rolling out in-store trials at locations across the country. 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 authority on retail



refrigeration, has joined the Frigesco team to help develop and commercialise the technology.

Bob Arthur said: "The 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.

He added, "Given the potential savings, and relatively low capital cost, I believe Frigesco flash defrost technology will be widely adopted by supermarkets in the near future." ■

ASHRAE proposes to move all Residential IAQ Requirements to Standard 62.2

Dwelling units of multifamily buildings of any height would fall under ASHRAE's residential ventilation standard, 62.2, under a proposed change designed to provide consistency of ventilation requirements. Currently, ANSI/ASHRAE Standard 62.1-2013, Ventilation for Acceptable Indoor Air Quality, has responsibility for multifamily residential buildings 4 stories or more, while ANSI/ASHRAE Standard 62.2-2013, Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings, has responsibility for residential buildings 3 stories and less.

"The Standards 62.1 and 62.2 committees are proposing scope changes that would result in the dwelling units of all multifamily buildings being covered by Standard 62.2," Paul Francisco, chair of the Standard 62.2 committee, said. "Common areas would be covered by 62.1. This will provide consistency of ventilation requirements



for dwelling units regardless of building height. For new construction, this will result in a change of requirements for dwelling units in 4+ story buildings. For the retrofit market, this change will result in coverage by ASHRAE ventilation standards for the first time in 4+ story buildings."

The proposed changes are being made via addendum a to Standard 62.1-2013 and addendum g to Standard 62.2-2013, which are open for public review from April 4 to May 4, 2014. For more information, visit www.ashrae.org/publicreviews.

The ventilation rates for dwelling units in Standard 62.1 are different from the rates in Standard 62.2, and this inconsistency has caused concern for some, according to 62.1 committee chair Roger Hedrick. Additionally, Standard 62.1 does not address modest retrofits whereas Standard 62.2 does.

"The retrofit market is a major user of ASHRAE ventilation standards," he said. "This will allow for consistency across dwelling units and also allow application of ASHRAE ventilation standards to the multifamily retrofit market."

Francisco agreed, saying, "Given the growth of the retrofit industry in multifamily dwellings it is important to ensure that these situations are covered in ASHRAE's ventilation standards." ASHRAE, founded in 1894, is a building technology society with more than 50,000 members worldwide. The Society and its members focus on building systems, energy efficiency, indoor air quality, refrigeration & sustainability. ■

Toshiba distributor AMP expands sales team to support strong growth in air conditioning

AMP, one of the UK's longest established and successful independent air conditioning distributors, is expanding its sales team to support continued growth.

The Toshiba distributor has taken on three new area sales engineers, Andy Coleman, Andy Wilks and Rob Woods, increasing its sales team to 15 external and five internal staff. The company's recruitment drive is ongoing, to support strong year-on-year growth.

Polly McConachie, AMP director, said: "The new appointments significantly extend the company's ability to support existing and new customers. We put huge store on the quality of our sales team and the excellence of the service they provide.

"Collectively, the expanded team has 130 years' experience with AMP, and – unbelievably – nearly 500 years in the industry. With this kind of experience and AMP's can-do approach, we believe we have the best team in the business – backed by fantastic sales support and admin staff.

"Couple this with in-depth technical knowledge and premium brands such as Toshiba, and you have a winning formula, that is proven to deliver for both installers and clients."

AMP puts great emphasis on staff training, with product workshops and Customer Relationship Management (CRM) training held in-house. It also organises tailored sales training for team members, based on individual requirements.

Staff are also supported and encouraged to study for NVQ

qualifications in management and customer care training.

Martin Michaelson, AMP co-founder and fellow director, says: "In our sector, where customers rely on detailed technical knowledge of the product and diverse applications, it is hard to exaggerate the importance of team work and experience. Many of our people have been in the industry since its infancy, and have grown up with it."

He adds, "The positive and supportive environment at AMP has helped produce some of the longest-serving and knowledgeable sales people in the industry."

He cites the examples of Rachel Wales, who has been with the company for 22-years, and Paul Court and Sean Puckle, each with 21-years' service.

AMP was established by Polly McConachie and Martin Michaelson in 1989, and currently celebrating its Silver Jubilee. The company is planning a series of industry and customer events to mark the achievement of this milestone, spanning the year.

Since being established, it has grown to become a £17m turnover business, specialising in high efficiency, premium brand air conditioning. The full AMP team is now 41 strong, with headquarters at Welwyn Garden City and branches in the Midlands and Bristol.

Despite substantial growth and continuing ambitions for the future, AMP prides itself in retaining its original strengths as a friendly, people-focused business, always willing to go the extra mile for customers. ■



Courtesy:
AMP Air Conditioning Limited, UK

RI. DA. P

The company founded in 1969, deals with processing plastics. It is located in Castello di Annone, ASTI-ITALY in two production units that occupy a total area of 50,000 sq mtr. The company is constantly evolving to satisfy the needs of the market & has the objective to collaborate with customers to constantly improving products and service provided. The constant commitment to all levels in managing the company is monitored and assisted by one of the most important certification authorities DNV according to ISO 9001:2008.



Technology

The company perspective of flexibility and customization to the request made by the customer follows the entire production chain, from the granulation of some of the materials used, the design of the mold, the realization of the extruded until the machine performed off-line. The facilities available to the department profiles are such as the equipment

extrusion; machines for injection; mechanical machining; machinery of finish; designing. The opportunity to working a large range of raw materials, allow covering almost all the request.

Industries

The main areas where the products made by RIDAP are refrigeration, furniture and storage, home accessories, construction, technician-industrial, food industry. ■

Website: www.ridap.com

Suroop Fresh Pvt Ltd

Suroop Fresh Private Ltd is a rapidly growing venture in post-harvest management of horticulture produce. Its first controlled atmosphere cold store is situated at village Lahe, near shahpur on Mumbai Nasik Express Way. This is the first of its kind CA Cold Storage in Maharashtra. Suroop fresh has set up this 5000MT facility with controlled atmosphere storage and cold chain facility with latest technology with the objective of reducing post-harvest losses of horticulture produce to overcome the lack of proper storage and supply chain facilities for fruits and vegetables. Suroop provides services such as CA cold store renting, sorting, grading &



packing lines, refer logistics, import & export processing, pre cooling of fruits & vegetables, space for distribution centre, supply chain of fruits and vegetables, packaging of fruits and vegetables. The company has technical expertise and professional approach with state of the art information technology, creativity and innovation as guiding principle. The company is first in Maharashtra, multi chamber multi commodity controlled atmosphere cold storage of perishable

commodities with temperature, relative humidity, and O₂ & CO₂ control, having storage capacity of 5000 MT. 20 CA Chambers of 250 MT each with computerized temperature & RH, O₂ AND CO₂ controls. Every Chamber can have different temperature, relative humidity, and O₂ AND CO₂ concentration to suit stored produce. Fully automated loading and unloading with efficient racking systems. State of the art technology of storage with necessary certifications and 24/7 online access to the best traceability and quick services to all their clients. ■

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Website: www.suroop.com

Wuxi Micro Research Co Ltd

Wuxi Micro Research Co Ltd is located in Wuxi Liyuan Economic Development Zone. The company is mainly engaged in development, manufacturing and sales of air conditioning fin dies, semiconductor packaging dies, high precision connectors, and precision spare parts, etc. It is established in May, 1995. As a first foreign company enters into the Chinese precise tooling industry. Wuxi Micro as an industrial leader owns a



professional technician and management group and world-class high precision equipments which provide professional services of designing. The company provides super excellent quality products and services. Overall the company has been making progress possible and driving positive

and sustainable changes in Chinese precise tooling industry. The company carries out the "863 Key Project of the Ministry of Science and Technology" in the university-industry collaboration mechanism, and founded the Jiangsu Micro-Nano Manufacturing Technology and Equipment Engineering Technology Research Center and Mobile Postdoctoral Station. ■

Website: www.wxmr.com

Advanced Test Products bring PROMAX ADS-100 "Slimline" Refrigerant Scale



A revised and updated version of the classic TIF Slimline scale, the ADS-100 brings greater performance, reliability and usability to the trade. With the greatest resolution in the industry, and no compromise on capacity, this unit offers features and specs that one won't want to do without.

Features

100 kg or 20 lbs capacity; three display modes, Kilograms; lbs/oz; Decimal lbs; Very high resolution: 4 grams / 0, 2 oz / 0.010 lbs; compact design and completely portable; extreme accuracy; auto zero; removable platform and control box with prop stand/hanging hook; charging and recovery capabilities; overload protected; CE approved; two year warranty.

Specifications

It has resolution of 4 grams / 0.2 oz / 0.010 lbs;
It has an accuracy of $\pm 0.5\%$ of reading;
Its operating temp is -100 to 490 C;
Power Supply is 1 x 9V Alkaline battery;
Its battery Life is 20 hours;
Coil Cord Length is 1, 8 m (6 ft).

Website: www.atp-europe.de

Convertible multi refrigerant 4-in -1 by CPS Products (Europe)

The FA 1234 is a patented multi refrigerant Convertable R/R/R machine that can be converted for use with any of the following refrigerants in 5 minutes or less: R-134a, HFO-1234yf, R-22 and R-407C. This R/R/R convertible unit is currently the only machine in the market without fear of cross contamination when converted back and forth.



Key Benefits

Ball valves instead of solenoid valves (increases flow rate/ avoids valve leakage caused by dirt contamination). Converting from one refrigerant to another in 5 minutes or less (back and forth). Can be used for cars, buses, trucks, heavy-duty (minimal conversion necessary).

Website: www.cpsproducts.com

Crystal Titan Containers bring Dry Van and Dry Specials



Company Operate the full range of dry van and dry special containers including

some models not generally available. It is available in various size /types. All types are available for hire or sale as new containers. Many types are also available in used and refurbished condition. Naturally all are supplied with valid CSC plates. Containers can be supplied from with return acceptable in many parts of the world. Similarly they can supply outside of India with return at Indian or other worldwide locations. Domestic use containers for DTA logistics and storage applications are also available. Long & short (spot) term hire as well as 1-way rental term are offered. For off shore containers please see the next pages; DNA Containers.

Website: www.ctcontainers.in

Drainsweeper UC-PL Series (Vacuum Suction Types) Centralized Drain System by Ucan Co Ltd



Drainsweeper Jumbo **UL-PL240S / PL240W**; and Medium **UC-PL140S / PL140W** are installed in the lower part of a building, such as in a basement machine room. A specially designed duct hose connects the drain port of an air conditioner to a drainage receiving tank. The drainage that accumulates in a receiving tank is sucked through a flexible tube into a

drain pipe normally built inside the building's pipe shaft and then ultimately into a Drainsweeper unit. The W-type utilizes two vacuum pumps, which work in parallel until a certain degree of vacuum is reached.

Features

Only one unit can handle the condensate draining from several tens of air-conditioning units. No need to be concerned with inclination in the pipe line. With use of easy to install one action fittings, there is no need for thread cutting or gluing. Installation is extremely simple and easy.

Application

For disposition of condensation draining from plugged into the ceiling type air-conditioning units. At the time of renovation of air-conditioning system.

Website: www.ucan.co.jp

Frick introduces Rotary Screw Compressors



The Frick rotary screw compressor units range in capacity from 255 CFM through 1120 CFM at 2950 RPM and has seven high efficiency models. This product is vibration-free, compact and designed for all industrial refrigeration and air conditioning requirements. These screw compressors can run for almost all gases like R-717, R-22, and R-134a etc.

Features

- Dual capacity control system.
- Variable volume ratio control.
- PLC based automation.
- Flexible operation parameters.
- Highly energy efficient.
- Low maintenance.
- Efficient oil separation system.
- Ideal for large plants with varying fluctuating temperatures.

Application

It is applicable for marine, petrochemicals, breweries, ice slurries, food and beverages, chemical industries, air-conditioning, cold storages, fisheries, pharmaceutical industry. ■

Website: www.frickweb.com

g-tek brings little master- transit

Little Master – Transit

Ideal for recording temperature during shipping and transport, LM Transit series are easy to use, accurate and affordable solutions for your requirements. Waterproof (IP 65) ensures that one can place them in the most demanding of environments.



Features

It is easy to use and gives indication for start of logging. Little master-transit is cost effective, single use data logger. Predefined logging interval- 15 minutes. Stops after the memory the memory is full or once the data is downloaded. Storage resolution 0.1. IP65 ingress of dust proof. Some of the software features are that the LMDisp Software is user friendly. It has a secure data and batch is automatically downloaded on connect. It display data in tabular and graphical format and has zoom in and out facility. ■

Website: www.gtek-india.com

Rotary Twin Screw Compressors (Bare Shaft Screw Compressors) by Howden

Howden Process Compressors also designs & manufactures a range of high efficiency turbo blowers for process air applications, over 1,250 howden turbo blowers have been supplied worldwide over the past 50 years.



Howden Compressors Ltd made the world's first commercial rotary twin screw compressor in the 1930's and supplies the largest and most versatile range of oil injected and oil free screw compressors. Howden Compressors Ltd supplies Oil Injected bare shaft screw compressors through their global network of nominated packagers and distributors. The company offers oil free screw compressors as bespoke designed, complete packaged systems supplied through their specialist packaging business Howden Process Compressors. ■

Website: www.howden.com

LAMILUX plan applications in cooling industry

Lamiluxplan meets European food grade requirements and is extensively used in food and pharmaceutical industry. It is hygienic and easy to clean and is moisture resistant. Since it is available in all colors no exterior coating and painting required. Some of the structural qualities are such that it is more than 40% lighter than steel and is high in mechanical strength.



It has higher thermal insulation and strong corrosion resistance. It is recommended in chlorine environment.

Lamilux product range

Sandwich panels become more efficient with the use of FRP/GRP as skin layers inside and outside all applications in the cold chain industry. This latest German technology is now available in India. The lamiluxplan comes in coils with maximum width of 3.2 m; thickness between 0.8 mm till 5.0 mm; density approximately 1,350 kg/m³; heat conductivity 0,21 W/Mk; gel coat layer provides UV resistance and color stability; all colors available. ■

Website: www.lamilux.com

Metaflex brings Horizontal Sliding Doors

Some of the benefits of horizontal sliding doors are that Metaflex has used European technology which meets all international quality standards and regulations. The door is surrounded by a four side rubber sealing gasket that ensures hermetic sealing, which reduces the risk of loss of cooling and controls the temperature. The door slides on an overhead track which is made of high quality aluminium extrusion with indentations for a 3D movement to ensure complete hermetic sealing while closing. The insulation properties ensure the environment temperature humidity can be maintained as required.

Features

Best suited for temperature controlled areas. Hermetic sealing to prevent leakages. European technology. This product is energy efficient. The trolley movements are easy through the door. There is no floor obstruction.

Applications

It is applicable to agri-horticulture; dairy; meat & fisheries; food processing units; warehousing; distribution centre; cold chains; pack houses; other special application areas. ■

Website: www.metaflexdoors.in

Refrigerant Pumps Type GP by WITT

T.H.WITT Kältemaschinenfabrik GmbH introduces refrigerant pump type GP that are strong, open-type standard pumps. They are extremely easy to service-an important benefit in many export markets. Since gas contained within the liquid refrigerant can also be delivered, the pumps possess automatic "self-recovery" properties. The pump complies with all national or international regulations, e.g. EN378. A full range of equipment options include isolation valves and combined discharge stop/ non-return valve, suction strainers, etc. Their discharge valves for GP pumps are designed and supplied with vent line and pressure gauge connection. They offer WITT GP pumps for a capacity range from 1 to 16 m³/h and delivery heads of to 70 m. ■



Website: www.th-witt.com

Compact Fans by Hicool Electronic Industries



Compact DC fans (all metal) also known as Brushless DC fans are used in Power Supplies, Telecommunication Equipment, Computer Equipment, High End Servers and other high temperature and high pressure operating systems. The all metal compact housing and impellers make this fan very efficient under extreme conditions & suitable for speed regulation. Amongst other advantages these brushless fans have low power consumption, low noise & a vast life span. Hicool Compact DC all metal fans are endowed with excellent safety features. ■

Website: www.hicoolfans.com

Chill Kart by Rinac India Ltd

Features

No fuel or energy required for refrigeration during transport. Eutectic plates provide necessary cooling hence nullifying use of fan cooling type evaporator unit. Temperature maintained for 10-12 hrs. Use of roll container system and side service door. Rigid Polyurethane Foam used as insulation for body. GRP Sheets bonded to insulation.



Benefits

Economical transport with saving on fuel, energy and labour. No moving parts while refrigeration systems is in operation. Easy unloading of products from roll containers through side service doors. GRP sheets ensures lowered weight hence higher payload capacity and effective areas for merchandising.

Advantages

Reduced operating costs. Skilled personnel not required for handling system. Life of system will be as long as the life of the truck. Excellent product protection in case of breakdown of truck. Temperature maintained without use of external energy source. ■

Website: www.rinac.com

Ucan Co Ltd offers FT-W40/W40S UVSV



It comes equipped with germicidal device with use of UV lamps and drainage solenoid valve. This wall-mounted unit is suitable for the whole range of applications from prefabricated refrigerator for vegetables and fruits to simplified environmental test laboratory. By using of new-type nozzle which can rotate in a 360-degree, and powerful fan ensure to spray twice as long distance as the conventional ultrasonic humidifier.

Features

Double throw of spray mist than conventional ultrasonic humidifier. Rotatable spray nozzles make it possible to spray any targeted area. High power humidity output: 2.4 liter / hour (W40 type) spray the ultrafine particle mist which does not drop down.

Application

Refrigerated storage for vegetables, fruits, grains, cut flowers, etc. Vegetable resuscitation storages in supermarkets Mushroom cultivations. Factories for tobaccos, printings, textiles, electronic components, food manufacturings etc. Air conditioning for test rooms, computer rooms, museums, clean rooms. ■

Website: www.ucan.co.jp

Nadi brings VKA



Nadi Technologies Pvt Ltd is a part of the Nadi Group of companies which has over 56 years of experience 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. Pfannenbergl GmbH, Germany for Thermal management, filters fans & signaling technology.

VKA

Circular duct fans 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. Motor: external rotor, motor protection built-thermal-contact, free-maintenance ball bearings. VKA powder coated painting RAL 7035. ■

Website: www.naditech.in

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ISH China & CIHE 2014 opens with over 970 exhibitors

New China International Exhibition Center, Beijing, China, May 2014



The 2014 edition of ISH China & CIHE – the China International Trade Fair for Sanitation, Heating, Ventilation & Air-Conditioning officially opens with one of its strongest collections of top industry suppliers on display. Organised by Messe Frankfurt (Shanghai) Co Ltd and Beijing B&D Tiger Exhibition Co Ltd, the fair ran from May 13 – 15, 2014 at Beijing's New China International Exhibition Center. Attendees to the show could find a wealth of specialties, including the latest innovations and practical solutions in HVAC, plumbing and sanitation technologies for commercial and residential use.

The launch of the building water supply and drainage section as well as a stronger German and Italian Pavilion line-up have contributed to greater participation from local and international exhibitors. The three-day event will welcome over 970 suppliers from 18 countries and regions, covering 85,000 sqm of exhibition space across six halls. This resulted in an 11% and 6% increase in both exhibitors and exhibitions space respectively from 2013. More than 40,000 professional visitors from worldwide are expected. The product category allocations at the exhibition venue are as follows:

- Hall E1, E2: Boilers/Wall-hung Boilers/ Heat Pumps / Solar Energy
- Hall E3: Radiators & Fittings/ Heat Exchangers
- Hall W1, W2: Floor-heating/ Pipes/ Sanitation/ Valves/ Ventilation/ Control Systems
- Hall W3: Heat Meters / HVAC Products for Energy-saving.

Over 50 concurrent events highlight the development trends of the HVAC & plumbing industry

Further expanding the exhibitor turnout, the show's organisers have gathered some of the sector's leading players from business and academia to share their views on the current market

as well as future developmental trends for the industry. Over 50 concurrent events are supposedly scheduled to run at the 2014 show and are categorised into four major themes, including technology exchange, idea innovation, match-making and technology display.

Technology Exchange & Idea Innovation

- **Sino European HVAC Congress:** With the support of overseas and domestic associations, the congress' organisers have added a series of discussion topics to better reflect the industry's most current issues and breakthroughs. It also serves as a premier platform for acquiring knowledge on heating technology and exchanging industry experience. Key areas for discussion include central heating, individual heating, heat pump technology, floor-heating as well as ventilation & air-conditioning.
- **China International Building Water Supply and Drainage Forum:** The organisers have partnered with the Architectural Society of China Water Supply and Wastewater Association, to debut the China International Building Water Supply and Drainage Forum at the 2014 show. "Rainwater Harvesting, Utilisation and Drainage Management" will serve as the theme for the congress, aiming to discuss the development and market trends of the building plumbing industry in China, as well as showcasing international cutting-edge plumbing technology and products.

Match-making

- **LOHAS Cocktail Reception:** Co-organised with Sina Dichan, the LOHAS Cocktail Reception aims to provide a professional networking platform for property developers and suppliers to share industry knowledge and market trends on different segments in the industry.
- **Plumbing Product Presentation:**

The plumbing product presentation is a leading platform where top plumbing brands can showcase their latest products and technologies. This presentation platform aims to facilitate business connections between quality buyers from various commercial enterprises with exhibiting suppliers.

Technology Display

- **Three Innovative HVAC Technology Display Zones:** With the support of multiple industry associations, the Innovative HVAC Technology Display Zones will showcase Europe's latest HVAC technologies as well as key HVAC energy-saving projects in China. The three display zones include BDH House, Energy and Environmental Technology, FGK Air-conditioning & Ventilation Technology and CDHA HVAC Energy-saving Achievement.

Over 10 buyer delegations present at the 2014 show

Known for attracting quality buyers and commercial enterprises from across the world, ISH China & CIHE continues to be the leading platform for HVAC and plumbing exhibitors to showcase their latest technology and solutions in Asia. Richard Li, General Manager, Messe Frankfurt (Shanghai) Co Ltd, commented, "Professional buyer delegations have always been acclaimed by the show's exhibitors. The delegations are comprised of executive leaders and decision makers with explicit purchasing objectives. This year, we organised over 10 buyer delegations consisting of representatives from leading HVAC and plumbing enterprises and organisations in China. I am confident that these buyer delegations will be able to discover great business opportunities at ISH China & CIHE."

The next edition of ISH Shanghai & CIHE is scheduled to take place from September 3 – 5, 2014 at the Shanghai New International Expo Center. ■

Hurricane Turbine Ventilator by Envira-North Systems Ltd.



Envira North designs, manufactures, sells and services the most innovative ventilation solutions. They provide solutions in applications including; hangars, warehouses, recreation facilities, shopping malls, distribution centres, office buildings, dairy farms or any other facility with high ceiling. The wind-driven Hurricane™ exhaust hot, stale air from buildings and allows it to be replaced at low levels with fresh air at ambient temperatures. The Hurricane was first industrial ventilator to incorporate the vertical vane design. Originally designed and manufactured in Australia for harsh operating conditions, the Hurricane is utilized around the world for industrial, commercial and community buildings. In cold climates, heat loss is a major concern. Optional dampers are available to provide operators with the ability to stop air flow and keep heat inside the facility. Hurricanes are available in

various sizes up to 900 mm. This is to provide custom ventilation for most application. The installation of the Hurricane will provide an efficient and cost-effective system of natural ventilation. Some of the highest standards are that it is manufactured from 5005 grade aluminum, the Hurricane has been tested by Construction Research Laboratories Inc., and withstood a continuous gusting wind of 240 km/h without damage. It has also passed the requirements of the Low Speed Dynamic Rain Penetration Test (31/m at 57.4 km/h).

Applications

The Hurricane is a wind-driven roof exhaust fan. The natural ventilator is alternative to traditional industrial ventilators that perform poorly and consume energy. ■

Website: www.enviranorth.com

PureAir REME -Reflective Electro Magnetic Energy by Zeco

Zeco 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'.

Ac/Heat Duct Air Purification System

The PureAir REME™ or Reflective Electro Magnetic Energy utilizes an electromagnetic energy cell to create ionized Hydro-Peroxides, Superoxide Ions and Hydroxide Ions. These all are friendly oxidizers made from oxygen and humidity and revert back to oxygen and hydrogen after oxidation of the pollutant. This purifying plasma is propelled into the HVAC duct or plenum by a silent plasma propulsion module that has no moving parts, yet propels the plasma at 2 cfm. The purifying plasma will be propelled through the ducts whether the fan is on or not. The PureAir REME Advanced Oxidation Technology is a group of Oxidants known as Hydro-Peroxides. Hydro-

Peroxides have been a common part of our environment for over 3.5 billion years; Hydro-peroxides are created in our atmosphere whenever three components are present: Oxygen molecules, water vapour and energy (electro-magnetic). The REME M Cell incorporates a device that utilizes high voltage to ionize, or electrically charge, molecules of friendly oxidizers (same as PureAir PHITM Cell). During operation PureAir REMETM Cell is designed to generate primarily negative ions (particles that temporarily contain an extra electron, causing the entire molecule to possess a negative electrical charge) as well as positive ions that other particulate matter are attracted to. It cleans the air by charging airborne oxidized particles. PureAir REMET has the ability to charge to super charge these Hydro-Peroxides or ionize them into Ionized - Hydro-peroxides. Ionized - Hydro-Peroxides are effective at destroying harmful microbial in the air and on surfaces. As oxidants, they do



this by either destroying the microbe through a process known as cell lysing or by changing its molecular structure and rendering it harmless (which is the case in VOC's and odors). The amount of Hydro-peroxides required to accomplish this task in a conditioned space is well below the level that is constantly in their outside air. ■

Website: www.pureair.co.in

Wi-Fi enabled commercial HVAC systems

Whether planning a new construction or just renovating your existing office, consider the latest advancement in HVAC technology: A Wi-Fi enabled system. With the arrival of new technologies, the HVAC process is becoming more efficient & person-friendly. The wi-fi version of a commercial air conditioning system is gaining a growing reputation among business owners.

Function

The wireless sensors are set round the industrial building. They are adjusted in keeping with the necessity of the environmental temperature. Not only is it easy to use, they are cost effective as well. These technologically-advanced systems interpret the needs of the



environment. You also require fewer parts & spend far less money on annual services as well. Wireless commercial HVAC systems work more effectively than the traditional counterparts. These HVAC systems are far more environmentally friendly than other brands on the market. Because they have sensors, these systems are tuned in to exactly which area needs heating or cooling, therefore, you won't be regulating an unused zone of the building. Since it is wireless, it is flexible. The motion sensors may be adjusted anywhere according to the needs. Even if you are planning to relocate place of work, the Wi-fi enabled system comes with you. ■

Global Refrigeration manufacturer makes all products in USA



For more than 65 years, True Refrigeration® has been the leading choice among top chefs, hotels and beverage providers. The family business, now in its third generation, is known globally for excellence yet all True products are proudly designed and handcrafted in the United States. With the recent addition of the company's True Professional Series® residential line,

homeowners can now "buy American" and enjoy the company's refined line of commercial-grade under counter refrigeration products. As reported by ABC News, if each person in the US spent an extra \$3.33 a year on American-made goods, it would create 10,000 new American jobs. "We're proud of not only our commitment to quality manufacturing, but are proud to do our part in creating American jobs," notes True Owner, Steve Trulaske. True's heritage dates back to the company's founding after World War II, when Bob Trulaske and his father Frank, along with brother Art, started the company in their St. Louis-area home. ■

Facts about Ground Source Heat Pumps

System of ground source heat pumps has been found to be in existence and is used in the UK. However, recent facts and technological developments have



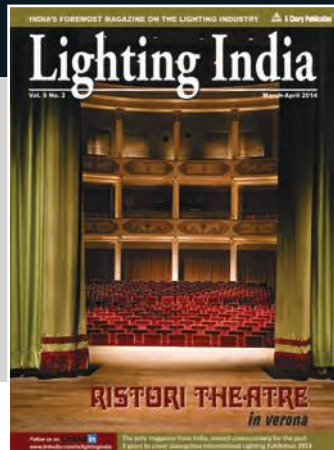
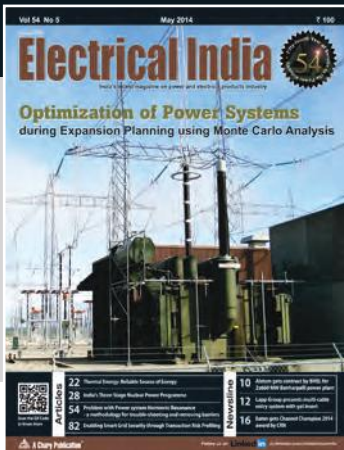
revealed that these GSHPs types of heat pumps have gained greater popularity. They function on using the principle of heat transfer. It extracts the heat stored in the ground and supplies it to your home, thus maintaining warm temperature inside the house. It also supplies heat to warm water meant for domestic use. Facts about these GSHP systems are as follows. A collector, heat pump and comprehensive distribution system are said to constitute the three main components of your GSHP system that you intend to install in your home. The collector is built using a number of pipes with appropriate insulation. They are buried under the ground at a depth ranging from 5 to 6.5 feet. In general, the configuration of the pipes is arranged to match the landscape in front of your home. It may be laid either in the form of a zigzag formation or a closed loop having a large perimeter. The ground pipes are laid in lengths depending on the size of your home that has to be heated and the quantum of heat that is required to keep it warm. ■

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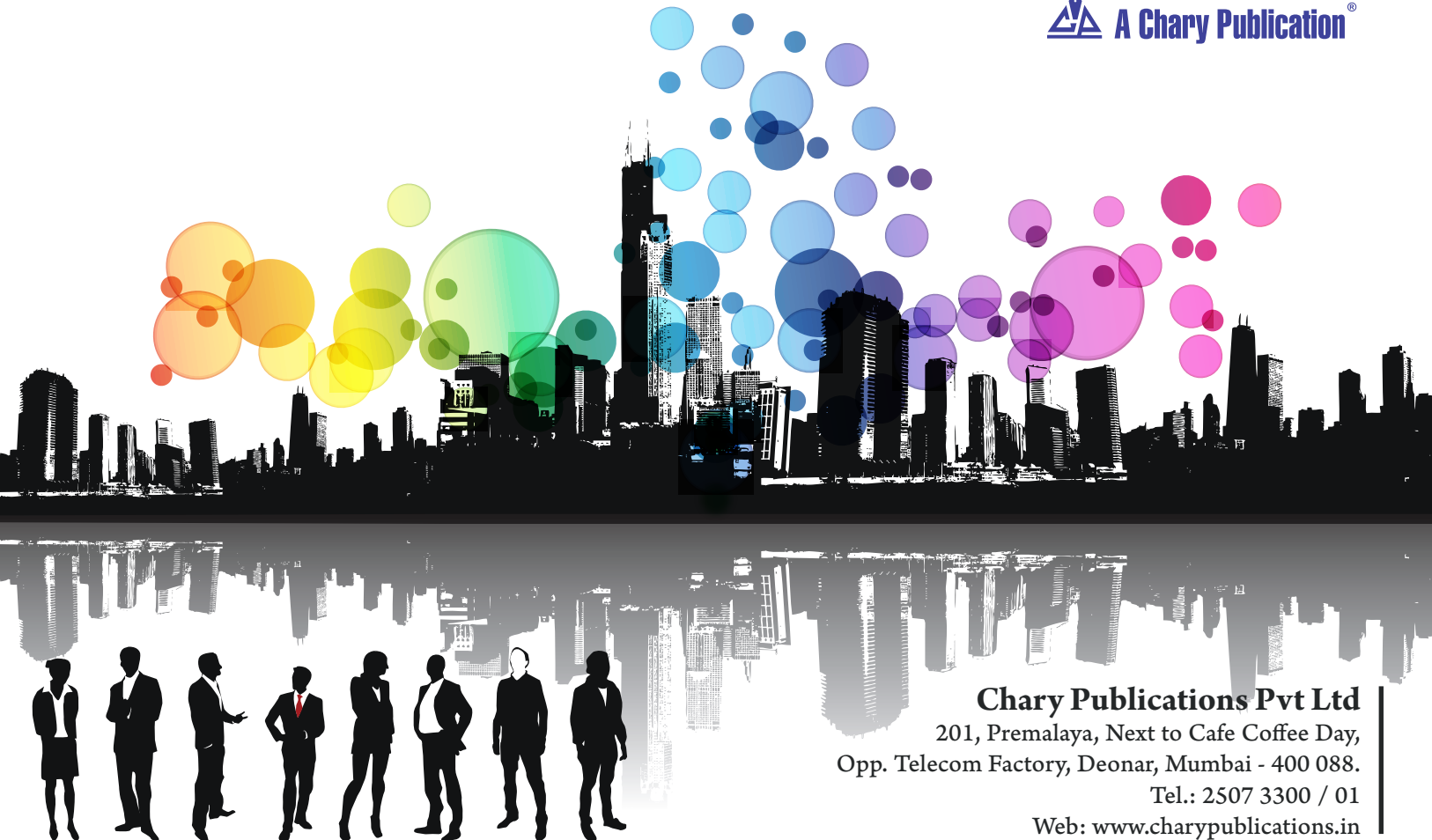
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