Vol. 12 No. 5 A Chary Publication ₹ 100

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Publisher's Letter

Future Of The Solar Heating & Cooling Industry

Although yet to be seen as a very common feature of the modern houses and commercial spaces, the solar heating and cooling segment is growing worldwide. Ken Guthrie, Chairman of the IEA Solar Heating and Cooling Technology Collaboration Programme (IEA SHC), reminds us saying, "It's important to remember that 47% of the world's energy demand is for heating, so the huge potential for solar heating and cooling will continue to expand as already seen with many large-scale applications, solar district heating, solar heat in industrial processes, and solar cooling."

Meanwhile, besides small ones, some amazingly large projects have been done worldwide. For example, one of the systems operated by CSIRO at Stockland Wendouree Shopping Centre in Ballarat, Victoria, uses concentrating solar thermal technology to produce heat energy used to power the air conditioning system. The system takes care of the huge amount of energy required to run a large commercial premises consisting of shopping centres and hotels. Around 60% of the total energy used in the said premises comes from this system.

The closed-loop system uses two 'desiccant' wheels to remove moisture from the air, acting as a dehumidifier. A high-temperature wheel uses solar heat for regeneration – while a low temperature wheel functions without any external heat to deliver greater efficiency on a commercial scale. Another exciting project has been done by a solar technology company from Austria. The company, named S.O.L.I.D. Gesellschaft für Solarinstallation und Design mbH, has received the Intersolar Award 2016.

It has designed the largest solar cooling system of its kind at Mountain High School in Scottsdale, Arizona, USA. The installation heats a single-effect lithium bromide adsorption chiller. Even at a high summer temperature that goes up – up to 43°C, the installed system in the high school takes care of all its cooling needs.

The massive project proves the possibility of a successful business model using solar thermal technology. It is not only cooling – and/or not only saving of electrical energy, but also this project indicates the potential for drastic reduction of carbon di oxide emission.

Therefore, it is quite evident that the demand for solar heating and cooling systems is spreading. In another few years, these systems will be ubiquitous.

Please send your comments at pravita@charypublications.in

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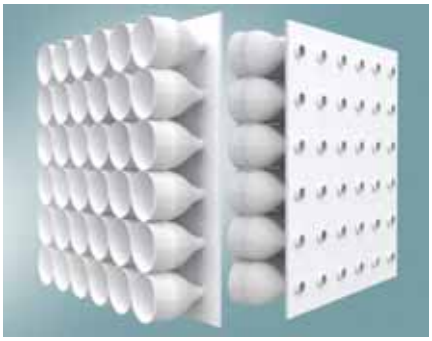
Contents

Vol. 12 No. 5, December 2016

Articles

21 Zero Electricity AC



22 Improving Efficiency in Ice Cream Plant

25 Geothermal Air Conditioning For Green Building

30 Geothermal Energy
Potential & Problems

36 Optimizing TES System

The penetration of Thermal Energy Storage (TES) systems has not been very high in the Indian Market, as compared to the more developed economies. This article discuss the issues that impact the performance of a TES system and what a building O&M team can do to utilize the system to its full capability…

38 Indirect Systems In Cold Storage

42 Solar Heating, Cooling & HVAC

44 Solar Refrigeration

48 Solar Heat Pumps
Prospect & Development

With the aim of providing a single point solution for dual purpose application, a product is launched but can provide simultaneous chilling and heating using its vapour absorption technology with 40% saving in heating energy. Using energy efficiency and managing customer energy use has become an integral and valuable exercise...

56 Addressing Urban Environment Woes

Feature

Interviews

Sanjeev Seth
Country Leader – HVAC and Transport – India and SAARC Markets Asia Pacific and India SBU, Ingersoll Rand

Departments

4 Publisher's Letter
6 Contents
8 Editorial
10 News
18 Appointments
20 Awards
66 Product Profile
69 Event Calender
69 Index to Advertisers
70 Cooling Museum

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FROM THE EDITOR

Ice-based Energy Storage

Of late the development of technology for energy storage is gaining never-seen-before kind of importance among the researchers. Out of several options under consideration, the ice-based thermal energy storage systems are gaining spectacular prominence in the industry owing to their low cost, easy availability and environment-friendliness. Ice-based energy storage provides microgrids, which are mostly fed by renewables, with a durable and smart technology for flexible use of solar and wind power through stored cold. Some companies are commercially implementing projects based on this technology, and others are now busy with investigating ways to further improve the technology to enhance its commercial viability under different conditions.

To cite an example of applications, let me talk about a project by CALMAC. The company's ice-based energy storage technology was implemented into the Naval PG School's Integrated Multi-Physics Renewable Energy Laboratory (IMPREL) in Monterey, California. This project consists of various types of energy storage systems depending on the form it will be needed in, and a unique multi-physics approach to optimise the use of onsite sources of renewable energy.

How is the thermal storage approach helping the process? Dr. Anthony Gannon, Assistant Professor, Mechanical and Aerospace Engineering Department, Naval Postgraduate School explains, "Applying the multi-physics approach to our microgrid project, over the traditional microgrid approach, allowed for the use of fewer renewable energy sources to meet demand, reducing size, costs and the amount of unused energy. Using thermal energy storage allowed for the project to greatly reduce its costs and improve efficiency by storing the energy in the form that it would be ultimately used in. Based on the project's operation, we feel like this design could easily be scaled-up for larger applications."

"Ice-based energy storage is the low-hanging fruit of the industry. The biggest advantage that fossil fuels have over renewable energy resources is that a barrel of oil or lump of coal is a form of stored energy that can be released any time. Sun and wind are forms of pure energy that, without being paired with energy storage, are either used or wasted. Luckily, energy storage can easily be integrated into our buildings and power grid," says Mark MacCracken, CEO, CALMAC.

There are many other instances of using ice-based energy storage. Devices like Ice Energy's Ice Bear 20 are also entering the market, which are suitable for residential and small commercial applications, and they seamlessly integrate with the HVAC systems of homes. Thus, we are gradually entering a new era where ice-based energy storage systems will be the most commonly used energy storage systems.

P. K. Chatterjee

We are gradually entering a new era where ice-based energy storage systems will be the most commonly used energy storage systems...

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Editorial, Subscription & Advt. Office:
905-906, The Corporate Park, Plot No. 14 & 15, Sector - 18, Opp. Sanpada Railway Station, Vashi, Navi Mumbai - 400 703.
Tel.: (022) 2777 7170

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Printed by Pravita Iyer and Published by Pravita iyer on behalf of Chary Publications Pvt Ltd., and Printed at Print Tech, C-18, Royal Ind. Est., Naigaum Cross Road, Wadala, Mumbai 400031 and Published at 201, Premalaya, Opp. Telecom Factory, Deonar, Mumbai 400088.
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Ace Pipeline commissions Mangaluru- Bengaluru LPG Pipeline

Ace Pipeline Contracts known for engineering and construction of cross country pipelines for oil and gas industry, recently completed works and commissioned the Mangaluru—Hassan – Bengaluru – Mysore LPG pipeline project which was being constructed by it for Hindustan Petroleum Corp. Ltd. (HPCL). This pipeline project which traverses through the treacherous terrain across the Western Ghats and large swathes of rubber and coffee plantations with undulating terrain for a length of 358 km, costing about Rs 838 crore shall make a drive across the highway safe and shall reduce environmental pollution.

The project completed mandatory statutory inspection and audit by Oil Industry Safety Directorate in September 2016 and was commissioned in November 2016 with 150 MT per hour of LPG being pumped from the dispatch terminal at Mangaluru, which is equivalent to 9 LPG bullet tankers. The pipeline is equipped with Supervisory Control and Data Acquisition (SCADA) enabled remote control system to monitor the pipeline round the clock. The pipeline is installed across various rivers such as Gurupur, Netrvathy, Hemavathy and Cauvery by using the state of the art trenchless horizontal directional drilling for which Ace Pipeline are well renowned. The pipeline is equipped with emergency shutdown valves at various locations to be able to block flow of LPG in case of any contingencies.

The success of the pipeline project is also a feather in the cap for the HPCL project team who built strong relationship with affected landowners and district administration with their CSR activities and fair compensation. ■

AAF Europe acquires Dinair

AAF Europe has acquired Dinair, one of Sweden's largest manufacturers and suppliers of air filters. Dinair, established in 1982, emphasizes balanced filtration solutions and has a history of developing its own products.

Philip Whitaker

Philip Whitaker, AAF International's Chief Executive Officer, said, "This acquisition is part of our strategy to become the clear leader in our industry, both globally and in every region. It is another clear example of our parent company Daikin's long-term commitment to both AAF and to the air filtration industry. Working with Dinair, we will offer Nordic customers more choice and better access to truly innovative filtration products and services." ■

Daikin establishes its subsidiary in New Zealand

Daikin Industries recently established Daikin Air conditioning New Zealand Limited in Auckland, New Zealand.

The utilisation rate in New Zealand for renewable energy exceeding 80% and a high awareness for the environment and energy savings, the technology in which Daikin excels, such as inverter and heat pump, is likely to gain wide acceptance. With its globally-cultivated product appeal, the company looks to meet the many needs in the local air conditioning market for heating and a variety of individual preferences, including the preference for the stylish designs seen in the European market.

Business in New Zealand before the new subsidiary proceeded through a local branch office of Daikin Australia Pty. Ltd., but with the establishment of this subsidiary the company intends to closely monitor market needs and leverage its wide product appeal ranging from residential to commercial use. The new subsidiary in New Zealand corresponds to a Group strategy for further growth of the air conditioning business in the Asia/Oceania region as outlined in the company's Fusion 20 strategic management plan. ■

McKinstry wins CleanTech Achievement Award 2016

CleanTech Alliance named McKinstry winner of the coveted CleanTech Achievement Award for 2016. The award, sponsored by Puget Sound Energy, was presented at the CleanTech Alliance Annual Meeting on November 10 in front of more than 300 business executives, investors and policymakers from across the Northwest region.

McKinstry accepts the 2016 CleanTech Achievement Award

The annual CleanTech Achievement Award honours an organisation or program for making significant contributions in developing the region's cleantech industry. CleanTech Alliance members nominate deserving organisations. An independent panel of judges evaluates each nomination before selecting three finalists and one winner.

McKinstry, Doosan GridTech and the Washington State Clean Energy Fund were named 2016 CleanTech Achievement Award finalists. McKinstry was selected for its efforts to continuously innovate the clean technology landscape. In the past 50 years, the company has transformed how buildings are designed, built, operated and maintained for optimal energy efficiency and occupant health. One example is the recent partnership with Clise Properties and Amazon, creating the nation's largest-scale heat recovery systems to cross property lines. This partnership, dubbed the 'EcoDistrict,' transfers data centre waste heat to offset 75 percent of the heat needed by Amazon's new corporate headquarters across the street. ■

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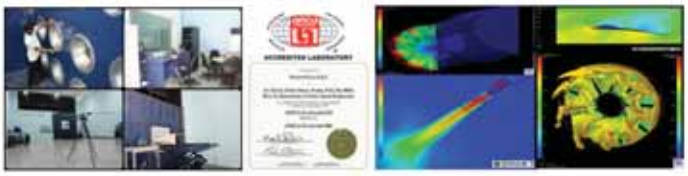

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Climaveneta units installed at shopping centre in Tuscany

Maremà, the new shopping centre, which belongs to IGD, is expected to become a reference point for shopping all over Tuscany. The mall has a total surface of 17,110 sqm divided into 44 small shops and 7 internal big shops to fulfill all consumers requests in terms of shopping.

The mall also has 5 external medium shops, a gas station and a large parking with 3,000 car parks, and an Ipercoop supermarket of 4,200 sqm, which belongs to and is managed by Unicoop Tirreno.

The building has a strong focus on sustainability: photovoltaic field, led lights, high efficiency HVAC system, rain water collection, column to recharge electrical vehicles and use of innovative material, even natural ones, are some of the most significant examples.

The HVAC system is based on three high efficiency class A FOCS-N/CA/Sheat pumps and 10 WSM/HR-P/S reversibile roof top units with heat recovery function. The HVAC system is thus able to grant perfect comfort all year round in an efficient and sustainable way, achieving a large reduction in running costs and a complete absence of local CO2 emissions.

Efficiency, reliability, and great experience in retail applications make Climaveneta the ideal partner for HVAC systems in the most modern and attractive shopping centres all over the world. ■

Eaton a part of Intervitis Interfructa trade show

The Filtration Division of power management company Eaton showcased its filtration products, technologies and services designed for use in food and beverage applications while exhibiting at the Intervitis Interfructa trade show in Stuttgart, Germany.

One of the highlights of Eaton's display was its BECO filter cartridges, specifically, pre-filter cartridges BECO PROTECT CS CellStream and FS FineStream. These filter cartridges are especially designed for use in food and beverage applications.

The company also presented its family of beverage treatment solutions, including innovations in Active dry yeast (IONYS) and Malolactic fermentation (BACTILESS).

In addition, Eaton featured the mineral-free BECOPAD depth filter medium as a flat sheet and as a stacked disc cartridge and CLEARGAF filter bags inserted in a TOPLINE filter housing that meet the strict requirements of the food and beverage industries. ■

enVerid bags R&D 100 Award

enVerid Systems revealed that its HVAC Load Reduction unit, the HLR 1000E, received a prestigious R&D 100 Award. The R&D 100 Awards recognise excellence across a wide range of industries. enVerid's HLR system uses a module integrated into existing HVAC systems to scrub the air of dangerous indoor air contaminants. This technology helps to reduce energy use and lower costs. Often referred to as the "Oscars of Invention," the annual R&D 100 Awards celebrate the most significant technology inventions of the past year. Udi Meirav, Founder and CEO of enVerid, said, "We are committed to innovating in aircare technologies, improving indoor air quality and saving energy for a more sustainable world. This award is the result of all of the efforts of the Department of Energy, NETL and many years of work by our own scientists and researchers." ■

Encycle partners with Honeywell

Encycle revealed its collaboration with Honeywell as a Total Connect Comfort partner. The company is Honeywell's first smart thermostat partner to focus exclusively on solutions for commercial and industrial consumers.

Encycle has already integrated Honeywell thermostats into its EASE (Energy as a Service by Encycle) solution for a nationwide restaurant and entertainment business. In 2016, the company added over $80,000 in utility cost savings to the customer's bottom line. The benefits of integrating Encycle's patented Swarm Logic technology with the leading features of Honeywell's thermostats have been so effective that the chain has standardised this platform for every one of their new locations.

Encycle's newest solution, the SwarmStat service, provides all the benefits of EASE using only IoT enabled thermostats. Honeywell's WiFi thermostat family is the first deployment platform offered.

One of the company's largest nationwide retailers is piloting SwarmStat to confirm that it meets their performance and payback criteria in utilities with very low tariffs and no demand response programs. This could lead to a rollout of approximately 1,500 SwarmStats from one customer alone.

Bob Chiste, Encycle's CEO, said, "SwarmStat is our first 'Swarm in a Cloud' product, where we are working with major thermostat and building management system OEMs."

"Our goal is to enable energy management hardware vendors to enjoy the benefits of our cloud-based Swarm Logic service," he further added. ■

THE EMERSON CUP 2016

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R&D Centre in Thailand starts full-scale operation

At Fujitsu General Engineering (FGE) Thailand, the company's development base of air conditioners in the country, the construction of Research and Development (R&D) Centre (total floor area about 10,000m^2) which is the biggest class in Thailand as air conditioner development facility was completed and the full-scale operation started in November. The total investment amount of the R&D Centre is about 2 billion yen, and adopting the latest test facility, it is positioned as the base in charge of product development of company group along with Japan (Kawasaki) and China (Shanghai).

To cope with the development of diversified and high-grade products, FGE is aiming to double the number of development models by increasing local engineers to double for the coming five years and expanding the ratio of full model change design.

FGE constructed R&D Centre acquiring the land (about 10,000m^2) adjacent to the main factory. The R&D Centre can accommodate more than 200 engineers and the function as development base was substantially strengthened adopting the latest test facilities. Besides, the building itself has the function as the verification test facility for large-size commercial use air conditioners.

The outline of the 3-story building is first floor for integration of test equipment, second floor for design examination and collaboration with factories and suppliers and third floor for the work room of all engineers aiming at the efficient floor composition arranged to suit the purpose and considering the activation of communication between engineers, factory staff and suppliers. ■

Goodman's new Mobile App

The new DealerFirst Mobile app from Goodman Manufacturing is accessible for free download, offering any Heating, Ventilation and Air Conditioning (HVAC) contractor in the United States and Canada with immediate access to a robust set of service, sales and business tools while on the job site via mobile phones or tablets. The DealerFirst Mobile app gives HVAC technicians immediate access to a variety of resources, from warranty claim management and product or diagnostic information to documents and support.

Key features of the DealerFirst Mobile app include Warranty Express, Documents and Support, Product/Diagnostic information, and Match-up and Ratings.

The Warranty Express tool lets technicians add, look-up and manage warranty claims (with appropriate credentials). Easy access to product brochures, warranty certificates, IO manuals and spec documents is available with the Documents and Support tool. ■

Hussmann launches new HVACR Troubleshooting App

Hussmann recently launched a new HVACR troubleshooting app designed for their field service technicians. The web-app is touch enabled as it takes technicians through a series of progressive options to identify, pinpoint and correct several different issues relating to performance of installed HVACR equipment. The tool is designed so technicians can experiment, test different troubleshooting options and view varying courses of action before taking repair actions. As part of its ongoing focus on technician training, Hussmann worked closely with the Refrigeration Service Engineers Society (RSES) in the development of the web app content. Jay Welu, Vice President Operations, Hussmann, said, "This new tool provides Hussmann internal technical teams with real-time training and diagnostic information to analyse and correct issues at the job site using mobile technology." ■

Johnson Controls and Hall of Fame Village enters into an historic agreement

Johnson Controls and Hall of Fame Village LLC (a partnership between the Pro Football Hall of Fame and Industrial Realty Group) have entered into a historic 18-year agreement to create the first sports and entertainment "smart city" that will carry the name Johnson Controls Hall of Fame Village. For the Hall of Fame and Johnson Controls, this agreement represents shared values of honouring the past and building a future driven by innovation and creating comfort for everyone who comes to the Village to honour the legends that have played the game.

Under the terms of the deal, Johnson Controls will become the "Official Smart City Partner" of Hall of Fame Village, which includes venues such as a virtual reality, state-of-the-art Johnson Controls Hall of Fame Experience. Additionally, the company will also be the presenting sponsor for the annual celebration in Canton each summer that will be known as the Pro Football Hall of Fame Enshrinement Week Powered by Johnson Controls.

A professional services contract calls for Johnson Controls' products, services and solutions used within the Hall of Fame Village including the museum. This will provide for the creation of a showcase "smart city" with the company providing its building management systems, HVAC equipment, fire and security systems and other technologies that will assure world-class environments and yield significant operational cost savings over the life of the agreement.

Johnson Controls Hall of Fame Village is the largest project currently under construction in Ohio and will be a top tourist destination for millions of visitors per year. It is projected to bring $15.3 billion dollars in economic impact to the region in its first 25 years as it transforms the Pro Football Hall of Fame's campus to impact the lives of people by focusing on programming rooted in values learned from the game of football – commitment, integrity, courage, respect and excellence.

Pro Football Hall of Fame President David Baker said, "This is an extraordinary partnership between esteemed partners that celebrates excellence everywhere. Johnson Controls and the Hall of Fame share strong values and a vision of improving others' lives and making the world a better place." ■

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Rheem, Powerhouse Dynamics partner for Online HVAC Management

Powerhouse Dynamics, creator of the award-winning SiteSage enterprise asset and energy management system, and Rheem, producer of water heaters, boilers, and HVAC equipment revealed their new partnership. The two companies have teamed to install SiteSage sensors on Rheem's innovative and award-winning H2AC Rooftop Unit, the first and only integrated air and water system designed specifically for full service restaurants and other commercial applications with high hot water demand.

By integrating their rooftop units with SiteSage, Rheem is able to provide their customers with enterprise-wide remote control and access to advanced diagnostic data, which to date has only been retrievable at the equipment site. The cloud-based SiteSage software delivers visibility into system performance on all Rheem units installed across all of a customer's locations. A complete SiteSage system can control and analyse all key facility equipment in real time to improve operational efficiency.

Rheem H2AC units are high-performance hybrid heating, air conditioning and water heating systems that deliver a comfortable environment and substantially reduced hot water costs at very high efficiency. The ClearControl running Rheem rooftop unit collects a broad range of data on the system's operation, which can be used to ensure the units are operating at peak performance and can help technicians diagnose any issues.

Jay Fiske, Vice President of Business Development for Powerhouse Dynamics, said, "Rheem is an innovator in offering highly efficient HVAC technology to their customers, reducing operating costs while keeping guests and employees comfortable. We are proud to partner with Rheem to bring that innovation to the next level, making actionable information available to restaurants, hotels, and other businesses, and their service providers, on demand in real time." ■

Rheem introduces Hybrid Electric Water Heater

Consumers looking to maximise their home's energy efficiency have a new option with the Rheem Prestige Series Hybrid Electric Water Heater.

Designed to reduce hot water energy use by up to 73%, the Prestige Hybrid Electric Water Heater can provide homeowners with $4,000 in energy cost savings over 10 years, and pay for itself in less than two.

Bill Alderson, Director of Marketing, Rheem, said, "The average water heater accounts for almost 20% of a home's total energy use so it is an appliance that should be carefully considered."

"This Prestige hybrid water heater has a measurable impact on energy savings thanks to its smart engineering and intelligent design," he further added.

This product qualifies for local special pricing opportunities, substantial utility rebates and federal tax credits to make this product more affordable to homeowners. ■

Trane provides Series R RTWD chiller for North America and Middle East

Trane, a well known global provider of indoor comfort solutions and services and a brand of Ingersoll Rand, has revealed that its Series R RTWD water-cooled chiller for commercial and industrial buildings is also accessible for customers in North America and the Middle East who are all set to transition to systems with lower Global Warming Potential (GWP).

The Series R RTWD chiller, available in 80-250 tons, delivers energy efficiency coupled with ease of installation, application flexibility and high reliability.

These chillers can operate with a choice of R-134A or Opteon XP10 (R-513A), a next-generation, low-GWP refrigerant from Chemours.

With an infinite unloading compressor design, wide operating temperature range, heat-recovery options up to 140 degrees Fahrenheit, advanced controls and high efficiencies, these chillers can be the perfect choice for tight temperature control in almost any application. ■

UAE Air Conditioners Market to grow at CAGR 9% till 2021

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

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

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Blue Star appoints Non-Executive Promoter Directors

Blue Star Limited has revealed the induction of two new members on its board, Rajiv R Lulla and Dinesh Vaswani. Both are being appointed in the capacity of Non-Executive Promoter Directors and will further strengthen the board with their vast and diverse experience across the globe.


Dinesh Vaswani


Rajiv Lulla

Rajiv R Lulla is a Senior Advisor at Voltaire Capital (UK) and the Founder of Voltaire Capital (India), which a technology enabled trading firm operating in the UK, US and recently in India. He holds a bachelors degree in Mechanical Engineering with Electronics and an MBA from Kings College and Imperial College, London. Rajiv has nearly 25 years of experience primarily as an investment banker engaged in advisory and corporate finance. He has held a variety of senior leadership roles at Merrill Lynch, the Credit Agricole Group, and Deutsche Bank.

Dinesh Vaswani is the Founder and Managing Director of Acuitas Capital Advisors and has over three decades of experience in both investing in and operating companies in India and the US. He holds an MBA from the Wharton School of Business and a BBA cum laude from the University of Texas at Austin. He was a Managing Director at Temasek Holdings, established Bessemer Venture Partners' operations in India, and CEO of Blue Star Infotech USA. He has served on a number of boards of public and private companies including Firstsource (then an ICICI group company), Mindtree, Venture Infotech and Borosil. ■


Chris Hews

AAF Europe appoints Business Development Manager

AAF Europe revealed that Chris Hews has been appointed Business Development Manager for High End Air Filtration in Europe.

Chris has worked within the high end clean air market sector for over 23 years in both Technical Sales and Marketing roles. Prior to accepting his new AAF appointment, he has been AAF's Cleanroom Business Development Manager in the United Kingdom and Ireland. In this new role, Chris will continue to develop cleanroom business in the UK and Ireland, and will also be responsible for the development of high end filtration solutions in the European region. ■


Gboyega Obafemi

Hitachi Air Conditioning appoints MD to take business forward

In line with its commitment to growing the UK market following the merger with Johnson Controls some 12 months ago, Hitachi Air Conditioning Europe has appointed a new Managing Director (MD) to drive the business forward.

Gboyega "Femi" Obafemi joins Hitachi from the Amsterdam office and European headquarters of US manufacturer Watts Water Technologies where he was Vice President and MD for Emerging Markets. He brings with him considerable experience in the HVAC sector having been Managing Director at both Carrier Corporation and Toshiba Carrier, followed by over three years at Johnson Controls as Executive Director with responsibility for Johnson's HVAC and control products throughout Europe.

Commenting on working with Hitachi, Femi said, "Following a period of consolidation, now is the time for Hitachi to drive growth in our important UK and Irish markets, and I am delighted to be joining the business at such a pivotal time. Historically Hitachi has led the way with new product innovation and quality engineering, and we have a number of exciting new products in the pipeline which will be far ahead of any current legislative requirements for energy efficiency. This is a very exciting time and I am looking forward to working with the team here to drive the business forward." ■

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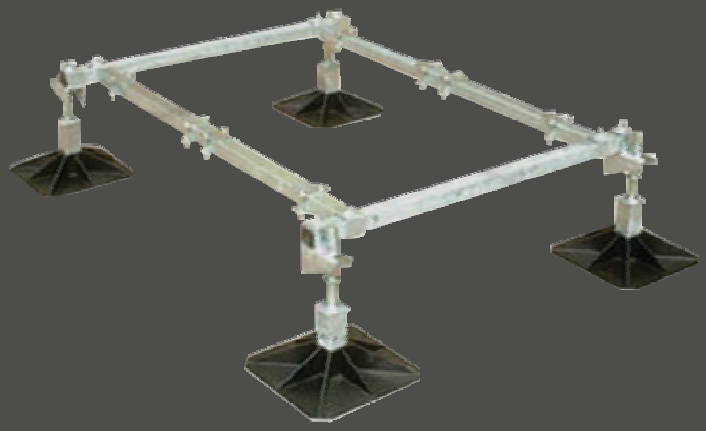

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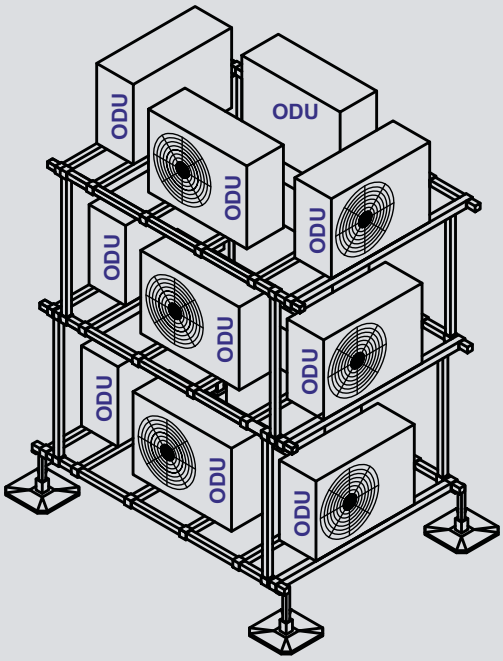

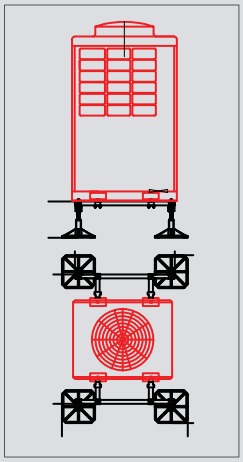

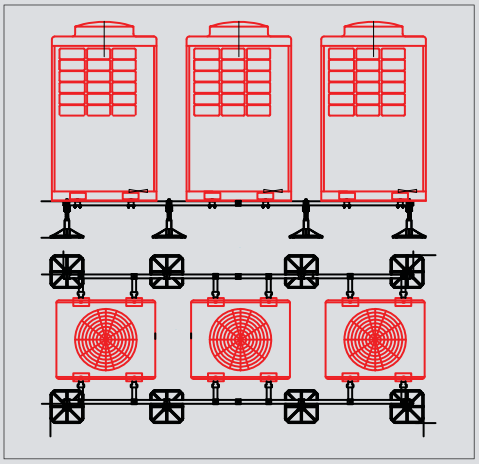

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Hanon Systems wins IR52 Jang Young-Shil Award

Hanon Systems, a well known global provider of automotive thermal solutions, has been named co-winner of the IR52 Jang Young-Shil Award with Hyundai Motor Company for its triple zone Heating, Ventilation And Air Conditioning (HVAC) for passenger vehicles.

The IR52 Jang Young-Shil Award is an annual award presented to companies in Korea with technologically outstanding and innovative new products. The award is presented in the name of the Minister of Science and Technology, and is jointly sponsored by the Korea Industrial Technology Association and Maeil Business Newspaper, a leading Korean business publication.

Hanon Systems' award winning Triple Zone HVAC is a single module that enables vehicle occupants to independently control the temperature, mode and strength of air flow in their immediate proximity to create an individual cabin comfort experience for the driver, front and rear passengers.

The unique and compact design of this technology reduces overall weight and material cost by up to 18 % compared to other multi-zone solutions, and improves packaging in the engine compartment to enable more available space in the vehicle cabin.

The Triple Zone HVAC was first introduced in Hyundai's premium brand Genesis EQ900. ■

Leminar recognised as Supplier of the Year

Leminar Air Conditioning Company, a well known distributor and service provider of HVAC and plumbing products in the GCC, won the prestigious 'Supplier of the Year' title at the MEP Middle East Awards 2016 in Dubai, UAE. This is the second time the company was chosen for this coveted industry recognition.

The key factor that weighed in favour of Leminar winning the award is its contribution to high-profile and complex projects in the region such as the Midfield Terminal Building in Abu Dhabi. The supplier worked with its brand partner Weicco to design and develop a custom pipe support to meet the aviation project's unique requirement.

In 2016, the company also commissioned a cooling solution using Rheem's high-efficiency R410a DX units for the ASAS Tower in Sharjah – said to be the tallest residential building in the emirate. The solution reduced the capital cost significantly and ensured a faster ROI for its client.

Team receives the award

The project successes aside, the jury applauded the company's adherence to industry best practices in Just-In-Time (JIT) supply and logistics that is focused on trimming excesses and ensuring a minimum reserve. ■

Luke Courtney wins SkillFRIDGE

Luke Courtney of South East Regional College Lisburn has been awarded a Gold medal in the national SkillFRIDGE competition, sponsored by Toshiba. The competition was held at The Skills Show, which took place from 17-19 November at the NEC Birmingham. The event, organised by WorldSkills UK, provides a national showcase for the brightest young talent emerging in five skills sectors: Engineering and Technology, Media and Creative, IT and Enterprise, Hospitality and Lifestyle, Construction and Infrastructure. The winners in each field may go on to represent the UK in the WorldSkills championships internationally.

Luke with head judge Mark Forsyth and David Dunn, director and general manager of Toshiba Air Conditioning and CIAT Ozonair

Luke, an apprentice refrigeration engineer at Dunbia Northern Ireland said, "This has been a good opportunity to learn and it's great to have on my CV. It also shows that my employer has provided me with the right training and experience. My hope for the future is to become a good qualified engineer and progress from there." ■

Zero Electricity AC

This paper is introducing zero powered air conditioning system for rural areas invented by Ashish Paul somewhere in Bangladesh. The system is not as efficient as traditional air conditioning system but technologically and economically it sounds better than traditional one.

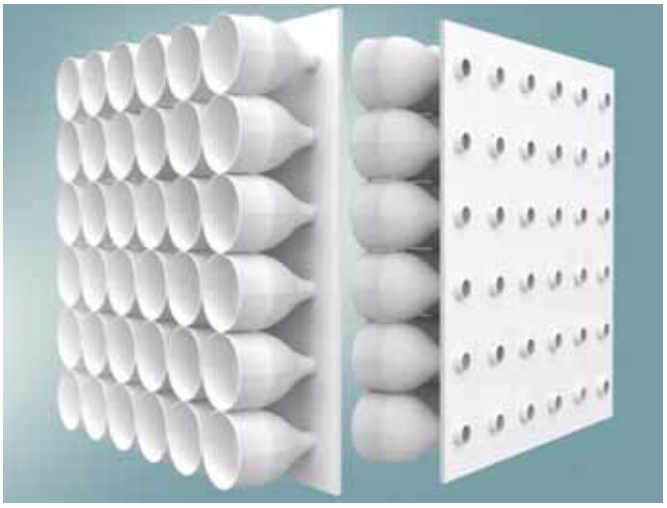
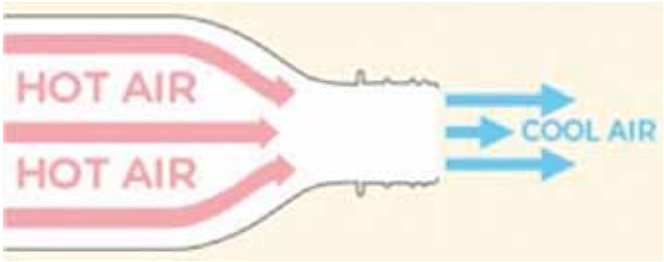


Figure 1: Schematic view of eco-cooler

A large number of people in developing countries still live in rural and remote areas like India where the grid electricity is yet unavailable or not envisaged by the people. The average temperature worldwide is also expected to rise because of the global warming and this might already have begun. Air conditioning is basically required for the purpose of comfort air conditioning that means to provide thermal comfort to the occupants. Thermal comfort is as important in rural areas as in urban areas. Nearly all air-conditioning systems in use are built around vapor compression systems driven by grid-electricity. However, most ways of generating electricity used today has some kind of negative impact on the environment, whether it is emissions of carbon, sulphur, and nitrogen dioxide (fossil fuel plants), radioactive waste (nuclear power), destroyed rivers and water falls (hydropower) or noise pollution (wind power). Therefore, it is desirable to reduce or at least to prevent the increase of electrical demand. Seeing all these problems, this paper is introducing zero powered air conditioning system for rural areas invented by Ashish Paul somewhere in Bangladesh. The system is not as efficient as traditional air conditioning system but technologically and economically it sounds better than traditional one.

Construction

The Zero Electricity Air Conditioner (also known as eco-coolers) method is fairly simple, from a construction standpoint. A board is cut to fit the desired window, and bottleneck-sized holes are cut out in a grid pattern. The bottoms of empty plastic bottles are cut off and discarded, leaving funnel-shaped bottlenecks that are placed on the grid. That's all there is to eco-cooler, except for the task of installing it in place of the regular window. When mounted, the wider part of the bottles faces outward and catches the passing wind, literally funneling cool air into the building's interior (Figure 1). Hot air will rush into each bottle, which is pushed to the rim where it starts to expand – this expansion cools the air before it enters the room (Figure 2). The efficacy of an eco-cooler varies widely based on conditions, but Grey Group reports it has the ability to reduce indoor temperatures as much as 5 degrees Celsius, which is on par with what an electric centrally installed air conditioning system can do. In some instances the eco-cooler can reduce indoor temperatures from a sweltering 86°F (30°C) to a comfortable 77°F (25°C). For the 70 percent of residents who live in tin-roofed huts that amplify the sun's heat, the eco- cooler could be a breath of fresh air just in time for summer.



Conclusion

The eco cooler is reportedly the world's first-ever 'zero electricity' air conditioner, and its inventor wanted to get the concept out there to help as many people as possible. The Grey Group stepped in to help, using its position as a multi-national advertising firm to put the plans online, at no cost, so that anyone can build their own eco-cooler system. Volunteers from Grameen Intel Social Business helped build and install the units, as well as teach locals how to make them, so the wisdom can be passed on. ■

Er Kapil Samar
Research Engineer cum Project Manager
Biogas Development and Training Centre, Udaipur

Improving Efficiency in Ice Cream Plant

The plant owner wanted to update plant for higher efficiency and safety with moderate investment in steps. Many a time plant upgrade or modernization leads to complete change of plant that involves heavy investment and ROI on such investments exceed three to four years...

The paper presents a case study of improving plant efficiency and safety at medium scale ice cream manufacturing unit. The plant is in Cuttack near Bhubaneshwar, Orissa. The plant produces 10 MT of ice-cream every day and supplies to Orissa and nearby states. The plant owner wanted to update plant for higher efficiency and safety with moderate investment in steps. Many a time plant upgrade or modernization leads to complete change of plant that involves heavy investment and ROI on such investments exceed three to four years. Hence, it was decided that plant upgradation should be carried only where necessary and to achieve highest efficiency and safety. The target was to keep ROI less than one year and achieve minimum 15% energy savings. The refrigerant used for plant is Ammonia which is natural choice because of the plant size and temperature requirement. The natural (gravity) feed system is used in plant for refrigeration.

We followed system approach to achieve our target. The first step was to study and prepare HAZOP report and find out the problems in operation of plant on day to day basis. We started recording plant operation parameters and work hours. After detail study, following problems were observed:

1. The cold storage and freezer rooms are not able to achieve desired temperature inspite of long running hours of compressors
2. All compressors including standby compressor was required to run the plant
3. The compressors were running at full load all the time
4. The compressor suction pressure and plant evaporating temperatures do not correlate. The suction pressure was much lower than the corresponding room temperature
5. The compressor discharge pressure was very high considering the ambient conditions
6. Complete plant was under manual operation
7. The cold rooms and freezer rooms were full with frost
8. The cold room and freezer rooms were designed for -25°C room temperature however, were never able to achieve below -14°C
9. The defrosting system was manual and was never able to defrost the coils completely.
10. Plenty of oil was getting accumulated in ACU or freezer coils.
11. Plant safety was totally bypassed
12. The level control system was bypassed and operators were manually throttling the valves on receiver supply line.
13. Thus, ACU or freezer coils were starving for liquid and operators were afraid of liquid stroke to compressor.
14. Operators were always busy with operating various valves and running around to check operation, temperature and liquid level.
15. Due to small leakages through flange joints plant had ammonia smell continuously.
16. The cold rooms and freezer rooms were located around the plant and many times the loader was trapped in the room. The trapped person was not able to communicate to plant operators.

All these conditions were leading to high energy consumption and loss of production. Overall plant was not able to perform at rated conditions.

Considering the budget availability, we decided to concentrate on achieving desired room temperature, increase plant efficiency and improving plant safety. We had limited to time to conduct all these activities.

Another constraint was limited availability of highly skilled and certified man power to operate the plant. Hence it was required to provide operating system which regular plant operators could handle and need of specialized manpower would be eliminated.

We decided to update following:

1. Install safety valves with dual manifold on all pressure vessels with suitable rating. We have selected resettable safety valves.
2. The compressor safety cut out were calibrated, repaired and re-connected for safety
3. Easy to use Automatic Compressor control system with energy monitoring was installed on each compressor

Plant discharge pressure before plant modification

Plant discharge pressure after plant modification

Fully automatic air purger in operation

Ammonia Leak detection system

Easy to use compressor automation system

Data monitoring system with web based operation and mobile application to monitor plant performance online anywhere in world

Cold room Safety Alarm system

Automatic liquid level control, temperature control and hot gas defrosting system

Plant piping before modification

Plant piping after modification

4. Fully automatic air purger installed on condenser and receiver
5. Automatic hot gas defrosting system installed to replace existing manual defrost system on all cold rooms and freezer rooms.
6. Temperature monitoring and control system was installed for all cold rooms and freezer rooms.
7. The automatic level control system was serviced and put into use.
8. The reflex type level gauges were installed instead of glass tubes.
9. The automatic ammonia leak detection system was installed
10. The flange type valves were replaced with 40 bar weld in line valves. The valves were chosen with back seating facility.
11. The cold room alarm system within built battery back was installed to located doors for trapped loader and generate alarm in plant room. The unit was provided with inbuilt battery backup so that it can work independently in case of electricity failure.

These all activities were complete in 10 working days with help of plant operators and only one welder, without distributing the regular plant operations.

The results observed after the modifications are:

1. The compressor discharge pressure reduced significantly to 160 PSI from 220 PSI
2. The automatic operation compressor removed operator interference and smooth loading or unloading compressor and overall energy requirement for compressor was reduced significantly
3. The safety valve and release system ensured increased safety at plant and no discharge of ammonia in plant incase safety valve pops up.
4. The automatic ammonia leak detection and alarm system increased plant safety and operator had more confidence in working around the plant
5. The automatic hot gas defrost system replaced manual defrost operation
6. The defrost time was reduced to 15 minutes instead of 45 minutes
7. The increase in cold room or freezer room temperature during defrost reduced to 2°C from 10°C
8. The cold room or freezer room design temperature of -25°C was achieved.
9. The time required for freezer operation reduced 25%
10. The number of compressors required reduced. The standby compressor remain as standby, was never required to operate
11. This reduced compressor running hours by 25%
12. The automatic level control system made sure that ACU or Freezer coils are flooded and no liquid is allowed on compressor.
13. The automatic level control system avoided operator's interference by throttling valves on receiver supply line.
14. The accumulation of oil in ACU and freezer units was eliminated
15. Frosting on ACU & freezer units eliminated
16. The online datalogging and remote monitoring system installed helped customer to monitor the plant on mobile phone while travelling abroad and enjoy his holidays.
17. The temperature control system made sure that required temperatures are maintained continuously. No under shooting / overshooting observed. All temperature were maintained within ±2°C
18. The weld in lines valves eliminated the leakages through flange joints of the valves and thus total number of flange joints in flange reduced to few.
19. The back seating facility in the valve assured operators that now they don't have to run around in tightening of valve glands.

Thus, over all plant performance improved by:

1. Reducing the plant operation time
2. Improving plant temperature
3. Operating at optimum suction and discharge pressure
4. The ammonia smell from plant room vanished
5. Increase plant safety
6. The automation of compressor, defrost system, liquid level control and plant monitoring generated comfort for operators and they could address other maintenance issues.

After observing plant operation for one year we observed 30% energy saving and improved product quality and production capacity as compared to last year.

Even though improved plant safety cannot be calculated in investment, the overall investment was recovered in 4 months. ■

Anand Joshi
Partner
Manik Engineers
Pune

Geothermal Air Conditioning For Green Building

HVAC industry has seen so many changes and new ideas in last few decades. Because of the comfort requirement and resources available, day by day new alternatives are also coming to limelight. Geothermal air conditioning system is a new gift to this...

40-year old building was not air conditioned earlier as it was used as a staff quarter

In the initial stages of designing, various options of air conditioning have evaluated along with different options to reduce the building load as well. This 40 years old building was not air conditioned earlier as it was used as a staff quarter. Now when it was converted into a high end hostel facility, air conditioning options were worked out. As thump rule, the initial load was coming around 150 sqft/TR, which was increasing the supplied electrical load for the building resulting to apply for new electric connection from state electricity board. To reduce the heat gain, first roof insulation was added with U value of 0.21 watt/sqmtr degree Kelvin. After that wall insulation has added in all side of the rooms which could further reduce the load. Then glass was changed to double glazed sandwiched type of U value 2.1 watt/ sqmtr degree Kelvin. In each case, three or four types of different materials have checked in thermal simulation software. The electrical fittings have changed by LED type fixtures which further reduced the heat load. Again fresh intake locations have altered. Instead of directly taking near fan coil units, it has drawn from the window panel, landscape area where the outside temperature is already down because of water bodies in surrounding. CO_2 sensors have installed in these rooms to check the fresh air level in these rooms. By doing more than 20 alterations in thermal simulation, 675 sqft/TR load have achieved.

Now, once we achieved, the load, various options of air conditioning also worked out. With the help of ACC staff, and expertise in the industry, this geothermal energy option has worked out.

Working Principle

While doing survey of the project, soil investigation and water taste have carried out and the water temperature in summer has found to be 28 degree celsius (max). Now, it was almost certain to go for some system utilizing the low temperature water below ground. Geothermal heat pump (chiller) collects the Earth's natural cold through a series of pipes, called a loop, installed below the surface of the ground. Fluid circulates through the loop and carries the heat to the building. There, an electrically driven compressor and a heat exchanger concentrate the Earth's energy and release it inside the building at a lower temperature. Chilled water is distributed to different rooms in MS pipes. Fan coil units are provided in different rooms which cools those rooms.

The underground loop draws excess heat from the building and allows it to be absorbed by the Earth. The system cools the building in the same way that a refrigerator keeps your food cool - by drawing heat from the interior, not by blowing in cold air.

The geothermal loop that is buried underground is typically made of high-density polyethylene. Open type geothermal system has carried out by drawing the low temperature water from ground by three number bore wells in three corner of the building. This water kept in an insulated underground tank connected with a submergible pump. Another MS pipe carries this low temperature water (28 degree Celsius) up to the heat pump (chiller) and cools the condenser. The return line of this loop is connected to one more tank, which further utilized for landscape and water body.

As with any heat pump, geothermal and water-source heat pumps are able to heat, cool, and, if so equipped, supply the house with hot water. Some models of geothermal systems are available with two-speed compressors and variable fans for more comfort and energy savings. Relative to air-source heat pumps, they are quieter, last longer, need little maintenance, and do not depend on the temperature of the outside air.

History of Geothermal Air Conditioning system

Geothermal Heating and Cooling uses the Earth's constant

temperature to achieve EER's (Energy Efficiency Ratings) in the 30's. The heating COP (Coefficient of Performance) is approaching 5. A 5 COP indicates that the Geothermal Systems are producing 5 units of energy for every unit of electricity consumed. The other four come from the Earth. That's why this technology is called "renewable". It is now widely used in different countries. In India, there is a great scope of this type of system and since last decade, many designers are showing interest in these types of systems.

A heat pump is a device that transfers energy from a low temperature source to a higher temperature sink. It differs from a pure refrigeration cycle in that the end result of the application could be either to heat or cool depending upon the direction that the refrigerant is currently flowing through the system. Figure 1 shows a schematic of heat pump system.

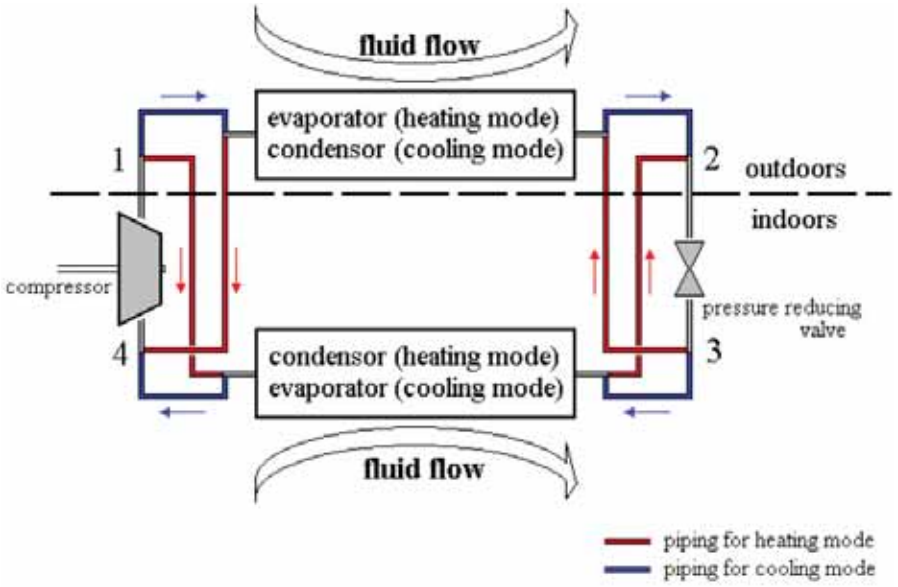


Figure 1: Heat Pump 1 - Schematic of Heat Pump System

Open Loop Heat Pump

Open loop heat pump system contains three loops; first loop is on the load side (chilled water loop). The second loop is the refrigerant loop inside the heat pump. The third loop in the system is on the source side (Cooling water loop) in which ground water exchanges heat with the refrigerant and to the earth.

As shown in figure 2 in the first loop the chilled water is circulating between AHU`s / FCU`s coil inside the building and evaporator of heat pump through the chilled water pump; chilled water takes the heat from the building and transferred this heat to the low pressure liquid refrigerant in to the evaporator; by absorbing this heat refrigerant changes its state from liquid to vapor phase. Refrigerant vapor is then goes in to the compressor; to increase its pressure. High pressure vapor refrigerant which is carrying the heat rejected by chilled water and the heat of compression then entered in to water cooled condenser where this total heat added in to the refrigerant is transferred to the cooling water coming from the underground tank.

As shown in figure 2 the cooling water will be supplied to the underground (UG) tank by three bore wells. UG tank submersible pump (one working + one standby) will supply this low temperature water to the condenser of heat pump. After exchanging heat the return hot water will be discharged in to the ground via two bore wells and one open well or it can be used for any hot water application.

UG tank is having one level controller which will sense high and low water level in to the tank to On/OFF bore well pump and to regulate the water supply from the bore well to UG tank.

The heat pump machine is having in built control panel with multiple protocol interface board, which will allow monitoring various performance parameters at a remote computer. Available protocols are BACnet MS/TP, Modbus, or Johnson Controls N2. The choice of protocol will be field selectable / changeable via the use of a simple selector switch. ■

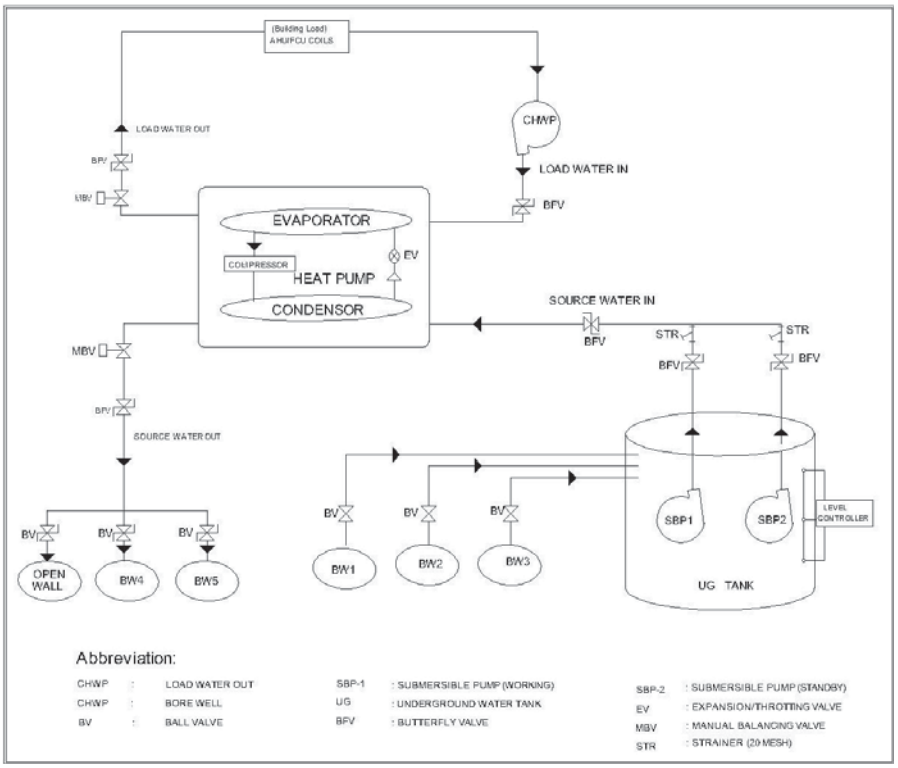


Figure 1: Heat Pump 2 - The schematic of open loop heat pump installation

(Note: Selected model of heat pump for ACC Thane project is TMW 340 AUT 20 N0 CS. Capacity is 20 TR and the manufacturer is Climate Master of USA.)

Firoj K Jena
CEO,
Clancy Global Consulting Engineers

Natural Refrigerants in Indian market

Aligned to global movements Embraco enters the Indian market in partnership with local company to provide more efficient compressors, equipped with R290 gas....

Embraco, a multinational company focused on innovation and one of the world's largest manufacturers of hermetic compressors for refrigeration, which focused previously on serving the medical equipment niche in India, now announces its entry into the household and commercial refrigeration market in the region. The company is the first to provide high efficiency compressors using natural refrigerants for the commercial refrigeration market in India.

With the world's second largest population, close to 1.2 billion people, India's electricity cost is very high and about 40% of food produced is wasted due to poor conservation. To address this issue, since 2013, the Indian government has encouraged refrigeration development in the country, through fiscal reform, as well as product cost and tax reductions.

There has been an ongoing trend, within the last five years, for the Indian commercial refrigeration sector to migrate to R290-equipped compressors. "We're betting on the potential of this market since compressors that use natural gas will enable a reduction of electric energy in the country. Embraco's greater intensity in India aims to facilitate Embraco's new vision in this market and is in line with the country's own objectives, which is to guarantee increasingly more energy efficiency. Embraco's pioneerism and know-how in using natural refrigerant gases makes us more competitive", says Esequias Pereira, Embraco's Commercial Manager for Asia.

Embraco's first partnership was with Rockwell and was established a few months ago during an ice cream trade fair. During the event, Embraco showcased the first R290 (propane) compressor for horizontal freezers in the Indian market, highlighting the environmental and energy efficiency benefits provided by using this natural gas.

With the aim of making the brand better recognized and expanding its participation in the Indian market, Embraco has set up a distribution network for small manufacturers – those that can not yet buy on a large scale – and has had, since 2016, a sales team dedicated to the business in the country.

"For 2017, we'll continue studying the market and hope to establish new partnerships, both in the commercial as well as the household segments," continues Pereira. "Our goal is to offer innovative and sustainable products and solutions to make Embraco a benchmark in the Indian market," emphasizes the executive.

Embraco X Natural Refrigerant Gases

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

The company continuously invests between 3% and 4% of its global revenue in R&D and directs efforts in developing innovative products that have the least environmental impact.

Embraco is a multinational in the sector of hermetic compressors for refrigeration focused on innovation. The compressor is the main component responsible for producing cold in the refrigeration system. With global operations and annual production capacity of 40 million units, Embraco offers solutions that are differentiated for their innovation and low energy consumption. Its more than 11,000 employees work in factories and offices located in Brazil, China, Italy, Slovakia, Mexico, United States and Russia.

Rockwell Industries Ltd was founded in 1986. In steady growth, the leader in the horizontal freezer segment in India is on its way to becoming the leader in commercial refrigeration equipment manufacturing to support the retail chain of its business partners. ■

A Journey From Passive To Passive PLUS

World's first Passive House in Darmstadt starts producing renewable energy...

About a year ago, a photovoltaic system was installed on the roof of a row house built in 1991 in Darmstadt. Since then, this pioneering Passive House project has been producing its own electricity, thus fulfilling the criteria of a Passive House Plus building. The official certificate was recently issued.

"Passive House buildings are perfectly equipped to utilise renewable energy. With their extremely low heating energy demand, it is even possible to derive as much energy from the sun on-site as is consumed in the house over a year", explains Dr. Wolfgang Feist. Together with his wife Witta Ebel, he recently accepted the Passive House Plus certificate.

The world's first Passive House building in Darmstadt-Kranichstein has just received Passive House Plus certification. The certificate was accepted by Dr. Wolfgang Feist and his wife Witta Ebel (left). Photos: Passive House Institute

Photovoltaik system for the anniversary

Twenty-five years ago, building physicist Dr. Wolfgang Feist built the world's first Passive House, thereby establishing this energy efficient construction Standard. Since that time, the founder and director of the Passive House Institute and his family have lived in the terraced housing complex in the Darmstadt city district of Kranichstein. In the year of its 25th anniversary, the Feist family installed a photovoltaic system on the roof of their house with a surface of 26 m² in order to utilise the sun's energy.

The building's two-part solar photovoltaic system covers 26 square metres and is mounted on the terrace as well as on the roof.

Efficiency plus renewable energy

With the Passive House Plus Standard, Passive House has contributed to the second step of the energy revolution. In addition to being highly energy efficient, it also generates on-site renewable energy. What matters here is that the energy demand of a building is considered and optimised separately from the energy generation.

Good basis for Passive House Plus

In a Passive House Plus building, the upper limit for the total demand for renewable primary energy is 45 kWh/(m²a). At the same time, at least 60 kWh/(m²ta) of renewable energy must be generated based on the projected building footprint. From the very beginning, the Feist family equipped their house, which has a living area of 156 m², with extremely efficient devices. The electricity consumption is therefore very low, even with the operation of the ventilation system. ■

Technology To Address Challenges

The system has been specifically designed to combat issues of excess moisture in the home in the hot southern regions of the United States of America...

One of the greatest trends in home building today is the move to energy-efficient home design. Homeowners seek out energy-efficient construction solutions and state-of-the-art appliances that help them achieve homes that are more comfortable, durable, and less expensive to maintain. However, as homes become more energy efficient and increasingly air tight, proper ventilation is negatively impacted.

In the southern United States specifically, additional challenges exist. In extremely hot and humid regions, increased air tightness and requirements for mandatory mechanical ventilation in homes can lead to excess moisture, increasing the likelihood of homeowners' discomfort, adverse health effects like asthma, allergies and other respiratory complaints and building degradation.

For such a situation in southern regions of the United States, Broan, a Nortek Company, has introduced a new fresh air solution. According to the company, "for today's tightly-constructed, energy-efficient homes, the Broan ERVS100 with exclusive Venmar core technology is an effective, balanced ventilation solution – that provides continuous fresh air to the home, manages excess moisture, and improves overall home comfort.

Broan informs that ERVS100 is specifically designed to combat indoor humidity that is prevalent in southern regions. In hot and humid regions, the Venmar core technology limits hot air and excess humidity from entering the home, while preventing cool air from leaving the home, creating a more comfortable living environment and improved indoor air quality in both climates.

"To combat poor ventilation, it is recommended that homes have a fresh air system with energy recovery capability to maintain a healthy indoor environment. We recognized an even greater need for these ventilation solutions in areas of the southern United States where hot climates increase the potential for homeowners discomfort and damage caused by excess moisture. The ERVS100's innovative features reduce the likelihood of those risks and provide increased comfort to homeowners overall," says Mathieu Lebel, Marketing Manager, Balanced Ventilation, Broan.

The ERVS100's advanced energy recovery Venmar core technology reduces excess moisture by up to 51 percent. The system's built-in humidity sensor measures outside humidity levels and temperatures every 10 minutes, restricting ventilation during times of excessive humidity. This decreases the chance of mold growth and provides homeowners with an energy savings of up to $180 annually (US calculation based on local energy pricing).

The system is easy to install and maintain due its smaller footprint and unique bracket system installation. The unit can be installed between 22-to-25" trusses or in the attic over trusses. An access door is all that is visible, used only for product maintenance and service.

It offers a maximum airflow of 105 CFM, which meets the ventilation requirements of a large portion of new home constructions. Moreover, when ducted to a bathroom, the ERVS100 can replace the need for an additional exhaust fan in the home – and therefore reduces the cost to the builder by up to $125 (US calculation based on local pricing). ■

Geothermal Energy Potential & Problems

Prospects of geothermal energy in India have huge potential to become a leading contributor in generating eco-friendly and cost effective geothermal power. Around 6.5% of electricity generation in the world would be done with the help of geothermal energy and India would have to play a bigger role in the coming years in this direction...

The ancient Romans used hot springs...

We always depend on energy in its any one of the forms in general and electricity in particular in order to accomplish our daily life routines. With more comfort seeking, less natural accommodating and thus away from sustainability living civilization, the demand for energy in its almost all forms other than industrial purposes, for compulsory lighting, heating and cooling is growing exponentially. Scientists say the sources of energy we need to power all the modern conveniences are running dangerously low. We could run out of oil in as little as 40 years and out of natural gas soon after that. These fossil fuels have been percolating beneath the Earth for hundreds of millions of years, and once they're gone, they're going to take millions more years to replenish. Not only are we running out of fossil fuels, but they're adding to our environmental woes by releasing nasty byproducts that increase pollution and contribute to global warming.

Quest for new sources of energy

Scientists are running a race against time to find cleaner, more efficient, renewable sources of energy. One potential source that we've barely tapped is right underneath our feet. Deep inside the Earth lies hot water and steam that can be used to heat our homes and businesses and generate electricity cleanly and efficiently. It's called geothermal energy – from the Greek words geo, or 'earth,' and therme, meaning 'heat.' There is plenty of heat in the center of the Earth. The deeper we dig, the hotter it gets. The core, about 6,437 kilometers beneath the surface, can reach temperatures of 4,204 degrees Celsius. Part of that heat is left over from the Earth's formation, about 4 billion years ago. The rest comes from the constant decay of radioactive isotopes inside the Earth. The heat inside the Earth is intense enough to melt rocks. Those molten rocks are known as magma. Because magma is less dense than the rocks surrounding it, it rises to the surface. Sometimes magma escapes through cracks in the Earth's crust, erupting out of volcanoes as part of lava. But most of the time magma stays beneath the surface, heating surrounding rocks and the water that has become trapped within those rocks. Sometimes that water escapes through cracks in the Earth to form pools of hot water (hot springs) or bursts of hot water and steam (geysers). The rest of the heated water remains in pools under the Earth's surface, called geothermal reservoirs. Deep wells, a mile or more deep, can tap reservoirs of steam or very hot water that can be used to drive turbines which power electricity generators.

People began harnessing geothermal energy thousands of years before they had the technology to dig down into geothermal reservoirs. The ancient Romans used hot springs to heat their homes, bathe and cook. In 1892, the first modern district heating system was developed in Boise, Idaho. It used water piped from hot springs to heat buildings. The first geothermal energy plant was built in Larderello, Italy, in 1904. Today, geothermal energy is used in France, Turkey, New Zealand, the United States and Japan, among others. Iceland is one of the biggest

users of geothermal energy – virtually the entire city of Reykjavik is heated with water pumped in from hot springs and geothermal wells. Some cities – like Klamath Falls, Ore. – even pump hot water underneath their roads and sidewalks in the winter to melt snow and ice. Costs for geothermal electricity generation are 4.5-7 cents per kilowatt-hour. This is competitive with some fossil fuel facilities, but one must keep in mind the drastic reduction of pollution. Delivered costs depend on ownership arrangements, financing, transmission, the quality of the resource, and the size of the project. Geothermal plants are relatively capital-intensive, with low variable costs and no fuel costs. Usually financing is structured so that the project pays back its capital costs in the first 15 years, delivering power at 5-10¢/kWh. Costs then fall by 50-70 percent, to cover just operations and maintenance for the remaining 15-30 years that the facility operates.

Applications of geothermal energy

Space/District Heating: In areas where hot springs or geothermal reservoirs are near the Earth's surface, hot water can be piped in directly to heat homes or office buildings. Geothermal water is pumped through a heat exchanger, which transfers the heat from the water into the building's heating system. The used water is injected back down a well into the reservoir to be reheated and used again. A few feet under the ground, the soil or water remain a constant 50 to 60 degrees Fahrenheit (10-15 degrees Celsius) year-round. Just that little bit of warmth can be used to heat or cool homes and offices. Fluid circulates through a series of pipes (called a loop) under the ground or beneath the water of a pond or lake and into a building. An electric compressor and heat exchanger pull the heat from the pipes and send it via a duct system throughout the building. In the summer, the process is reversed. The pipes draw heat away from the house and carry it to the ground or water outside, where it is absorbed.

Agriculture and Aquaculture: In temperate and colder climates, greatly improved plant and fish growth can be achieved by heating soils, greenhouses and fish ponds using geothermal heat.

Power Generation: Hot water and steam from deep underground can be piped up through underground wells and used to generate electricity in a power plant. With over 8,000 MW of installed capacity, geothermal electric power generation is a well-proven technology that has been especially successful in countries and islands that have a high reliance on imported fossil fuels. There are three types of geothermal power plants in use today, and they are:

i. Dry Steam Plants which use geothermal steam directly. Dry steam power plants use very hot (>235 °C) steam and little water from the geothermal reservoir. The steam goes directly through a pipe to a turbine to spin a generator that produces electricity. This type of geothermal power plant is the oldest.
ii. Flash Steam Plants which use high pressure hot water to produce steam when the pressure is reduced. Flash steam power plants use hot water (>182 ºC) from the geothermal reservoir. When the water is pumped to the generator, it is released from the pressure of the deep reservoir. The sudden drop in pressure causes some of the water to vaporize to steam, which spins a turbine to generate electricity. Both dry steam and flash steam power plants emit small amounts of carbon dioxide, nitric oxide, and sulfur, but generally 50 times less than traditional fossil-fuel power plants. Hot water not flashed into steam is returned to the geothermal reservoir through injection wells.
iii. Binary Cycle Plants which use moderate-temperature water (107 to 182 ºC) from the geothermal reservoir. In binary systems, hot geothermal fluids are passed through one side of a heat exchanger to

heat a working fluid in a separate adjacent pipe. The working fluid, usually an organic compound with a low boiling point such as Iso-butane or Iso-pentane, is vaporized and passed through a turbine to generate electricity. An ammonia-water working fluid using system boosts geothermal plant efficiency by 20-40% and reduces plant construction costs by 20-30%, thereby lowering the cost of geothermal power generation.

iv. There is also another method, called geothermal heat pumps. The earth's surface layer remains at an almost constant temperature between 10 and 160C. In this method, geothermal heat pumps use a system of buried pipes linked to a heat exchanger and ductwork into buildings. In winter the relatively warm earth transfers heat into the buildings and in summer the buildings transfer heat to the ground or uses some of it to heat water. These heat pumps function as both air-conditioning and heating systems in one.

Geothermal energy in India

Prospects of geothermal energy in India have huge potential to become a leading contributor in generating eco-friendly and cost effective geothermal power. Around 6.5% of electricity generation in the world would be done with the help of geothermal energy and India would have to play a bigger role in the coming years in this direction. But, the power generation through geothermal resources is still at nascent stage in India. Geological Survey of India has identified about 340 geothermal hot springs in the country. Most of them are in the low surface temperature range from 37o C-90oC which is suitable for direct heat applications. These springs are grouped into seven geothermal provinces i.e. Himalayan (Puga, Chhumathang), Sahara Valley, Cambay Basin, Son-Narmada-Tapi (SONATA) lineament belt, West Coast, Godavari basin and Mahanadi basin. Some of the prominent geothermal resources include Puga Valley and Chhumathang in Jammu and Kashmir, Manikaran in Himachal Pradesh, Jalgaon in Maharashtra and Tapovan in Uttarakhand. A new location of geothermal power energy has also been found in Tattapani in Chhattisgarh. In addition, Gujarat is set to tap geothermal electricity through resources which are available in Cambay between Narmada and Tapi river. For harnessing Geothermal energy in the country, the Ministry of New & Renewable Energy (MNRE) has been supporting R&D on exploration activities and Resource Assessment during last 25 years. This includes formation of expert groups, working group, core group and committees in addition to providing financial support for such projects and for resource assessment. MNRE is targeting for deployment of geothermal capacity of 1000 MW in the initial phase till 2022. Resource Assessment is being planned in 2016-2017 for public domain.

The objective of the program is to assess the potential of geothermal resources in the country and to harness these resources in two distinct categories namely:

i. **Power production**: Government of India, Ministry of New and Renewable Energy (MNRE) contemplate major initiative in RDD&D of geothermal technology for harnessing the geothermal energy in the country for the period 2015-17. Geothermal electricity generation is site and technology specific and India is in low geothermal potential region with low/medium heat enthalpy. Government is planning to encourage the demonstration projects at the first stage to assess the technical viability of the project before going to the commercial models. Various resource assessment carried out by GSI, UNDP and NGRI under aegis of CEA,UNDP & MNRE established the potential 10600 MWth /1000 MWe spread over 340 hot springs across seven Geothermal provinces/11 states . The average rough capital cost on not exceeding basis stands 30 Cr per MW (Rs 12 per KWhr). As per the international reports, a 1 MW Geothermal Power Plant generates about 8.3 Millions Units (MU) per MW per annum compared to solar 1.6 MU per MW, Wind 1.9 MU per MW and Hydro 3.9 MU per MW.

ii. **Ground Source Heat Pumps (GSHPs)/ Geo-exchange Pumps**: Ground Source Heat Pumps (GSHPs) use the earth's relatively constant temperature between 16 - 240C at a depth of 20 feet to provide heating, cooling, and hot water for homes and commercial buildings. GSHP harvests heat absorbed at the Earth's surface from solar energy. The temperature in the ground below 6 metres (20 ft) is roughly equal to the mean annual air temperature at that latitude at the surface. It uses the earth as a heat source (in the winter) or a heat sink (in the summer). GSHPs is effective in all kind of climate zones or can be deployed anywhere in India on 24 x 7 bases. This technology is being used worldwide from last 50 years. According to the reports published in the World Geothermal Congress 2010, the installed capacity of GSHP in the world is 52.7 GWt up to the year 2013. More than 3 million GSHP units of capacity 7 kW to 35 kW (24 000 to 120 000 Btu/h) installed worldwide in 43 countries. The leading countries using this technology are USA, Sweden, Germany, Switzerland, Canada, Japan and China. Government of India, Ministry of New and Renewable Energy (MNRE) contemplate initiatives in RDD&D of Geothermal technology specifically for the purpose of cooling, drying, space heating, greenhouse cultivation, industrial processes, cold storage, poultry & fish farming, Mushroom farming, horticulture etc. MNRE is also working in collaboration with BEE on increasing the efficiency by more than 50% of conventional HVAC system by retrofitting or replacing the cooling towers (Air cooled) by Energy Star qualified Geothermal Heat Pumps.

Indian organizations working in geothermal energy

- Central Electricity Authority
- Geological Survey of India
- Indian Institute of Technology, Mumbai
- Regional Research Laboratory, Jammu
- National Geophysical Research Institute, Hyderabad
- Oil and Natural Gas Corporation, Dehradun

Ongoing Projects in India

- Magneto-telluric investigations in Tattapani geothermal area in Madhya Pradesh
- Magneto-telluric investigations in Puga geothermal area in Ladakh region, Jammu & Kashmir.

Geothermal Energy Pros and Cons

Technically speaking, geothermal energy is a renewable source of energy that can produce energy as long as earth exists. Geothermal energy is a type of energy that can really make it easy for companies to get what they need without using a lot of fossil fuels in the process. Let us list here some of the most important pros and cons that are related to using geothermal energy.

Pros of Geothermal Energy

1. **Renewable**: Geothermal energy is extracted from earth's core and will be available as long as earth exists. It is,

therefore, renewable and can be used for roughly another 4-5 billion years. While fossil fuels have an expiry date, renewable sources like geothermal energy is not going to expire anytime soon.

2. **Environment friendly**: Geothermal energy is green in all aspects of its production and use. It is actually known for having the least impact of any power source. When it comes to the process of developing and making it, geothermal power is practically completely emission free. There is absolutely zero carbon used when it comes to the production of this type of power. Also, the whole procedure can clean out sulfur that may have generally been discharged from other processes.
3. **No fuel needed**: No fuel is used at all during the production and use of the energy. Because there is absolutely no mining or transportation related to the process, which means that there aren't trucks emitting fumes and gas, which means that the atmosphere is not being as affected by the process.
4. **Abundant supply**: With geothermal energy, there are no shortages or other sorts of problems that sometimes occur with other types of power. They are not subject to the same issues as solar or wind power, which means that we won't get a shortage because the weather isn't cooperating. There is a practically boundless supply. It is also intrinsically basic and dependable, so don't have to worry about it being more of a hassle than it is actually worth.
5. **Significant savings**: There has been a tremendous increase in the number of homeowners who want to utilize geothermal energy for heating and cooling purposes. The result is that less energy is used for heating homes and offices which results in significant savings for home owners. It might prove expensive initially but 30-60% savings on heating and 25-50% savings on cooling can cover that cost within few years. A geothermal heat pump can help to save enough money in energy costs.
6. **Smallest land footprint**: Geothermal energy extracts heat from hot water, the steam from hot water move the turbines that produce electricity. To extract this energy, substantial amount of piping is required to be laid underground. But, thanks to new innovation in the field of technology, geothermal energy has the smallest land footprint of any major energy source in the world. The costs are very competitive. As of now, geothermal energy is quite cost aggressive in a few areas where it is being produced, so want to keep an eye on how much it is changing the world of energy in the areas where it is located.

Cons of Geothermal Energy

1. **Suitable to particular region**: Everything that deal with geothermal power seems to be really far away from, well, everything that is in and around the area. Prime destinations are exceptionally zone specific, so can't really find geothermal power outside of those areas. Also, the prime destinations are frequently a long way from urban areas, which means that they're virtually useless when it comes to cities and such.
2. **High initial costs**: For those residential owners who are thinking to use geothermal energy, high upfront costs is something that turns out to be a huge distraction. For an average sized home, installation of geothermal heat pumps costs between Rs 7 – 8 lacs that can pay off itself in another 5-10 years down the line through significant cost savings.
3. **Cost of powering the pump**: Geothermal heat pumps still needs a power source that can run it. The pumps needs electricity to run that can transfer energy from earth's core to the home.
4. **Surface instability**: Geothermal has become infamous for causing earthquakes as setting up of geothermal power plants can alter the land's structure. A process called hydraulic fracturing is an integral part for building a large scale and efficient geothermal system power plants that can trigger earthquakes.
5. **Environmental concerns**: There are some environmental concerns like water use is one of the big concerns, because geothermal power uses a lot of water in its processes and such. There are also a number of different compounds that go into the air, water, and ground as a result of the process, including sulfur dioxide and silica discharges, both of which can harm the environment.
6. **High temperatures needed**: The process is not exactly an easy one to be executed as boring into warmed rock is extremely troublesome.
7. **May run out of steam**: If the heat in place is not taken care of properly, it can cause a meltdown or other issues where the energy is not properly distributed or used.

The future of geothermal energy

Geothermal energy has the potential to play a significant role in moving any particular region in general and the whole world in particular towards a cleaner, more sustainable energy system. It is one of the few renewable energy technologies that can supply continuous, baseload power. Additionally, unlike coal and nuclear plants, binary geothermal plants can be used a flexible source of energy to balance the variable supply of renewable resources such as wind and solar. Binary plants have the capability to ramp production up and down multiple times each day, from 100 percent of nominal power down to a minimum of 10 percent. The costs for electricity from geothermal facilities are also becoming increasingly competitive with conventional energy resources. There is also a bright future for the direct use of geothermal resources as a heating source for homes and businesses in any location.

However, in order to tap into the full potential of geothermal energy, two emerging technologies require further development: Enhanced Geothermal Systems (EGS) and co-production of geothermal electricity in oil and gas wells. Geothermal energy is generally regarded as environmentally friendly, sustainable and reliable and this makes geothermal energy a no-brainer in some places, but heavy upfront costs stops us from realizing the full potential. How much influence geothermal power will have on our energy systems in the future depends on technological advancements, energy prices and politics (subsidies on energy). When it comes to green energy, geothermal energy is one of the first types that is being explored. New innovations are coming out for it all of the time, which means that it will likely be easier to deal with some of the difficulties with the technology as time goes on. It can also be manufactured underground. New innovations that are coming out are basically guaranteed to be able to use lower temperatures in future iterations of the technology as well. ■

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"We are focusing on reducing global warming..."

Ingersoll Rand is one of the leaders in the commercial HVAC market providing products and solutions with advance technology. Having two brands Trane and Thermo King, Trane offers HVAC solutions for commercial market through its complete range of product line. Thermo King is a leading brand in refrigeration and cooling solutions for truck and bus market. **Sanjeev Seth, Country Leader – HVAC and Transport – India and SAARC Markets Asia Pacific and India SBU, Ingersoll Rand** talks to **PK Chatterjee** about HVAC and refrigeration for the hospitality industry and much more...

How is Ingersoll Rand HVAC&R business expanding in India considering the growing need for cooling because of global climate change?

Ingersoll Rand in India has two major market leading brands namely Trane and Thermo King. Trane is one of the leaders in the commercial HVAC market providing products and solutions with advance technology. Trane offers HVAC solutions for commercial market through its complete range of product line which include air cooled and water cooled chillers, air side products and Trane care solutions. Trane also offers complete range of unitary product offering which includes VRF, ducted splits, and ductless splits for commercial and residential applications. Thermo King is a leading brand in refrigeration and cooling solutions for truck and bus market.

We have wide range of energy efficient and technologically advanced products and services which can cater to changing environment needs of India and the globe. We focus in offering solutions which exceeds the performance requirement for the given application and provide lower overall cost of ownership with high quality and reliability, resulting in lower maintenance cost.

What are the major segments that you are eyeing on in India?

In the HVAC market, Trane participation has been for both comfort and process applications and has been a leading player in segments like industrial, pharma, hospitality, commercial, healthcare, education and large infra projects. With Unitary product offerings, Trane is now growing in residential and retail segment as well.

In transport, with Thermo King offering for bus AC, our focus is in to applications for intercity coach bus, staff bus, school bus, tourist bus and special applications like tarmac & Army requirements. In transport refrigeration focus is in transport of perishable products like dairy, ice cream, pharma, poultry, meat & fisheries, fruits & vegetables, etc.

How acute is the competition in the Indian market as far as the HVAC&R sector is concerned?

Indian Market is very dynamic in terms growth in residential, commercial & mobility solutions in the air-con space. The demand for energy efficient solution with lower operating and maintenance costs is increasing. Trane & Thermo King leads the market with solutions which are high in performance, high in efficiency and high in reliability – durability.

What is your contribution to the emerging segments like retail, cold chain and smart building?

For retail and smart building applications also Trane works closely with the customers for solutions which are energy efficient.

For smart building, the practice is of creating healthier and more resource-efficient models of construction, renovation, operation and maintenance. Sustainable building takes into account the building's entire lifecycle – there could be slightly higher initial costs, but green designs, upgrades and operations create savings that will almost always pay for the added costs, reduce the use of other resources and enhance productivity. Green building practices can help organizations achieve and maintain operational efficiencies that help create a sustainable future for the community, economy and environment.

Trane HVAC is focused on reducing global warming through reduced emission, reducing energy costs, which will help businesses meet their sustainability goals with better return on investment. Building owners consistently see immediate returns on investments by installing high-efficiency HVAC and automated control systems that optimize HVAC central plant performance.

> Indian Market is very dynamic in terms growth in residential, commercial & mobility solutions in the air-con space. The demand for energy efficient solution with lower operating and maintenance costs is increasing.

Technology convergence is a key towards smart building solutions. Our wide range of controls or automation solution (BMS)enables optimize plant performance , increase reliability enable intelligent controls and analysis with focus on reduced energy consumption. Thus, the overall lifecycle or total cost of ownership is less with these smart systems.

For cold chain, Thermo King offers a comprehensive range of product solutions, specifically, designed for the transport temperature control application. We pride ourselves in the research and development of market leading innovative solutions in offering our customers the most reliable, efficient and effective products.Thermo King is working to develop innovative solutions such as Telematics solutions which help customer not only to monitor their reefer trucks remotely, but also manage and control the unit. This helps the customer to increase its sustainability for both large and small deliveries.

What are the major projects that you have contributed to in the last (say) two years in India?

Our presence is cut across various vertical market segments and each segment requires different value proposition. Trane is part of the major projects in the Metro expansion projects in India or industrial projects like textiles, R&D labs, information technology, healthcare and hospitality projects, data centres across India. Our projects are designed to address the need of vertical market in India and we create value by providing solutions as each building requires customised solution.

Do you offer support for customized product or system development? What about retrofit support for upgrading old HVAC&R plants?

The requirement of each customer is different and hence our solution to them are customised. Every building has a scope of improvement in reducing energy demand and retrofits are part of the solution basket which we offer to our customers. In recent product series, we have introduced high energy efficient products, a high return on investment (ROI) proposal which give opportunity for our customers for reduction in energy demands in their buildings. We offer retrofit kits in certain range of products which enable easy switchover from the existing plant setup to the new upgrade. New Trane launches such as Trane chillers with adaptive frequency drive helps to save significant energy consumed by chillers and improve performance of plant. Upgrading high end cost chillers help customers for lower cost of ownership. These variable frequency drives are also available as kits for upgrade for existing machines in certain ranges. Automatic Tube cleaning (ATB) system, adiabatic systems, life cycle analysis, service contracts, and controller upgrade are part of the retrofit products in services.

How do you manage to provide after sales service efficiently all over this sub-continent?

When it comes to service and service capability, Trane stands out as the best as we have highly trained service engineers, technicians and supervisor. They provide after sales services and also partner with customer for proactive approach to avoid any breakdown by providing service contract helping customers to lower cost of ownership and improve chillers performance. When there is acute competition, managing the after sale is the key which is the clear differentiator in the market. We position ourselves as premium service provider, offering wide range of demand services, catering to the after sale market. We have been serving our customers over two decades. We provide specialised contract like Trane Select, Eddy current test, Compressor overhauling helping to enhance lifecycle of our chillers. We also have warehouse in all major cities in India for managing demand services for part and consumables. For service of AC & Refrigeration products in transport, we have service touch points across all major routes the customers operate these vehicles. Our channel partners and service providers are exclusively trained to provide the best service support. Our key value offering in service helps saving energy for our customers. ■

Optimizing TES System

The penetration of Thermal Energy Storage (TES) systems has not been very high in the Indian Market, as compared to the more developed economies. This article discuss the issues that impact the performance of a TES system and what a building O&M team can do to utilize the system to its full capability...

Ice has been used as a means to store energy from ancient times, when people stored ice during winters underground and reused the ice in summers for cooling. In the 17th and 18th century, Ice was a major commodity and traded across Europe and the Americas, employing more than 50,000 people in North America alone. Most of the Ice was used in cooling buildings. Closer home, even to date, in North India, it is a common practice to put ice cubes from the refrigerator into the water basin of the domestic air coolers (desert coolers). Small vendor and hawkers also use the stored energy of Ice to cool their wares (beverages) where electricity is not available for installing a refrigerator.

The principle applied in these rudimentary cooling system is simple. Energy is used to create Ice and when the requirement to cool a space or products arises, the stored energy of the Ice is again utilized as Ice melts and absorbs the latent heat of the surrounding. A Thermal Energy Storage (TES) based air conditioning system works on a similar principle – Energy is stored (in the form of Ice or using other medium) during the night and is used during the day to cool the buildings. This allows for lowering sizing of the chiller and also reduces operating costs as ice formation is undertaken during off peak hours when energy rates are lower. In theory, a TES is an excellent use of spare capacity of the chillers and a low cost option. However, the penetration of TES systems has not been very high in the Indian Market, as compared to the more developed economies. This article discuss the issues that impact the performance of a TES system and what a building O&M team can do to utilizes the system to its full capability.

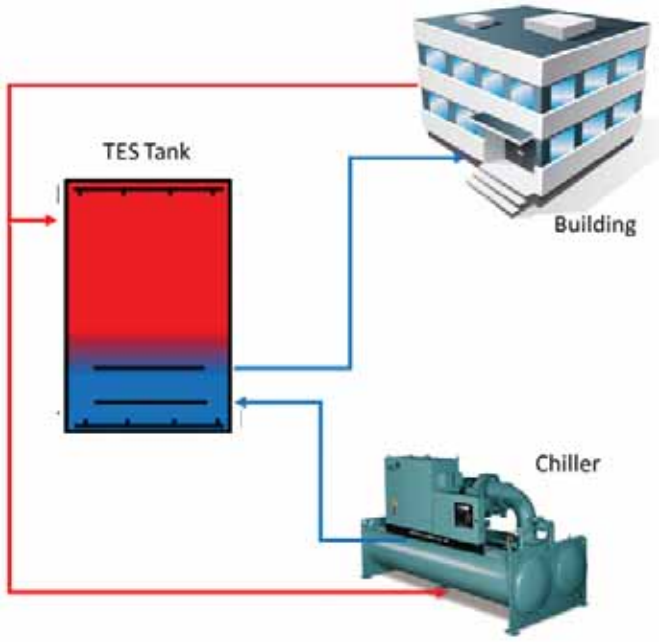

Figure 1: TES Integrated with HVAC System

Overview of TES Systems

Typically, building air conditioning plants have a cyclical load patter – low loads in the morning and evening and very high loads during two to three hours of the afternoon. This load variation requires the system to be sized accordingly, resulting in idle chiller capacity during off peak hours. Additionally, the electricity tariffs are high during the day (peak load times) than at night where the local utility has time of day (ToD) pricing. Thus, the cost of running chillers during the peak tarrif periods is high. A thermal energy storage system is well placed to address both these aspects of a building chiller system.

Basic Principle of TES

In a TES system, cooling capacity is generated at a different time and used at time. During off peak tarrif periods (usually night time), the chillers are run at optimum loads to create ice or store energy in special mediums in storage tanks. During the day, the stored energy is used for cooling by circulating the chilled water through the storage tanks. Figure 1 shows a typical TES chiller application. TES systems are of two types – Full storage systems which provide the entire cooling loads of the building during the operating hours of the building and partial storage system which supplement the chiller cooling capacity during the peak hours. A TES system not only shifts load to non-peak tarrif periods, it also reduces the energy use. A typical TES energy use over a 24 hour cycle is shown in figure 2.

Benefits of a TES system

While a TES system may appear to be complex, there are significant benefits the building owner can accrue by configuring the HVAC system with a TES system. Some of the key advantages of a TES are

- Energy savings through operation of chillers during off peak tarrif periods.
- Reduction in energy use since the chiller operates at design load during storage cycles. Upto 12% reduction in energy use have been reported
- Lower capacity of chillers – Since the stored energy is used during

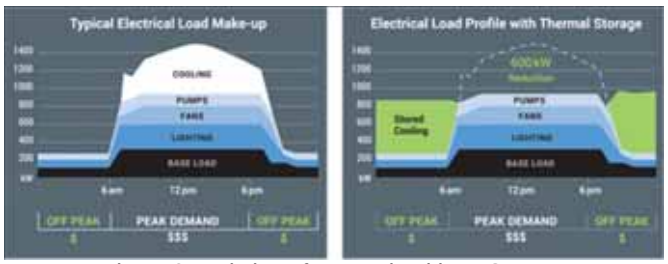

Figure 2: Variation of energy load in TES setup

the day to supplement the chiller capacity, the net size of the chiller can be reduced thereby lowering initial capex costs. The cost of the TES system is lower as compared to the incremental 'per TR' cost of chillers. There is also the added benefit of lower electrical loads for the building which further reduce the cost of operation. Typically, chillers are designed to cater to peak load which occurs only for 5- 10 days in a year and hence are generally oversized. A good TES design can lower the chiller capacity by as much as 40% since the TES can cater for the peak loads easily.

- Back up for critical systems – Even if the chiller fails, there is back up cooling capacity for the server rooms/data centers etc. in a TES system till repairs are effected. Additionally, since the system has a 'back up' ability, the cost of installing standby chillers for critical requirements can be avoided and the TES used for emergencies.
- Increasing system capacity – In existing HVAC systems, when there is need to increase the overall capacity due to an increase in load, a TES can be a suitable option rather than adding chiller capacity.

TES Systems Adoption

The integration of TES system in a HVAC design appears to be beneficial to both in terms of operating costs and system reliability. However, the adoption of this technology in India has not been very encouraging. There are only a handful of installations in metros and even where the systems are installed, the TES is either not being used to its full capacity or not used at all. A TES system comes at cost on account of the storage tank, storage media in case of phase change materials and the associated piping and control systems. Very often, despite the investments, the TES is not utilized leading to loss on investments and inadequate cooling of the workspace. Some of the factors that impact the use of a TES in design and also effective use of the installed TES are as follows:

- **Improper design**: In most of the cases where TES is not used to its full capacity or remains idle, the reason is wrong choice of TES. A HVAC system where loads are mostly even during the day, such as in process industries or in regions where the climatic variations are not high is not a suitable choice for a TES. While a TES in these cases will reduce energy costs, the increase in complexity will override any benefits.
- **UniformTariff**: In one instance that I had an opportunity to review, the TES was installed in city where there was no differential pricing at night. A TES system is mainly used to shift the time of cooling energy storage from high cost tariff to lower cost tarrif periods. If there is no differential tarrif, then the usability of the TES is limited.
- **Lack of awareness of O&M teams on TES use**: In HVAC systems where a TES is installed, the operators do not have in depth knowledge of the new system and end up operating the plant inefficiently. In many cases, the TES system gets by passed when the operators see that the ice formation is not adequate or overall cooling is not sufficient. Improper commissioning, lack of training of the O&M team and limited knowledge of this new technology lead to the TES system not being used as per the design.

Making best use of the TES system

Where a TES system has been installed, a few simple maintenance practices and awareness of the complexities of the system will ensure that the system operates at the design point. The key factors that the O&M team needs to keep in mind for an efficiently running TES system are:

- **Commissioning**: Since the TES system has lesser redundancy than a non-storage system (Excess capacity is built in the chiller load at design), the commissioning process helps in identifying any potential gaps in the design and corrective measures can be incorporated. A good commissioning program should commence at the design stage itself and carry on for the first year of operations. It should also include training of operators and adequate documentation of the various operating modes of the TES.
- **Maintenance Aspects**: The key maintenance consideration for the maintenance team for a TES system is to keep the heat transfer qualities of the fluid intact. Any deterioration of the heat transfer parameters will impact the entire system and lead to loss of cooling capacity. Thus, regular quality assessment of the cooling water or heat transfer medium is essential. Manufactures specify specific additives to maintain the heat transfer coefficients and these should be introduced at the manufacturer recommended frequencies.
- **Efficiency monitoring**: The best way to assess effectiveness of the TES is to measure the mega joules per kilowatt of cooling capacity delivered. The values obtained when compared to the design or commissioning values will indicate the level of performance of the plant.
- **Trained manpower**: While the TES system is part of the overall HVAC installation, the operation of the TES requires a deep understanding of loads, tarrif assessment, cycling frequency etc. It is, thus, essential to have a trained TES engineer on site to optimally utilize the system and extract maximum benefits for the owner. Similarly, the operations team should also be trained by the OEM and regular follow or refresher trainings should be undertaken to operate and maintain the system at design point.

Conclusion

TES systems are part of our everyday lives in the form of water heaters – stored water is heated and the storage heater keeps the water hot for a period of time, thus negating the need for continuous heating. The TES system integrated with a HVAC system is an adaptation of that strategy and has substantial benefits such as lower operating cost, higher system reliability and a lower carbon footprint. The TES system also helps in reducing the chiller capacity of a design. Despite the benefits, the adoption of TES technology has been slow in India, and where installed, the utilization has been poor. This can be overcome by designers choosing TES system for the right operating conditions and the O&M team understanding the functioning of the system in depth. ■

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Indirect Systems In Cold Storages

We should find out which of the different parameters that are especially important in the application we are considering and then try to choose the secondary refrigerant that is best for that particular case.

Indirect systems with secondary refrigerants or coolants have been used for multiple applications including supermarket chains for cold storage, cooling cabinets and freezers. The secondary refrigerant is used to transport energy from the cooling object to the evaporator. In an indirect system it is possible to designthe primary refrigeration unit in a compact way and with an extremely small refrigerant charge. In order to choose a suitable fluid and for technical calculations of the system there is a need to know the thermophysical properties of the liquid secondary refrigerant. The liquid chosen should give enough freezing security, good transport capabilities, good heat transferability and low pressure drop giving small pumping power. This article includes a comparison of liquids for cooling cabinets and freezers with indirect system in a supermarket. The comparison shows that salt solutions can perform quite well from a thermophysical aspect, also for freezer applications. When choosing secondary fluid, attention should also be given to material compatibility, toxicity, handling security and environmental pollution and we find that no secondary refrigerant is ideal for all types of applications. Much research is today also carried out with phase-changing secondary refrigerants, such as CO_2 and ice-slurry.

Indirect systems have several advantages in comparison with direct systems. Factory built units can be used, local construction of primary refrigerant piping can be avoided and installation work can be made in a

more simple way. In an indirect system it is possible to design the refrigeration unit in a compact way and with an extremely small refrigerant charge.

An indirect system with a secondary refrigerant circuit introduces the added cost for pump and heat exchanger as well as an added temperature difference. However, in practice the total energy consumption over the year of a well built indirect system is often lower than of a direct system. With indirect systems there is of course a need to find a suitable secondary fluid. All liquids used have some negative aspects as we will see later. The challenge becomes more difficult to handle with very low temperatures.

Some systems for supermarket chains use separate circuits for cooling cabinets and freezers. In other systems the main secondary refrigerant is used to cool the condenser of the freezer unit and a low-temperature liquid secondary refrigerant is used to keep the freezer cabinets at a right temperature.

Secondary refrigerants

Water solutions of ethylene and propylene glycol, ethyl alcohol and chloride salts have long been used as secondary refrigerants. A number of non-aqueous heat transfer liquids are also used. Some indirect systems today use water solutions of potassium acetate or potassium formate or a mixture of these organic salts. How do these newer products compare with those used for many years? What aspects must be considered when choosing secondary refrigerant? There are several requirements that have to be fulfilled by an ideal secondary refrigerant. It should possess good thermophysical properties. High values of specific heat and thermal conductivity but low viscosity at the operating temperature are desirable, making it possible:

1. to transport a large refrigerating capacity with small volume flow and small temperature change,
2. to get high heat transfer coefficients giving small temperature differences in heat exchangers and cooling object and
3. to get small pressure drop for the system fluid flow so one can use a pump with little power consumption.

When determining which secondary refrigerant to use in a particular application, close attention should also be given to aspects such as corrosion, toxicity, flammability and cost. It is important that the fluid does not give cause to any material problems, is environmentally acceptable, and can be handled without danger. There is a need to examine carefully the product information and safety sheets available for the commercial products. A brief guideline will be given of these aspects for the various types of secondary refrigerants examined.

Much research is today carried out with phase-changing secondary refrigerants such as phase-changing CO_2 and ice-slurry and these technologies will no doubt develop further during the next few years.

Comparison Of Thermophysical Aspects

Basic thermophysical properties are introduced and equations are given to help determine refrigerating capacity, volume flow, Reynolds number as well as heat transfer and pressure drop for turbulent and laminar flow.

Basic thermo-physical properties

For technical calculations of refrigeration and heat pump systems and for choice of secondary refrigerant we need to know the concentration and freezing point temperature (or cooling limit) as well as basic thermo-physical properties of the liquid, such as density,specific heat, thermal conductivity and viscosity.

The freezing point temperature should be somewhat below the lowest operating temperature of the liquid secondary refrigerant. Water solutions do not freeze to solid ice even if the temperature is lower than the "freezing point" (at which ice crystals may begin to form), except near eutectic concentration. The risk for serious damage due to freezing up of a heat exchanger is, therefore, small with the aqueous solutions. The liquid used should have enough freezing security, yet not more than needed as a higher concentration of the freezing point depressant additive will mean less water and thereby poorer thermo-physical properties.

The concentration of a certain known solution can be measured by checking the density. High values of specific heat and thermal conductivity are desirable as it contributes to good heat transfer and thereby decreases the temperature difference between liquid and tube wall.

The viscosity is of special importance, since it is inversely proportional to the Reynolds number and hence influences the type of flow that will occur in a heat exchanger, cooling object and also determines the pressure drop. A high viscosity makes it impossible to keep the flow turbulent in a conventional heat exchanger with a reasonable pumping power.

Reynolds number and type of flow

The Reynolds number, *Re*, is a good indicator of the type of flow occurring, laminar or turbulent, The flow of water will generally be turbulent for $Re > 2300 - 3000$, especially if some form of flow disturbanceis used. For lower Re number values, the heat transfer coefficient and friction factor decreases rapidly due to transition to laminar flow that usually occurs between $2300 < Re < 3000$.

Heat transfer

The heat transfer coefficient for laminar flow is generally much lower than for turbulent flow. The heat transfer coefficient will influence the temperature difference, between liquid and inner tube wall. This temperature difference may be too highwith laminar flow in circular tubes. How can it be reduced? One way used in supermarkets is to reduce volume flow in each channel by using parallel circuits. Other possible ways are to use shorter length of each straight tube, smaller tube diameter or for instance by using rectangular shaped flow channels.

Comparison Of General Liquid Characteristics

When determining which secondary refrigerant that is to be used in a particular application along with thermo-physical properties, we also have to take into consideration aspects such as material compatibility, environmental pollution and toxicity, flammability and handling security aswell as cost. It is important that the fluid does not give cause to any material problems by corrosion, is environmentally acceptable, not toxic and can be handled without danger.

All secondary refrigerants seem to have one or more negative sides, as we can note from the following list where some characteristics are listed for each type of liquid.

Water (H_2O): Freeze at or just below 0°C. Water (and most aqueous solutions listed below) is corrosive when oxygen is present, if suitable and efficient corrosion inhibitors (such as Protectogen C Aqua) are not used.

Aqueous Solutions:

Ethylene glycol (EG): Health hazard if consumed (highly toxic for humans); risk of environmental pollution; most commercial products for indirect heat pump and refrigeration systems have good corrosion protection, but that may not be true of glycols for the car industry or of

Table 1: Corrosion of metals in g/m², tested in accordance with ASTM D 1384 (336 h/88 °C, 61 air/h)

	Antifrogen N[a]	Ethylene glycol[b]	Main water[c]	Calcium chloride brine[d]
Copper (Cu)	-1.2	-2.8	-1	-11
Soft solder (WL 30)	-1.4	-135	-11	-443
Brass (MS 63)	-0.6	-7.6	-1	-36
Steel (CK 22)	-0.1	-152	-76	-95
Cast iron (GG 25)	-0.2	-273	-192	-310
Cast aluminium ($A1Si_6Cu_3$)	+0.1	-16	-32	-135

[a] Antifrogen N/water mixture 1:2; [b] Ethylene glycol/water mixture without inhibitors 1:2; [c] 14° GH (GH = German hardness; EH = 1.25 GH), without inhibitors; [d] 21% (w/w)

Picture 1

products without corrosion inhibitors. **Antiforgen N** is one of good ethylene glycol based secondary refrigerant with pre mixed corrosion inhibitors.

Propylene glycol (PG): Very high viscosity at low temperatures; less toxic than ethylene glycol; risk of environmental pollution; most commercial products for indirect heat pump and refrigeration systems have good corrosion protection. One such example is **Antifrogen L**. It is approved, by the FDA (Food and Drug Administration) in the USA for use as a food additive. It should, therefore, be givenpreference to MEG in all instances where the product is intended to be used in the food and drinkssector or where the possibility of the heat transfer medium entering process water or hot water cannotbe excluded.

Potassium formate (KFo): Long term effects are not well known yet. Rather high pH-value. Viewed as less toxic than ethylene glycol; Antifrogen® KF is a non-toxic clear liquid, based on an aqueous formate solution which is used as a low-temperature brine down to -50 °C in industrial and food refrigeration systems. The brine has a low viscosity at low temperatures.

Improvement of corrosion protection

ASTM D 1384 is used as the main quality test (Picture 1) for judging the corrosion performance of glycol basedheat transfer fluids.

In this test, various metal coupons (copper, brass, soft solder, steel, cast iron and cast aluminium) are submerged in an aqueous dilution of the heat transfer fluid for 336 hours. Temperature is maintained at 88°C with introduction of six liters of air per hour. After the test, the weight change is measured. The difference before and after is used as a quality criterion for the stability and the corrosion protection of the heattransfer fluid. (Refer table 1.)

Conclusion

After considering both thermophysical properties and these other general characteristics of the liquids, it becomes evident that all liquid secondary refrigerants seem to have one or more negative sides, no secondary refrigerant is ideal for all applications. We should find out which of the different parameters that are especially important in the application we are considering and then try to choose the secondary refrigerant that is best for that particular case. We have to consider company information sheets closely especially when it comes to material compatibility. ■

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Solving The Urban Water Crisis

A recent report by PwC; states that the situation warrants utilities and the government to ensure optimal use of available water resources while duly addressing the social, economic and commercial considerations...

Water stress has become a perennial concern in most Indian cities. India is expected to add approximately 404 million new urban dwellers between 2015 and 2050. This rapid urban growth will be linked with higher industrial output and greater energy demand, thus adding to the urban water stress. Institutionalising the reuse of treated wastewater can help utilities in addressing this challenge in an effective manner.

There is a need for developing wastewater reuse as a sector, identifying the interventions that could help in the development of this sector and also identifying suitable structures that can help in mainstreaming the implementation of wastewater reuse projects in the country.

According to a PwC report, "Closing the water loop: Reuse of treated wastewater in urban India," the situation warrants utilities and the government to ensure optimal use of available water resources while duly addressing the social, economic and commercial considerations.

Ranen Banerjee, Partner and Leader Public Sector and Governance, PwC said, "The wastewater sector will be driven by government initiatives based on which the implementation models will be designed. Hence, sound policy and regulatory interventions by the central and state governments are a prerequisite for the launching of innovative reuse projects. Government interventions will need to focus on incentivising the use of reclaimed water and developing institutional support mechanisms."

To promote reuse, the central and state governments should jointly issue a national wastewater reuse policy, with clear policy targets, setting out the legislative, regulatory and financial measures needed to achieve those targets.

Furthermore, the Ministry of Environment and Ministry of Water Resources should together define quality norms for different grades of industrial water, which will help standardise design of reuse systems nationwide. National level norms for water safety planning and risk management are also needed to build credibility for reclaimed water as a reliable alternative.

There are three forces that are propelling the business case for reuse of treated wastewater in India.

- **Water security:** At present, this issue ranks high in the minds of policymakers in India with several cities facing water crises.
- **Reuse of treated wastewater** is getting strong support from government policy. It is an important element in the ambitious plan to clean up the River Ganga, a flagship initiative of the ruling government (Clean Ganga Mission), and is also included in other urban policies and their related funding streams.
- By signing the Paris Agreement on climate change in April 2016, India has signaled its concern for the sustainable use of natural resources. Water reuse fits well with these broader environmental goals, helping, as it does, to conserve scarce resources and to promote efficient use.

Given the worsening water crises in many Indian cities, the moment has come for the government to engage efforts and resources in developing wastewater reuse to meet industrial water demand. It may be a tough road ahead for utilities and government to fast-track the necessary interventions, but the long-term benefits of reusing wastewater are substantial. ■

Solar Heating, Cooling And HVAC

Regulations across the country have required smarter cooling and heating in new buildings, and hence new buildings will become more energy efficient...

Wall-mounted evacuated tube solar thermal system

Solar thermal energy is appropriate for both heating and cooling. Key applications for solar technologies are those that require low temperature heat such as domestic water heating, space heating, pool heating, drying process and certain industrial processes.

Solar Heating

Solar thermal systems consist of a solar collector, a heat exchanger, storage, a backup system and a load. This system may serve for both, space heating and tap water heating, known as combi system. Refer Figure 1.

In most applications, solar combi systems are used, generating energy for hot water and space heating, comprising mainly solar collector, heat exchanger and storage device.

Solar Cooling

One of the main advantages of solar cooling is the fact that cooling demand and highest solar gains are at the same time (summer period). Especially, in Mediterranean regions with high solar gains and high cooling demands solar cooling will become more and more an alternative to conventional cooling systems. For solar cooling in general two concepts are possible:

Cooling with PV collectors

A conventional vapour compression machine is operated by electricity provided by PV collectors. As the only difference to conventional cooling systems is solar produced electricity, as systems with thermal collectors are emerging and as systems with thermal collectors offer, promising approaches (both from energy efficiency and financial aspects).

This process employs a chemical refrigerant (e.g. R134a) and is the most common refrigeration process applied in air-conditioning.

Cooling with thermal collectors

There are three thermal driven systems:

- Absorption cooling with chilled water
- Adsorption cooling with chilled water
- Desiccant cooling for air based cooling systems

Main advantages of solar cooling are

- The availability of high solar radiation during the time when cooling is needed
- The applicability of thermal energy as driving energy
- Low operating costs
- Low electrical power rating
- Durability and environmental compatibility

The disadvantage of solar cooling systems is high installation costs, the space needed for heat storage and the additional backup system necessary.

Recommendations for solar heating and cooling

- Before considering active cooling systems the first step is to reduce the cooling load. This can be done very effectively by intelligent building design. Passive cooling strategies based on 'bioclimatic design" (such as orientation and size of windows, reduction of solar

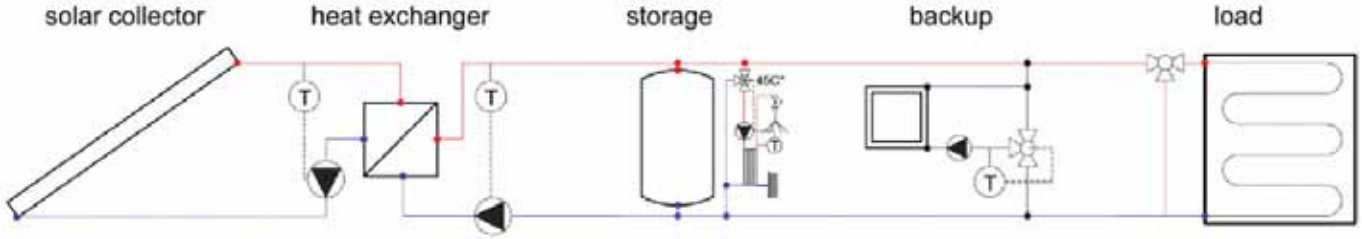

Figure 1: Typical solar thermal system

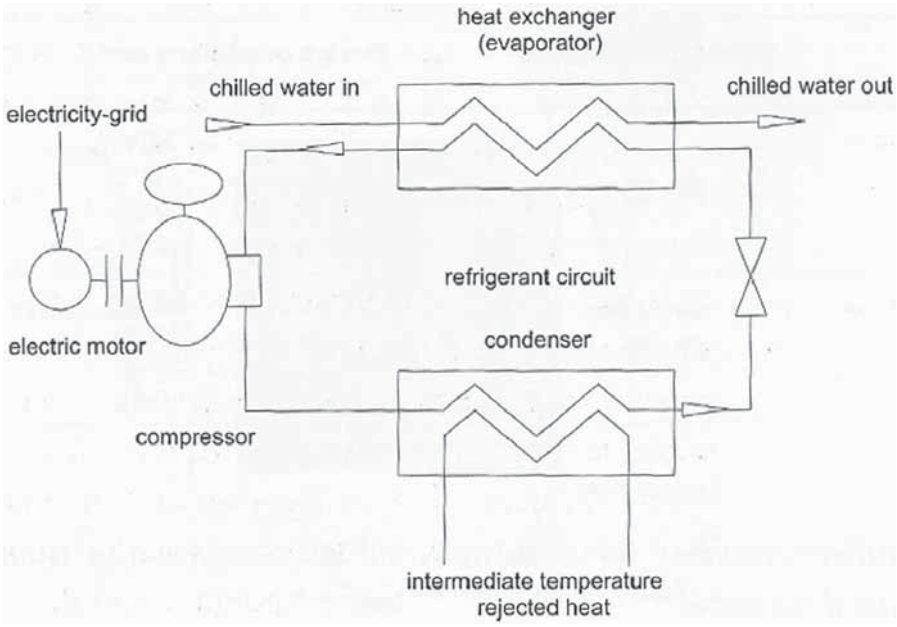

Figure 2: Vapour compression chillers

gains by sunblind, implementation of thermal mass, night ventilation, etc). Due to this a simplified assessment of cooling loads in early design stages (e. g. architectural competitions) should be done. More detailed information can be found in the state-of-the-art report 'Innovative cooling concepts for office buildings'.

- If solar heating and cooling is planned, solar collector areas need to be considered in early design stages, as they will have huge impact on the building design. This has to be taken into account by procurers, especially, for architectural design competitions.
- In climates with heating and cooling demand, combined systems (solar heating and cooling) make sense.
- Comparisons or assessment of the environmental impact of solar heating and cooling systems should be done on the primary energy level and on CO_2- emissions. If possible technical specifications in tendering documents should deal with benchmark values of primary energy and CO_2-emissions. It is recommended to use primary energy savings as a measure for the value of energy saving and using it during design and in the tendering process for comparison or assessment of different bids.
- As the calculation of costs (like payback times) in comparison to conventional heating and cooling systems is quite complex, expert input is required. Generally speaking costs (payback times) are effected by following aspects:
  - Solar radiation on the site
  - Efficiency of the HVAC system for heating and cooling
  - Construction costs for the HVAC system for heating and cooling
  - Additional construction costs for the implementation of the solar panels in the building structure
  - Operation costs of the HVAC system

Solar Air Cooler

Solar Air Conditioner

  - Future development of interest on borrowings
  - Future development of energy prices

Heating Ventilation & Air Conditioning (HVAC)

The future of smart HVAC (heating, ventilation and air conditioning) systems is critical to the Indian economy with the cost of natural resources, especially, fossil fuels, undoubtedly set to rise over the coming years. Regulations across the country have required smarter cooling and heating in new buildings, and hence new buildings will become more energy efficient. But for the millions of homes and offices built over the past decades, smart HVAC systems will become a necessary investment if companies–and consumers–are determined to mitigate their effects on the environment and, of course, save money.

Heating, ventilation and air conditioning (HVAC) electricity consumption typically accounts for around 40% of total building consumption and 70% of base building (i.e. landlord) electricity consumption. It also contributes to manufacturing facility energy use and costs. HVAC dominates peak building electricity demand, so improving its efficiency can reduce peak demand electricity charges. Capital and maintenance costs of HVAC equipment also comprise a significant proportion of building costs. In addition, high performing buildings are now getting better returns as tenants and purchases are demanding to occupy sustainable buildings. The introduction of the Commercial Building Disclosure (CBD) regulations is also providing greater incentive for building owners to improve building performance and HVAC efficiency.

While significant energy and capital savings can be made through investing in energy efficient HVAC systems during construction of new buildings, good strategies exist to optimize energy use in existing HVAC systems. These strategies include reducing demand for HVAC services and ensuring good maintenance practices. ■

S D Bandal
Managing Director
Solar Electronics
Solapur

Solar Refrigeration

Solar refrigeration system will be used more and more with the decrease of conventional energy sources and the increase of environmental pollution in future. Solar refrigeration can be used in freezers, refrigerators, building air conditioning systems, food preservation, ice-making, cooler etc...

Solar energy is a very large, inexhaustible source of energy. The power from the sun intercepted by the earth is approximately 1.8×10^{11} MW which is much larger than the present consumption rate on the earth of all commercial energy sources. Also, solar energy is much cleaner than most of the conventional energy sources. Thus, the use of solar energy may be an option to meet the ever increasing energy demand. The expected shortage of conventional energy sources such as fossil fuels and the associated detrimental effect on the environment are the driving forces for using solar energy. Refrigeration and air conditioning systems are among the most suitable fields for the application of solar energy.

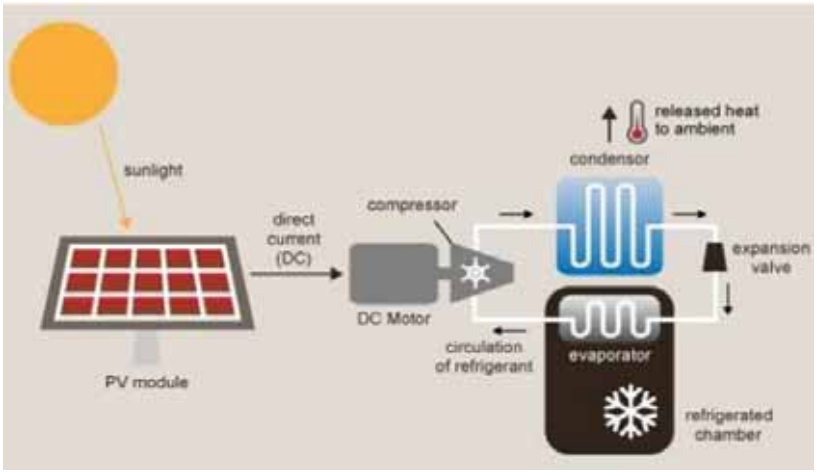

Figure 1: Schematic diagram of a photovoltaic operated refrigeration system

Refrigeration is a process in which work is done on a system to move heat from lower temperature to higher temperature to get cooling effect. Refrigeration is done to maintain the temperature of certain space at a temperature lower than the surrounding. The mechanical device extracts heat from the refrigerated space maintained at a lower temperature and rejects it to the surrounding that is at relatively higher temperature to achieve the cooling effect. Refrigeration is used to provide favourable condition for storing of food products and preservation of medicine. It is also used to provide comfort through the process of air conditioning in hot and humid places. Solar refrigeration system is operated using electricity directly produced from solar radiation using photovoltaic cell or using radiant heat

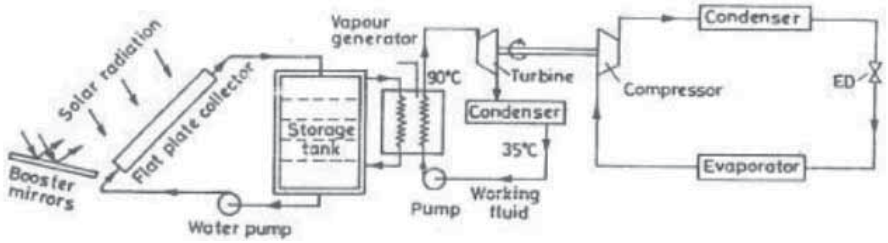

Figure 2: Schematic diagram of a solar mechanical vapour compression refrigeration system

from the sun collected by the different types of solar collectors. It is expected that this type of refrigeration system will be used more and more with the decrease of conventional energy sources and the increase of environmental pollution in future. Solar refrigeration can be used in freezers, refrigerators, building air conditioning systems, food preservation, ice-making, cooler etc.

Types of Solar Refrigeration System

Solar refrigeration systems can be classified in three different categories. They are:

i. Photovoltaic operated refrigeration system
ii. Solar mechanical refrigeration
iii. Absorption refrigeration

Photovoltaic Operated Refrigeration System

In this system, solar radiation is directly converted to direct current electricity using semiconducting materials. The operation of a PV-powered solar refrigeration cycle is simple. Solar photovoltaic panels produce DC electrical power that can be used to operate a DC motor, which is coupled to the compressor of a vapour compression refrigeration system. The process that makes the refrigeration possible is the conversion of sunlight into DC electrical power, achieved by the PV panel. The DC electrical power drives the compressor to circulate refrigerant through a vapour compression refrigeration loop that extracts heat from an insulated enclosure. This enclosure includes the thermal reservoir and a phase change material. Figure 1 shows the schematic diagram of a photovoltaic operated refrigeration system.

Solar Mechanical Refrigeration

In this type of refrigeration system, required compressor power to drive the compressor in refrigeration cycle is provided by a solar Rankine cycle. Sunlight strikes the solar panel which drives a Rankine cycle and produces work in the turbine. This work is then utilized to run the compressor of the vapour compression refrigeration system. The schematic diagram of a solar mechanical refrigeration system has been shown in figure 2.

Solar Absorption Refrigeration System

In this system, low grade energy as heat from solar panel is used as input for chilling purpose. Figure 3 shows the schematic diagram of a solar absorption refrigeration system. This system is different from a conventional vapour compression refrigeration system. Basic components of such refrigeration system are absorber, generator, solar panel, condenser, expansion valve, evaporator, DC battery and fan. The compressor in the vapour compression system is replaced by a generator, absorber and pump. Refrigerant (NH_3) in the evaporator absorbs the heat from the refrigerated space and gets evaporated. It is then passed to absorber where it is dissolved with absorbent (H_2O) and pumped to generator. Electrical energy from solar panel is utilized for heating in the generator and the refrigerant enters into condenser. The refrigerant is converted to liquid in the condenser and the pressure of the liquid refrigerant is dropped to the evaporator pressure with the help of an expansion device (ED). The main advantage of absorption system is compression of liquid instead of vapour which results in less mechanical work requirement as input. But the system is much expansive compared to compression refrigeration system. Other than ammonia-water combination, few more refrigerant - absorber pairs have been tried which are listed in table 1.

The performance of a refrigeration system is judged by a parameter called coefficient of performance (COP). The COP of a solar absorption refrigeration system can be expressed as

$$COP = \frac{\text{Heat absorbed in the evaporator}}{\text{Generator heat supply} + \text{Pump work input}}$$

As pump work is very small and the above expression can be approximated without much error as

$$\text{COP} = \frac{\text{Heat absorbed by the evaporator}}{\text{Generator heat supply}} = \frac{Q_2}{Q_4}$$

General energy equation for flat plate collector is given by, $Q = I \times A_C$

where,

Q = Amount of solar radiation received by collector = $\dot{m} \times c_p \times (T_P - T_a)$

I = Intensity of solar radiation

and AC = Collector surface area

Useful heat gain by the collector can be written as $Q_u = F_R \times A_C \times (S - U_l \times (T_p - T_a))$

where, S = Incident solar flux absorbed by the absorber plate

F_R = Collector heat removal factor

U_l = Overall heat loss co-efficient

T_p = Fluid temperature at inlet of collector

Solar Absorption Refrigeration System Performance

Different researchers investigated on absorption refrigeration system varying

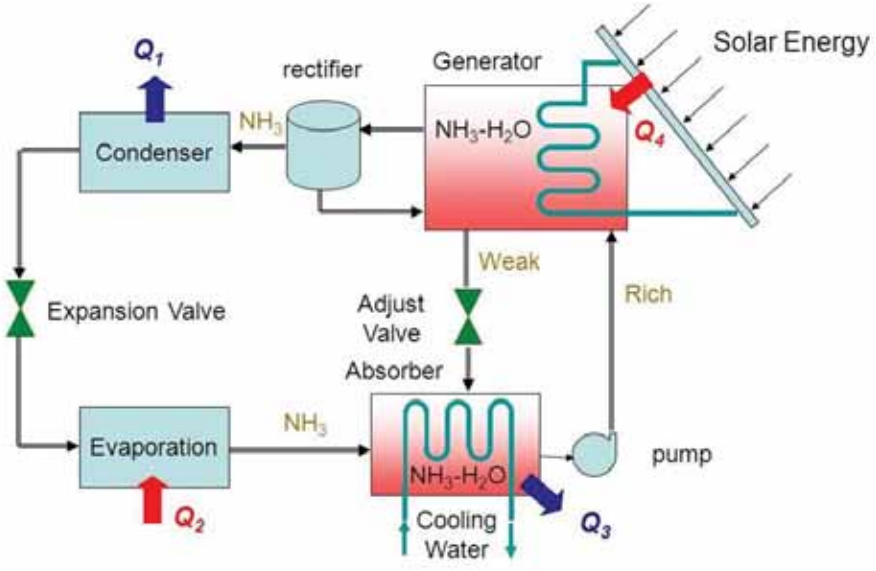

Figure 3: Schematic diagram of a solar absorption refrigeration system

Table 1: Different Refrigerant – Absorber Pairs

Refrigerant	Absorber	State of Absorber
Ammonia	Sodiumthiocynate	Solid
Ammonia	Lithium Nitrate	Solid
Ammonia	Calcium Chloride	Solid
Ammonia	Isobutane	Solid
Water	Lithium Bromide	Solid
Water	Lithium Chloride	Solid
Methyl Chloride	Dimethyl Ether or Tetra Ethylene Glycol	Liquid

different parameters and recorded the performance of the system under such varying conditions. Karno and Ajib simulated a vapour absorption refrigeration system using acetone-zinc bromide solutions and reported that initially the COP of the system increased rapidly then the increment was found to be slightly flatter in nature with the increase in generator temperature for fixed evaporator temperature. The results are shown for condenser and absorber temperature both fixed at 28°C and refrigerant heat exchanger effectiveness at 75%. However, COP of the system increases with the increase in evaporator temperature when other parameters are kept constant. An approximate correlation for COP of the system in terms of generator temperature (T_G) and evaporator temperature (T_E) has also been developed which is as follows:

$$COP = \frac{0.78 - 0.0134 \times T_G - 0.015 \times T_E}{1 - 0.018 \times T_G - 0.0177 \times T_E}$$

The variations of COP with generator temperature and evaporator temperature have been shown in figure 4. Calculated values from the simulation program have been plotted together with the values calculated from the above said correlation.

Effects of evaporator temperature at different condenser or absorber temperature on COP have also been shown in figure 5. The generator temperature is kept constant at 57°C. It shows that the COP of the system decreases with the increase in condenser or absorber temperature for any evaporator temperature.

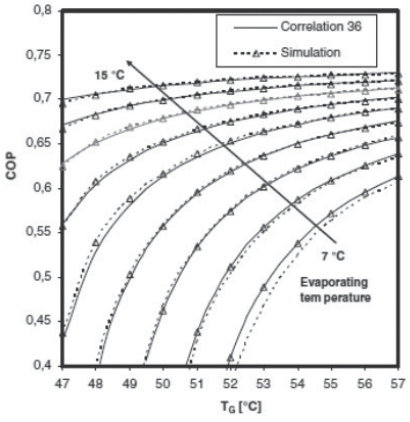

Figure 4: Variation of COP with generator temperature and evaporator temperature

Advantages of Solar Refrigeration

Solar energy is the main source of energy that is utilized to run solar refrigerator. So, significant amount of electrical power is saved and it also causes less pollution that would have been added due to the use of power produced by the conventional power plants. The solar energy is available in every part of the world and unlike fossil fuels and nuclear power, it is a clean source of energy. Additional power from the solar collector can also be used for the other domestic purposes. The solar refrigerators can be very useful where there is no continuous supply of electricity or difficult to get conventional fuel. More importantly it is renewable in nature. Conventional refrigeration systems emit significant amount of gas which pollute the environment. This solar refrigeration system is also needed to lower the environmental impact caused due to conventional refrigeration systems. The maintenance cost of such system is considerably low compared to that of the conventional system. Those facts encourage to use solar refrigeration system whenever possible.

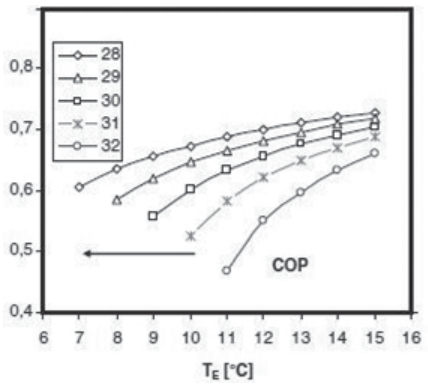

Figure 5: Effect of evaporator temperature on COP for different condenser/absorber temperature (18-32°C)

Disadvantages of Solar Refrigeration

Solar refrigeration systems also have some disadvantages. As solar radiation is not available throughout the day, power production is not uniform. Again it depends on the intensity of the beam radiation. Even in the hottest regions on earth, the average solar radiation flux rarely exceeds 1 kWh/m^2 and the maximum radiation flux over a day is about 6 kWh/m^2. These are low values from the point of view of technological utilization. So, those refrigeration systems can be used in those places where those problems are not present. To produce sufficient energy from solar system, it needs bigger collector. So, there is a need of bigger space for the collector which is another major problem for using solar refrigeration system. Initial investment to develop such set up is also large.

Challenges

The variation in availability of solar radiation occurs daily because of the day-night cycle and also seasonally because of the earth's orbital motion around the sun. In addition, variation occurs at a specific location because of local weather conditions. Consequently, the energy collected when the sun is shining must be stored for use during periods when it is not available. The need for storage significantly adds to the cost of the system. Thus, the real challenge in utilizing solar energy as an energy alternative is to address these challenges. One has to strive for the development of cheaper methods of collection and storage so that the large initial investments required at present in most applications are reduced.

Reference

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Storing Wind Energy

Siemens' researchers are establishing a complete thermal store on the Trimet aluminium smelter site in Hamburg-Altenwerder...

Siemens is developing economic storage technology: alongside Technical University Hamburg Harburg (TUHH) and urban utility company Hamburg Energie, Siemens is researching a storage solution in the Northern German city that will set a future standard in efficiency. After having been converted to heat in rock fill, excess wind energy is stored and protected with an insulated cover. When there is a need for additional electricity, a steam turbine converts the heat energy back to electricity. The simple principle of this store promises an extremely low-cost set-up. The project has therefore received research funding from the German Federal Ministry for Economic Affairs and Energy.

Siemens is currently operating a test set-up for the storage solution, named Future Energy Solution (FES), at Hamburg-Bergedorf. Alongside scientists from the TUHH Institute for Thermofluid Dynamics, the company is researching how to make charging and discharging the store particularly efficient. The arrangement of the rock fill and the form of the surrounding insulating container are crucial. The store is being tested at temperatures over 600 degrees Celsius. Just like a hot air gun, a fan uses an electrically-heated air flow to heat the stones to the desired temperature. When discharging, the hot stones in turn heat the air current, which then heats a steam boiler; its pressure drives a generator via a steam turbine.

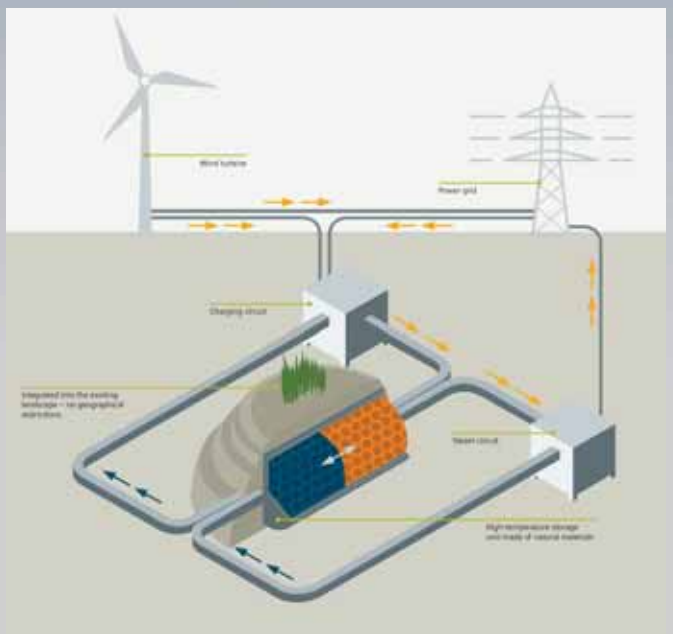

Image Courtesy: Siemens

The thermal store for wind energy, which is being developed in Hamburg, is a joint project between Siemens, Hamburg Energie and TUHH. The German Federal Ministry for Economic Affairs and Energy is funding the project...

As the current test set-up only tests the thermal requirements for the storage process, no reverse current is generated. However, researchers wish to test the complete energy conversion in spring 2017: from electricity to heat storage in the rock fill and back to electricity. They are establishing a complete thermal store on the Trimet aluminium smelter site in Hamburg-Altenwerder to the south of the River Elbe on the German A7 highway. The full-size FES will be able to store around 36 megawatt hours (MWh) of energy in a container with around 2,000 cubic meters of rock. Via a boiler, the heat it contains will generate so much steam that a Siemens compact steam turbine can generate output of up to 1.5 megawatts of electricity for up to 24 hours a day. The researchers expect to generate effectiveness of around 25% even in this early development phase. In the future, the concept has the potential for an effectiveness of around 50%. Partner Hamburg Energie will investigate appropriate marketing options for the stored energy.

"The technology of our FES store deliberately uses mainly tried and trusted technology. Because we are working here with tested thermal components and a series-ready steam turbine, we will be able to offer a practical solution within a few years. Our complete experimental system will be operational in just around 15 months," says Till Barmeier, Siemens' Project Manager.

Whereas many other stores generate high costs or only permit limited storage capacities, the FES technology can be used in the most varied of sizes and output classes, and therefore always remains extremely economical. The only limit to the concept is the space required for the rock-filled insulated container. ■

Solar Heat Pumps
Prospect & Development

With the aim of providing a single point solution for dual purpose application, a product is launched but can provide simultaneous chilling and heating using its vapour absorption technology with 40% saving in heating energy. Using energy efficiency and managing customer energy use has become an integral and valuable exercise...

One of the most energy efficient methods of domestic heating is to use heat pumps. Heat pumps use electrical energy to reverse the natural flow of environmental heat from cold to hot. A typical heat pump requires only 100 kWh of electrical power to turn 200 kWh of freely available environmental heat into 300 kWh of useful heat. In every case, the useful heat output will be greater than the energy required to operate the pump itself. Heat pumps also have a relatively low carbon dioxide output, less than half that of oil, electric and gas heat production.

Heat pumps for domestic heating are a relatively new concept in Britain; however the technology is widely used in an industrial capacity. Across Europe, hundreds of thousands of domestic heat pump units are in use, and the technology is tried, tested and reliable.

Ideally, a refrigerant will have the following characteristics.

- Non-toxic - for health and safety reasons.
- Non-flammable - to avoid risks of fire or explosion.
- Operate at modest positive pressures - to minimise pipe and component weights (for strength) and avoid air leakage into the system.
- Have a high vapour density – to keep the compressor capacity to a minimum and pipe diameters relatively small.
- Easily transportable - because refrigerants are normally gases at SSL conditions they are stored in pressurised containers.
- Environmentally friendly - non-polluting and non-detrimental to the atmosphere, water or ground.
- Easily re-cycleable.
- Relatively inexpensive to produce.
- Compatible with the materials of the refrigeration system - non-corrosive, miscible with oil, chemically benign.

In practice, the choice of a refrigerant is a compromise, e.g., Ammonia is good but toxic and flammable. R12 is very good but detrimental to the Ozone layer. An air-source heat pump is convenient to use and so it is a better method for electric heating. The ambient temperature in winter is comparatively high in most regions, so heat pumps with high efficiency can satisfy their heating requirement. On the other hand, a conventional heat pump is unable to meet the heating requirement in severely cold regions anyway, because its heating capacity decreases rapidly when ambient temperature is below -10°C. According to the weather data in cold regions, the air-source heat pump for heating applications must operate for long times with high efficiency and reliability when ambient temperature is as low as -15°C. Hence, much researches and developments have been conducted to enable heat pumps to operate steadily with high efficiency and reliability in low temperature environments. For example, the burner of a room air conditioner, which uses kerosene, was developed to improve the performance in low outside temperature. Similarly, the packaged heat pump with variable frequency scroll compressor was developed to realise high temperature air supply and high capacity even under the low ambient temperature of –10 to –20°C. Such a heat pump systems can be conveniently used for heating in cold regions. However, the importance of targeting the low capacity range is clear if one has in mind that the air conditioning units below 10 kW cooling account for more than 90% of the total number of units installed in the EU.

Energy Efficiency Consideration

Heat exchangers are devices, designed to efficiently transfer heat, from one medium to another, i.e., water-to-air, refrigerant-to-air, refrigerant-to-water, stream-to-water. Heat exchangers are widely used in power engineering, chemical industries, petroleum refineries, food industries and in HVAC technology. Therefore, heat transfer and the design of heat transfer equipment continue to be a centrally important issue in energy conservation. With increasing worldwide awareness of the serious environmental problems due to fossil fuel consumption, efforts are being made to develop energy efficient and environmentally friendly systems by utilisation of non-polluting renewable energy sources, such as solar energy, industrial waste heat or geothermal water. The GSHPs are suitable for heating and cooling of buildings and so could play a significant role in reducing CO_2 emissions. Ground source or geothermal heat pumps are a highly efficient, renewable energy technology for space heating and cooling. This technology relies on the fact that, at depth, the Earth has a relatively constant temperature, warmer than the air in winter and cooler than the air in summer.

Heat Transfer Mechanisms

- Single-phase convection on both sides
- Single-phase convection on one side
- Two-phase convection on other side
- Two-phase convection on both sides

Examples: condensers, boilers, evaporators and radiators (Figure 1).

Naturally, it would be preferred, for comfort reasons that this index would be small, preferably nil. It may be seen that the variable is directly related to temperature discomfort: the larger the value of the index, the farthest will inside conditions be from expected wellbeing. Also, the use of electricity operated air conditioning systems will be more expensive the higher this variable is. Hence, energy expenditure to offset discomfort will be higher when comparing two index values; the ratio of them is proportional to the expected energy savings.

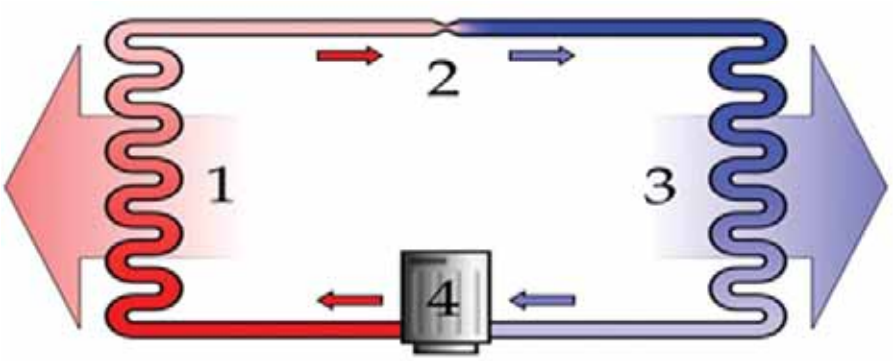

Figure 1: Diagram of a phase change heat pump
1) condensator coil 2) expansion valve 3) evaporator coil and 4) compressor

When the external shade blocks the windowpane completely, the excessive heat gains belong to the lowest values in the set, and the dimensionless index will be constant with orientation. For the climate conditions of the locality, it can be seen that a naked window can produce undesirable heat gains if the orientation is especially unfavourable, when the index can have an increase of up to 0.3 with respect to the totally shaded window.

Heat Sources

The technical and economic performance of a heat pump is closely related to the characteristics of the heat source. An ideal heat source for heat pumps in buildings has a high and stable temperature during the heating season, is abundantly available, is not corrosive or polluted, has favourable thermophysical properties, and its utilisation requires low investment and operational costs. In most cases, however, the availability of the heat source is the key factor determining its use. The Table 1 presents commonly used heat sources. Ambient and exhaust air, soil and ground water are practical heat sources for small heat pump systems, while sea/lake/river water, rock (geothermal) and waste water are used for large heat pump systems.

Table 1: Heat sources temperatures

Heat source	Temperature range (°C)
Ambient air	-10 - 15
Exhaust air	15 - 25
Ground water	4 - 10
Lake water	0 - 10
River water	0 - 10
Sea water	3 - 8
Rock	0 - 5
Ground	0 - 10

Geothermal Heat Pumps

Geothermal heat pumps are the most energy efficient, environmentally clean, and cost effective space conditioning systems available according to the Environmental Protection Agency in the United States of America. Ground source geothermal heating and cooling is a renewable resource, using the earth's energy storage capability. The earth absorbs 47% of the suns energy amounting to 500 times more energy than mankind needs every year.

The closed loop portion of a ground source heat pump system consists of polyethylene pipe buried in the ground and charged with a water/antifreeze solution. Thermal energy is transferred from the earth to the fluid in the pipe, and is upgraded by passing to a water source heat pump. One 100 metres vertical closed loop borehole will typically deliver 14000 KWh of useful heating energy and 11000 KWh of useful cooling energy every year for life. For typical commercial building early trials indicate annual HVAC energy consumption in the order of 75 kWh/m² compared with 156 kWh/m² 'good practice target', and 316 kWh/m² typical consumptions published by the Department of the Environment (DOE) in Energy Consumption Guide No.19. Low energy consumption means associated lower CO_2 emissions than from conventional systems.

Water Source Heat Pump

Water source heat pump (WSHP) systems are one of the most efficient, environmentally friendly ways to heat and cool buildings because of their ability to move energy from where it is not needed to where it is needed. High-efficiency, self-contained WSHP units can be placed in virtually any location within the building and connected via a water loop. Heat is added and rejected from the loop using a boiler and a cooling tower, or using geoexchange from natural sources such as the ground, a pond or a well. Each unit responds only to the heating or cooling load of the individual zone it serves. This provides excellent comfort levels for occupants, better control of energy use for building owners and lower seasonal operating costs. Systems are commonly applied to office buildings, hotels, health care facilities, banks, schools, condominiums and apartments. Features include: Lower utility bills, less maintenance, no visible outdoor plant, reduction in emissions, and versatility of system. Ground as a heat source for a heat pump coupled with low temperature heating system can fulfil most of requirements of small-scale application. The seasonal temperature fluctuations are small and decrease very quickly with depth. With the increase of ground depth down to 10 meters the temperature becomes constant and equal to 10-11°C. In Europe the freeze zone in the soil is one meter and in some regions one and half meter deep. This makes it preferable to use vertical ground heat exchangers rather than horizontal.

Pumps And Underground Thermal Energy Storage (Utes)

The general principle of a heat pump operation is to extract heat from low temperature heat source and to give it off at a higher temperature level. The useful energy output must be significantly greater than additional energy required to drive a heat pump to achieve a real reduction in primary energy use. Heat pumps can use renewable energy or waste heat as a heat source. Energy extracted from these sources is converted into useful heat in the low temperature range. This low temperature useful heat can be applied with good efficiency for example for space heating. Generally, when heat pumps are considered for effective use, the following characteristic features of a heat source will be taken into account:

- Availability,
- Steady and relatively high temperature,
- Coherency between source and user,
- Thermal capacity,
- Heat extraction cannot disturb natural energy balance of the environment,
- Cost of heat extraction and transmission,
- Ecological issues.

In a ground heat pump system heat is extracted from the ground by means ground heat exchangers and is used as a heat source for a heat pump evaporator. During the heat extraction ground is cooled down. When heating system does not operate ground body should recover to the initial thermal balance (in order not to disturb its natural state), due to

natural heat and mass transfer processes (influence of ambient environment and geothermal energy). However, when heat demand is high it is recommended to apply artificial charging of the soil, e.g., by solar energy or waste heat. This called long term or seasonal Underground Thermal Energy Storage. UTES improves efficiency (COP) of a heat pump, due to better thermal performance (higher temperature) of a heat source and allows ground medium to return easily and quickly to initial thermal balance. Additionally, in combination with seasonal energy storage, solar energy and waste heat can make a major contribution to heating of buildings.

The seasonal storage facility can be designed in many different ways. Heat can be stored in the ground (clay, sand), un-fractured rocks and in water. Four fundamental options of long-term thermal energy storage can be considered:

- Water tanks and solar ponds;
- Rocks (boreholes in rocks, rock cavern, pit);
- Soil storage (boreholes, ducts in earth, earth coils);
- Aquifers- systems that use ground water flow.

Actually, according to the energy conservation through Energy Storage (UTES) water tanks, solar ponds, rock caverns and pits are not classified as UTES systems. Rocks can be used as a storage medium by drilling in rocks to make a number of boreholes, which are filled with plastic tubes in which water flows.

Geothermal Aquifers

Geothermal aquifers exist where heat from the earth's crust is absorbed by groundwater that collects naturally in the deep porous rocks of certain geological structures. To exploit these aquifers as a source of energy, it is necessary to drill two boreholes: a production borehole to extract the naturally heated water and an injection borehole to dispose of the water once that heat has been removed by surface use. It is also possible to use a single-hole configuration if the used water is discharged elsewhere – to the sea or to some other convenient sink. Because of the poor thermal conductivity of rock and the low rates of natural fluid recharge, heat is usually extracted at a greater rate than it is replenished from the surrounding rock mass. Geothermal aquifers are not, therefore, "renewable" resources in the strict sense of the word, although they are usually placed in the renewables category. The exploitation of geothermal energy has, to date, concentrated on these hydrothermal resources, most economically from aquifers in countries where seismic activity is high.

Water Heating And Comfort

The ground-source machine had lower demand (summer and winter) and lower heating energy use than either of the air heat pumps. Comparisons with natural gas must be based on cost since the units for natural gas (therm = 100,000 Btu) are different than electrical energy units (kWh). The development can also be seen in individual regions. In Figure 2, the number of installations realised within an incentive programme of the German utility RWE is depicted.

The high seasonal efficiency of the GSHP systems reduces the demand for purchased electricity and the associated emissions of CO_2 and other pollutants. Figure 3 shows the relationship between utilisation efficiency and CO_2 emissions for different domestic fuels. For example it can be seen that, assuming an average CO_2 emission factor for electricity of 0.414 kg/kWh, the use of a GSHP with a seasonal efficiency of 350% would result in the emission of 0.12 kg CO_2 for every kWh of useful heat provided. By comparison, a condensing gas boiler (assuming a CO_2 emission factor for gas of 0.194 kg/kWh) operating at a seasonal efficiency of 85% would result in 0.23 kg CO_2 for every kWh of useful heat supplied i.e., the CO_2 emissions would be almost double those from the GSHP. In practice the environmental impact of a heat pump will depend not only on the amount of electricity used but also on the demand profile. In periods of peak demand some electricity will have to be provided by less efficient power stations with emission factors as high as 0.8 kg CO_2 / kWh. As well as reducing purchased energy consumption and resulting in low CO_2 emissions, the GSHP have a number of other environmental and operational advantages:

- High reliability (few moving parts, no exposure to weather).
- High security (no visible external components to be damaged or vandalised).
- Long life expectancy (typically 20-25 years and up to 50 years for the ground coil).
- Low noise.
- Low maintenance costs (no regular servicing requirements).
- No boiler or fuel tank.
- No combustion or explosive gases within the building.
- No flue or ventilation requirements.
- No local pollution.

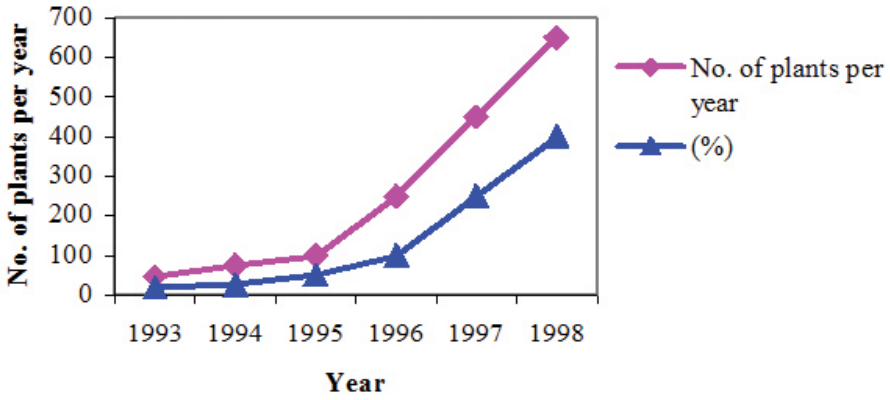

Figure 2: Market Developments for Heat Pumps in the RWE-Area

Conclusions

Underground Thermal Energy Storage is a new idea. Some UTES systems have been already constructed worldwide. Sometimes the users are not aware, that they have used an UTES system. Most of the ground heating systems use heat accumulated in the ground medium in a natural way and they are typically ground coupled heat pump systems. Different types of horizontal and vertical ground heat exchangers are being applied. Due to a lack of tradition and sometimes knowledge of heat pumps and ground systems, some mistakes in planning, designing and construction have been made. Therefore there is a great need to develop good demonstration project to show advantages of UTES and its role in energy conservation. The building sector is a major consumer of both energy and materials worldwide, and the consumption is increasing. Most industrialised countries are in addition becoming more and more dependent on external supplies of conventional energy carriers, i.e., fossil fuels. Energy for heating and cooling can be replaced by new renewable energy sources. New renewable energy sources, however, are usually not economically

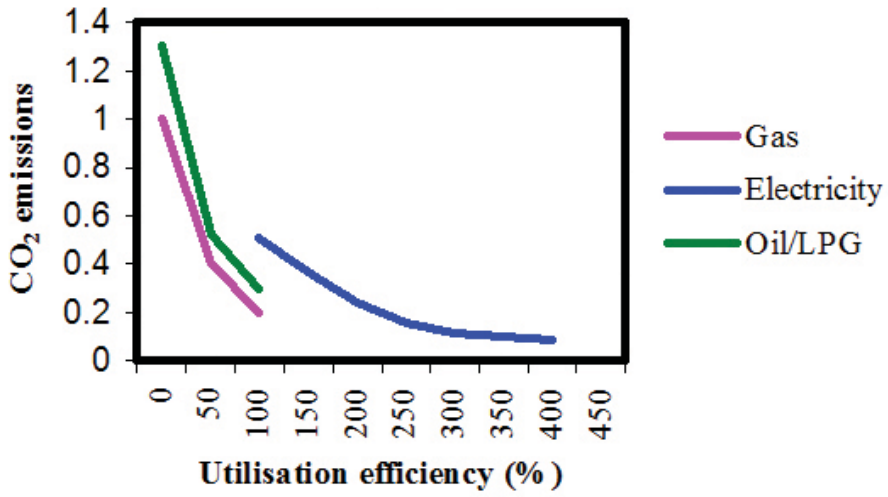

Figure 3: CO2 Emissions and Fuel Use Efficiency (kg/kWh Useful Heat Delivered)
Assumed CO_2 emission factors: Electricity = 0.414 kg/kWh delivered, Gas = 0.194 kg/kWh; Oil = 0.271 kg/kWh

feasible compared with the traditional carriers. In order to achieve the major changes needed to alleviate the environmental impacts of the building sector, it is necessary to change and develop both the processes in the industry itself, and to build a favourable framework to overcome the present economic, regulatory and institutional barriers. Today, buildings are largest consumers of energy. Air conditioning and heating consume about 40% of the power in the buildings. Demand to conserve energy has become necessity as there has been rising costs of energy consistently and this make us to think to go green and innovate the greener concept for buildings. A green building uses less water, optimises energy efficiency, conserves natural resources, generates less waste and provides healthier spaces for occupants. And, a green home can have benefits, such as reduction in water and operating energy costs of the building. This may also mean refrigerant-based chillers and compressors to be shut off or to be operated at reduced capacity. With the environmental protection posing as the number one global problem, man has no choice but reducing his energy consumption, one way to accomplish this is to resort to passive and low-energy systems to maintain thermal comfort in buildings.

Naturally, it would be preferred, for comfort reasons that this index would be small, preferably nil. It may be seen that the variable is directly related to temperature discomfort: the larger the value of the index, the farthest will inside conditions be from expected wellbeing. Also, the use of electricity operated air conditioning systems will be more expensive the higher this variable is. Hence, energy expenditure to offset discomfort will be higher when comparing two index values; the ratio of them is proportional to the expected energy savings. When the external shade blocks the windowpane completely, the excessive heat gains belong to the lowest values in the set, and the dimensionless index will be constant with orientation. For the climate conditions of the locality, it can be seen that a naked window can produce undesirable heat gains if the orientation is especially unfavourable, when the index can have an increase of up to 0.3 with respect to the totally shaded window.

The European experience with GSHP systems so far is excellent. It is expected that the market will further expand, in the leading countries like Sweden and Switzerland as well as in other countries to follow. The growth can be exponential as the Swiss example. An important factor, related to the further development of electric heat pump systems in general and the GSHPs in particular, is the current process of deregulation in Europe. The energy sector and, especially the electric utility companies, are currently under deregulation and privatisation. This affects not only the producers but also the customers. The deregulation process may affect the heat pump market in two ways: 1) heat pump economy might be influenced by changes in the energy price structure, and 2) the heat pump market might be stimulated or hindered, depending on changing utility market strategies. So far, in the regulated market, some utilities have clearly supported heat pumps, in line with governmental energy-efficiency programmes (e.g., by offering grants or special electricity tariffs). However, in a deregulated energy market, the market strategies of utilities will change. Only when the market matures and energy prices drop to a stable level will utilities offer incentives such as products/bonuses or energy efficiency services. Nevertheless, the ecological incentives like avoiding GHGs emissions will further support GSHP development. The CO_2 tax in sight is a further (financial) incentive. Of course, there will be considerable differences in this respect from country to country. ■

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Indian Air Conditioners Market to Cross USD 6bn by 2021

Increasing urbanisation, growing purchasing power and changing climatic conditions to drive India air conditioners marketthrough 2021...

According to TechSci Research report, 'India Air Conditioners Market By Product Type, By End Use Sector, By Tonnage Capacity, By Top City Competition Forecast & Opportunities, 2011–2021', the air conditioners market in India is anticipated to cross USD 6 Billion by the end of 2021, On account of extreme climatic conditions, rising disposable income, growing construction activities in both commercial and residential sectors, coupled with various government initiatives aimed at improving energy efficiency. Moreover, implementation of energy efficiency labelling system and standardization for air conditioners is expected to have a positive impact on the country's air conditioners market in the coming years.

Air conditioners market of any country across the globe is primarily dependent on the construction and infrastructure sectors. During April 2000 – March 2016, around USD24.19 billion were invested for the development of construction industry in India. Moreover, the Government of India allocated around USD1 trillion for the infrastructural development of the country. Hence, backed by booming construction sector and growing infrastructural development, the market of air conditioners in the country is expected to register healthy growth rate during 2016-2021.

South region is the highest demand generators for air conditioners in the country, and its dominance is expected to continue during 2016 – 2021 as well. South region comprises of cities such as Bengaluru and Chennai, which are considered as the IT Hubs of the country, are developing, and the demand for air conditioners is increasing from these areas. In 2015, light commercial air conditioners dominated the India air conditioners market, followed by Chillers, VRF and Ductable Splits.

"Growing air conditioners market in India resulted in high energy demand, increasing electricity bills and environment degradation, which has ultimately resulted in increasing demand for environmental friendly technologies. India aims to reduce its power consumption from air conditioning segment by the implementation of "Energy Star Ratings" for air conditioners. With the introduction of HFC-32 and HC-290 room air conditioners, India is taking several measures to reduce its emissions in atmosphere, and the country's government proposed a HCFC phase-out management plan. Hence, the demand for environment friendly air conditioners is expected to grow at a robust pace over the next five years." said Mr. Karan Chechi, Research Director with TechSci Research, a research based global management consulting firm.

"India Air Conditioners Market By Product Type, By End Use Sector, By Tonnage Capacity, By Top City Competition Forecast & Opportunities, 2011–2021" has evaluated the future growth potential of India air conditioners market and provides statistics and information on market size, structure and future market growth. The report intends to provide cutting-edge market intelligence and help decision makers take sound investment evaluation. Besides, the report also identifies and analyses the emerging trends along with essential drivers, challenges and opportunities in India air conditioners market. ■

Easy Way of Buying HVAC Tools

Online shopping is continuously becoming popular and safer in India. It has witnessed tremendous growth. People are experiencing benefits of purchasing at their convenience...

Infinity HVAC Spares & Tools has been a leading supplier of high quality tools for the last two decades all over India. Infinity also has exclusive retail outlets in Dadar, Thane, Pune and Nashik.

Over the years, Infinity has developed a reputation for dealing in great products at honest prices. www.hvacmall.in is an extension of the same. Here the company is enabling its customers to purchase online from the comfort of their home globally tested products of reputed brands.

The client's online shopping experience at www.hvacmall.in is easy, enjoyable and secure. It has a wide range of products from thermometers, vacuum gauges, vacuum pumps, data loggers, measuring instruments, manifolds, hand tools, water pressure pumps, etc. A few of its benefits:

- Our best prices – Infinity offers their best prices at www.hvacmall.in.
- Free Shipping – The client gets free shipping and that saves his/her more money.
- Cash on delivery- COD option is available within the city limits of Mumbai, Thane, Pune & Nashik for order values of above Rs 1000/-
- Secure Payments – www.hvacmall.in is tied up with Infibeam, one of the largest online retailer and a premier technology provider in India.
- Company backing – The online portal is run by the reliable and trusted Infinity HVAC Tools, so the customer has the backing and after sales support.
- Top brands – All the best brands - Supco, Refco, Mighty Mounts, Rex, Kyowa, Extech, Aspen, Microdam well-known in the industry for years.
- Way to the future – The online retail industry is the way of the future, so step in & reap the benefits!

A few advantages of online purchase:

- Save precious time and energy
- Save money
- Secure Payment Systems
- At your Convenient Time
- Compare prices & features

Addressing Urban Environment Woes

Generally speaking, a green roof is any vegetated open space on a roof of a building intended for a variety of purposes including thermal, environmental, and other amenities either for improvement of conditions in individual buildings or the surrounding urban area...

India is the fourth largest consumer of energy in the world after China, the United States, and Japan (EIA, 2016). Despite the increasing rate of consumption with GDP (Figure 1), local energy production has not been able to catch up with imports (Figure 2). Even though the gap between consumption and import is less significant with other energy sectors (natural gas and coal), the rapid economic growth is predicted to persist, which makes the need for substantial investment in energy demand reducing policies through the implementation of large-scale sustainable infrastructure as well as renewable energy resources, more urgent.

With the rapid growth in population and economy, the pressures on fragile environmental conditions threaten to create unhealthy environments, especially in urban areas. In addition to the noticeable increase in storm water-related disasters, unprecedented expansion in urban areas has led to record levels of air pollution. In addition to the loss of agricultural productivity, the environmental conditions in urban areas have been degraded further by an increase in ambient temperatures (Urban Heat Island) and depletion of ground water due to stormwater run-off from impervious surfaces.

Buildings have a profound impact on energy consumption, CO_2 emissions, and consequently on climate change (United Nations Environment Program, 2009). Estimated to contribute about 40% of the World's carbon dioxide emissions, the role of buildings in mitigating the rapidly increasing problem is paramount. It is necessary then for the building scientists to seek solutions to reduce energy demand first and substitute the fossil fuels second.

For the last decade, it has been established that wide-scale implementation of sustainable infrastructure can play a leading role in mitigating Carbon emissions especially from urban areas as well as contribute to the reduction of energy consumption in buildings. Through research and practice, the use of passive cooling techniques has proven to be effective, economical, and easily acceptable by the design community. Consequently, Asian countries lead by India have been adopting high performance design at unprecedented rates. According to the Confederation of Indian Industry, currently, there are over 25 million square meters of high performance building seeking or already achieved a LEED certification.

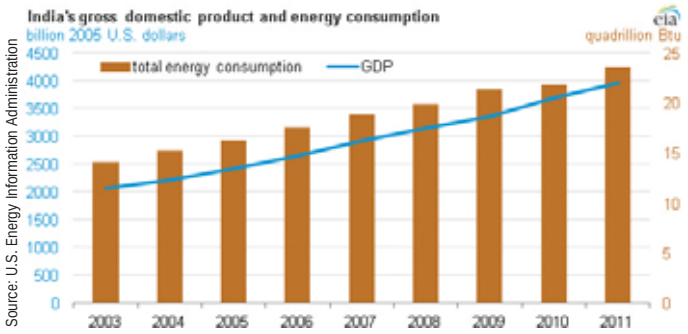

Figure 1. The increasing Energy Consumption in India.

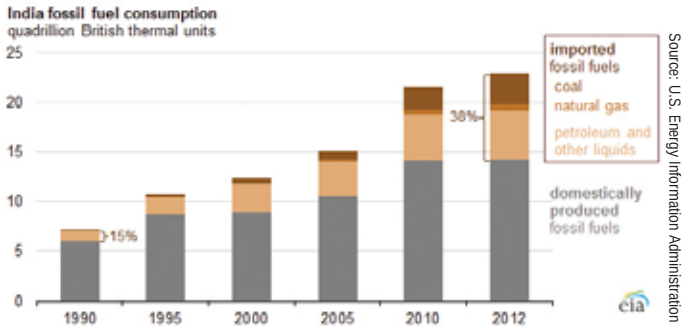

Figure 2: Increasing dependence on imported energy relative to domestic products.

What are Green Roofs?

According to Steven Peck (2008), roofs are forgotten spaces, left empty with often unwanted storage items among heating and cooling equipment. Estimated to represent about 25-50% of the area of the city, roofs may offer an excellent opportunity to replenish the diminishing urban parks and provide Indian cities with visual as well as environmental amenities. Generally speaking, a green roof is any vegetated open space on a roof of a building intended for a variety of purposes including thermal, environmental, and other amenities either for improvement of conditions in individual buildings or the surrounding urban area.

Green roofs existed throughout history in one form or another. They were first recorded in Babylon in the 7th century BC. Unfortunately, they did not gain wide acceptance from building designers until recently. According to Nigel Dunnett and Noel Kingsbury in their book 'Planting Green Roofs and Living Walls,' the earliest known modern green roof can be traced to Germany (2004). Today, green roofs are a worldwide phenomenon with thousands of built and more planned in almost every city (Figure 3).

Figure 3: A green roof atop a building in Beijing. (Source: http://www.treehugger.com/)

Why Green Roofs?

Contemporary use of green roofs is often attributed to a combination of political, economic, environmental, and technological advancements. In addition, scarcity of land popularized their use in Germany and other parts of northern Europe. The design and application, however, depend on the climate, culture, and environmental reasons for which these green roofs are intended. In urban Europe where the population is densely concentrated, green roofs are designed to be used as recreational or open spaces for plazas and playgrounds over under or above ground parking garages. In England, many eco- roofs are specifically designed to provide habitat for bird species in populated areas (Gedge, 2003). In a way, they compensate for the loss of landscape in cities where rapid urban development had led to the loss of vegetative cover.

In contrast, green roofs in North America have been installed for economic reasons; as a cost-effective method for reducing energy consumption, resulting in long-term savings for the owner (Dunnett and Kingsbury, 2008). In the hot-humid climate of South East Asia and parts of South America vegetated roofs are primarily intended to mitigate Urban Heat Island Effect. In 2001 city of Tokyo put into effect a mandate that requires new private and public buildings with an area more than 1,000 m² to green at least 20% of the roof area. Other Japanese cities are following suit.

Benefits of Green Roofs

Mitigation of Urban Heat Island

We may attribute the loss of vegetative covers and increase in urban paved areas, roads, and non-permeable hard surfaces to the rise in temperatures above those measured in the surrounding rural areas (Oke, 1982). Impervious surfaces especially roofs and pavements tend to be thermally massive, thus attributing positively to the increase of ambient temperatures. In addition, they result in

Table 1: Influence of substrate depth and vegetation on the percentage of total rainfall running off a roof.

Roof type	Runoff (m)	Runoff (%)
Standard	0.66	81
Standard with 0.05 m of gravel	0.63	77
Green roof with 0.05 m of substrate	0.40	50
Green roof with 0.10 m of substrate	0.36	45
Green roof with 0.15 m of substrate	0.32	40

Source: Mentens, et al., 2003

Source: Author

Figure 4: A green roof designed for wildlife benefit, showing a variety of indigenous grasses.

Source: Author

Figure 5: The Living Roof, California Academy of Science.

increasing the stormwater run-off, reducing water retention needed to replenish ground water reserves, and increasing pressures on stormwater management systems.

A green roof is effective at reflecting solar radiation and reducing heat absorption when compared to a conventional roof. Reduction of urban heat island effect is hard to quantify as a large area of green roofs are required to make a substantial impact. However, there is evidence that implementation of green roofs at a large scale in urban areas may have a significant impact on the reduction of urban heat island effect through lowering air temperatures (Berardi et al., 2014). According to a study conducted by the Centre for Atmospheric Sciences, Indian Institute of Technology in Delhi, Urban Heat Island (UHI) is found to be as high as 8.3 °C (Mohan, M, et al. 2008). Such high UHI values demonstrate the seriousness of the problem and its impact on the environment and the energy consumption in Indian cities. The study also found that plants and vegetation have the greatest impact on reducing the impact of UHI

One of the major problems caused by the elevation in ambient temperature of the city is the increase in the building cooling loads. As a result, buildings in urban areas tend to need larger mechanical cooling systems to compensate for the added cooling loads. In a research conducted by Pravin Bhiwapurkar (2015) from the University of Cincinnati, a clear relationship was revealed between building energy use and proximity to downtown areas.

Health represents another adverse effect of UHI. During summer, city dwellers often are forced to work on remain in exposed areas for prolonged periods of time. Heat-related illnesses include heat exhaustion, cramps, stroke, and death. In a study conducted by Sharag-Eldin (2016) at Kent State University, fatalities of heat waves could have been saved if green roofs were used. By drastically reducing conduction of heat through building roofs, the indoor temperatures in apartments on the top floors would remain within acceptable levels even with disruption of the power supply.

Stormwater runoff management

Green roofs may be especially valuable urban assets if designed specifically to manage stormwater runoff by reducing the peak flow and overall runoff quantity. Depending on substrate depth and vegetation coverage, green roofs reduce runoff from rooftops in most of the cases except for intense storms (Table 1). Despite the reduction in retention, during intense storms, the rate of runoff from green roofs remains lower than those of conventional roofs. Due to the drastic reduction in run-off rates and amounts, the absorption of rainwater by vegetated roofs may also reduce the chance of contamination.

In addition to overwhelming the stormwater management systems in urban areas, stormwater runoff may contain pollutants and contaminants collected from impervious surfaces e.g. conventional roofs, parking lots and roads. In urban areas precipitation cannot permeate through the asphalt and concrete surfaces and contaminated storm water often joins existing rivers, streams and sewer lines. The increased quantity of runoff during storms

Source: Author

Figure 6: Roof gardens provide outdoor spaces that are away from noise & pollution.

Source: Author

Figure 7: Fruit, vegetable, and herb gardens are an economically viable option for green roofs.

Figure 8: Roof garden at Knowlton School of Architecture Library, OSU, improves the quality of space through reduction of glare and shading the interior spaces.

overburdens the systems leading to their failure. If the system is not maintained well or does not exist in the first place, urban areas will be exposed to high fold risks, increasing chances of property damage and human losses. India is in great need for sustainable stormwater management systems in urban areas. Such systems need to take into consideration of combining roof drainage as well as road and open spaces.

Mitigation of Urban Pollution

Although one of the most commonly quoted benefits of green roofs, effects on air pollution is relatively unstudied when compared to thermal and water benefits. In a study conducted for the city of Chicago in the Department of Landscape Architecture and Horticulture, Temple University, researchers surmised that green roofs could reduce the levels of air pollution (Yang et al., 2008). The amount of annual pollution removal per hectare was estimated to be about 85 kg. They also speculated that by using intensive green roofs on all roof surfaces in the city of Chicago, over 2000 metric tons of pollution would be removed. Using a model developed by the USDA Forest service Northeastern Regional Station, researchers from the University of Toronto, Canada agreed with the previous study in the superior performance of intensive roofs in the removal of air pollution (Currie & Brass, 2008). They also surmised that by increasing the existing areas of vegetated roofs in the city by 10-20% in downtown buildings "would contribute significantly to the social, financial, and environmental health for all citizens."

Habitat restoration and wildlife preservation

In urban areas where green spaces are disappearing at the ground level due to human activities, green roofs are potentially a means of increasing vegetative spaces in the city. These spaces can sustain semi-natural plant communities, create healthy and functioning habitat for a certain amount of wildlife. In these circumstances, the roofs are not designed to be accessed by the public and remain undisturbed (Figure 4 & Figure 5).

Research indicates that high level of biodiversity may be achieved on extensive green roofs. Nonetheless, the ability of to support biodiversity is being explored alongside the thermal and hydrological studies, but results are still in the nascent stage. If designed well, green roofs can become a part of the functioning network of urban habitats.

Roof longevity

One of the major benefits of green roofs is their contribution to prolonging the life of both building insulation and roof surfaces. Plants and the growing media of the green roof moderate the temperature on the roof and protect the roof's waterproofing membrane. In

addition to infrared radiation, leaves shield roofing materials from the Sun ultraviolet rays that cause degeneration of insulation and roofing felt. In cold climates, well-designed green roof substrate resists freeze-and-thaw cycles that cause the expansion and contraction of the roof membrane, thereby weakening it and consequently accelerating its aging process and reduces its durability.

Aesthetic pleasure

Green roofs can play a major role in providing recreational spaces in urban areas where there are insufficient ground-level parks. Green roofs that are accessible to the public or private owners add to the enjoyment of the property and provide more interest for the people living or working in neighboring high-rise buildings.

With the increased motivation towards living in compact and high-density cities, there are immense pressures on planners to limit providing adequate green spaces at the ground level. Roof spaces are highly underutilized resources in the urban area and have enormous potential in providing urban dwelling with recreational space (Figure 6 & Figure 8). Adding to that, recreational spaces at the roof level most probably have controlled access making them safe from vandalism and other social problems that are common in public green spaces at ground level.

Food production

Roof surfaces offer an opportunity for the city dwellers to grow food, particularly, in high-density urban areas where garden space may be limited (Figure 7). Food producing plants can substitute ornamental plants in traditional roof gardens. Herb species are also known to perform well in free draining soils of extensive roofs and have the potential to become economically viable. In many countries around the world like England, Haiti, Colombia, Thailand, Russia rooftops have been used to produce a range of fruits and vegetables (Dunnett & Kingsbury, 2008).

Weight bearing capacity of the roof is a consideration for the successful plant growth. For production purposes, the roof design may require soil depth of 0.3 – 0.45 m along with frequent irrigation. One of the examples of green roof food production is the Fairmont Hotel in Vancouver, Canada. The garden provides for all the herbs requirements of the hotel thereby making a yearly saving of Canadian $25,000-$30,000. Apart from the food, they also provide outdoor recreational space for the guests. According to research conducted by Michigan State University (Wittinghill & Rowe, 2012), green roofs represent a viable means for urban agriculture as they alleviate some of the land-related problems affecting urban agriculture in general. The use of roof space for food production is still a new concept but may become a commercial possibility in the future, as no additional land purchase cost is associated with food production.

Noise Pollution Attenuation

With increasing population, vehicular traffic, and construction noise pollution is an important consideration in modern cities like New Delhi. Hard surfaces of urban areas reflect sound. Green roofs, at a large enough scale, may reduce outdoor noise levels in areas around them. Indoors, green roofs may prove beneficial in two ways; First, they provide sound isolation due to the high mass and low stiffness and second, but to a lesser extent, reduce noise pollution through sound absorption at the surface. According to Peck et al. (1999), Green roofs are excellent at attenuating low-frequency sounds often plaque downtown areas. In fact, while extensive roofs reduce externally-generated noise levels by about 40 dBA., intensive green roof may attenuate the noise by 46-50 dBA.

Healthy work environment and Amenity value

The cooler temperatures on green roofs in hot weather makes green roofs an asset and a valuable amenity for people who live or work in the building below or directly facing them (Figure 8). Green roofs act as recess spaces in offices where people can come and relax during break time and connect with the outdoors. In residential units, green roofs help to improve the quality of life for the residents, as they provide spaces for recreational activities.

Conclusions

Many of the environmental problems facing Indian cities could potentially be addressed through the extensive use of green roofs in urban areas. There is evidence that green roofs are capable of reducing energy consumption for cooling. As a result, HVAC engineers do not have to oversize the building cooling systems or upgrade the existing systems due to inadequacy to meet the increasing cooling demand in urban areas. It is also becoming clear that the stormwater management problems could be addressed through the comprehensive consideration of all water-repelling surfaces including building roofs. It should be noted that use of vegetated roofs could improve water quality through retention as well as absorption by the plant materials. In addition to water, green roofs are capable of reducing air pollution significantly especially with the city-wide application of intensive vegetated roofs. Other benefits as their use as parks, reduction of noise pollution, and providing a natural habitat as well as food production will have more limited and targeted applications. ■

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Reduction Of Food Loss And Carbon Emissions

A pilot study, funded by Carrier, has examined the extent to which the cold chain can help increase the quality, reach and profitability of kinnow, a citrus fruit rich in micronutrients...

A study has been conducted by the Indian School of Business under the direction of the National Center for Cold-Chain Development (NCCD) of India and Carrier Transicold India, and in collaboration with Balaji Kinnow, one of the largest aggregators in the Punjab region, and the first to use a Carrier pre-cooling system, which is designed for the rapid removal of heat from freshly harvested produce. This process is typically done before the produce is shipped to market or put into cold storage. The study was commissioned by Carrier, a part of UTC Climate, Controls & Security, a unit of United Technologies Corp., and released at Carrier's World Cold Chain Summit to Reduce Food Loss, held recently in Singapore.

This is an area of critical importance to India, which is the world's second largest producer of fruits and vegetables, but accounts for just 1.5% of global produce exports due to losses of up to 20-50% of total production.

A cold chain can be simple yet effective

Demonstrating positive value for all stakeholders along the supply chain – growers, aggregators, transporters, distributors and retailers – the pilot study corrects misperceptions that the cold chain requires a complex setup from farm to retail, dependence on other stakeholders to invest along the supply chain, and a high cost of investment. The study also provides a general framework for aggregators and distributors to analyze profitability for any crop when using the cold chain.

Profit Margin Per Metric Tonne Sold

	Scenarios 1-2 (no refrigeration)	Scenario 3 (refrigerated truck only)	Scenario 4 (cold storage + refrigerated truck)
Aggregator	1.9%	12.5%	20.7%
Distributor	1.2%	3.1%	3.8%
Retailer	2.0%	1.5%*	7.9%

*Retailer profit impacted by space limitations

"The cold chain, simply put, serves as a cross-geographical bridge between a rural source and distant concentrations of consumption. The cold chain is a modern agri-logistics system that is transformational in its impact and key to bringing about the next agricultural revolution. We look forward to many more, similar pilots to demonstrate the wide-reaching advantages of the cold chain," said Pawanexh Kohli, Chief Advisor and CEO, NCCD.

Besides the economic value, the study also compared the carbon footprint of the kinnow supply chain with and without refrigeration, and determined that the cold chain can have a net decrease in overall carbon footprint – when compared with the carbon emissions of kinnow that is lost or wasted.

Expanding reach and profits

The study measured the effects of cold storage and refrigerated transport from Abohar, in northern India to Bangalore, in southern India, a roughly 2,500 km (1,600 mi) overland journey that is a four- to five-day drive by truck. This allowed for ample analysis of the time- and distance-related aspects of cold chain investment. Unlike other fruits, kinnow is available only for three to four months a year, is highly perishable and is grown primarily in a few districts of Punjab. To keep spoilage to a minimum, kinnow is best kept at 4- to 5-degrees Celsius and a relative humidity of 85- to 90%. Increasing yield and acreage has meant that production is too large for the local market, but there are challenges in distribution to markets that are further away.

"The small percentage of kinnow that is exported to other domestic and international markets is often transported in open trucks, with cumulative losses as high as 32%. Many markets in India and abroad have never enjoyed a flavorful, nutritious kinnow. The challenge is to convince all the stakeholders that the cold chain is a smart investment with a relatively short payback period," said Pankaj Mehta, Managing Director, Carrier Transicold India, in announcing the results at the World Cold Chain Summit.

The study demonstrated that the payback for pre-cooling equipment is only about two years, while for refrigerated trucks it is just over four years. Government incentives, which were not included in the study, would only further serve the attractiveness of the investment.

"This project reinforces government commitment to setting up a cold chain infrastructure for local growers. The cold chain is new technology for growers. After looking at the potential for this technology, the government has already announced subsidies related to the cold chain," said Jaspal Bhatti, Government Representative, Citrus State Abohar. ■

Cooling The Remote Field-based Instrumentation

This form of cooling is widely used for 'off grid' applications where electrical power is unavailable and/or unreliable...

Hybricool water coolers can be added to passively-cooled cabinets and shelters to provide ultra-reliable cooling for remote field control and instrumentation equipment...

Intertec has launched a family of high-performance water coolers, specially designed to work in combination with passive cooling systems. The combination of active and passive cooling technologies provides process control and instrumentation engineers with the means to configure field protection cabinets and shelters with extremely reliable cooling. The combination is ideally suited to protecting remote and mission-critical control and instrumentation equipment.

The two cooling technologies can work together to handle extreme climatic conditions, or maintain continued operation in the event of one system failing. Should electrical power fail completely, the passive cooling system continues to operate indefinitely – maintaining low shelter temperatures until maintenance work can be performed.

The new family of water coolers -dubbed Hybricool – are housed in tough GRP enclosures, which are suitable for use in the

harshest of environmental conditions.

Intertec's Hybricool water coolers offer an IP rating of IP65 and can also be provided in versions suitable for use in hazardous areas. A range of sizes and cooling capacities allows users to select optimal cooling solutions for all common scales of outdoor protection applications from enclosures, to larger cabinets and walk-in shelters.

The main target application for the new water cooler family is enhancing the performance and reliability of shelters and cabinets fitted with passive cooling – a technology that operates by natural convection and requires no electrical power. Intertec's passive cooling systems typically employ water as a medium to store the coolness of the night and use it to moderate temperatures throughout the day. This form of cooling is widely used for 'off grid' applications where electrical power is unavailable and/or unreliable, and in remote locations, such as on SCADA systems for pipelines and oil and gas wellheads.

A passive cooling system can typically limit the maximum internal temperature of cabinets and shelters to around 10 degrees Centigrade above minimum night-time temperatures – making it ideal for applications in arid and desert climates. The addition of an Intertec Hybricool water cooler reduces the dependence on low night-time temperatures, opening up applications in a much broader range of climates and geographical locations. Such hybrid or 'semi-passive' cooling systems – combining active and passive cooling technologies – can easily be configured to maintain internal shelter temperatures at 20 degrees C or less.

Hybricool operates on the refrigeration principle, and has a closed loop system with four main components: compressor, condenser, throttle and evaporator. The evaporator is a heat exchanger element that can be installed inside the water storage tank of a passive cooling system to decrease temperature. The interior and exterior compartments are isolated to keep any outside weather from entering the cabinet or shelter. No filters are required, as the condenser – which sits in the external compartment – is coated with a special dust protection system. The coating also ensures advanced protection against aggressive media. No condensate is formed, and no icing is possible, due to the direct thermal transfer to the water buffer. Hybricool can be controlled to suit the application, such as by timer, or regulated by thermostat.

Intertec expects the combination of a Hybricool and passive cooler to allow process instrumentation and control engineers to create highly reliable cooling strategies for critical equipment - with a high degree of failsafe redundancy. When electrical power is available, the cooler feeds cool water into the cabinet's passive cooling system to provide a highly efficient cooling mechanism. If the cooler should fail for any reason – because of an electrical power loss for example – the passive cooling system retains enough capacity to keep a cabinet or shelter cool for several days, allowing plenty of time for maintenance to take place.

Hybricool coolers are typically provided in the form of a compact wall- or panel-mounting enclosure made from GRP (Glass Reinforced Polyester). Intertec's GRP is produced using long-fibre glass strands, which makes it almost as strong as stainless steel, yet around 75% lighter. GRP does not rust or degrade in any meaningful way in outdoor field protection applications. Combined with its excellent insulation characteristics, these properties make GRP an excellent choice for the construction of robust outdoor enclosures – allowing maintenance-free lifecycles of 30 years and more. Intertec has been using the technology for over 50 years and can cite many examples of GRP enclosures that have operated for 30 years and more in harsh and aggressive outdoor environments, including oil and gas processing facilities, pipelines and wellheads, and coastal and desert locations. ■

ASHRAE & IES Revising Their Residential Energy Standard

The residential sector consumes a fifth of all the primary energy used by the United States (21%) and more than half (54%) of all energy used by buildings. Similar trends are also observed in other parts of the world...

Recognizing the amount of energy used by the residential building sector, ASHRAE and IES are revising their residential energy standard with a goal of making it 50% more efficient than the 2006 International Energy Conservation Code, which serves as the industry benchmark.

The residential sector consumes a fifth of all the primary energy used by the United States (21%) and more than half (54%) of all energy used by buildings. Similar trends are also observed in other parts of the world. For example, in Europe, residential buildings accounted for 75% of the total building stock and were responsible for 26.2 % of the total European Union final energy consumption in 2012.

ASHRAE/IES Standard 90.2-2007R, *Energy Efficient Design of Low-Rise Residential Buildings*, is open for public comment.

Theresa Weston, chair of the Standard 90.2 committee, said the

revision of the standard, last published in 2007, represents a new approach in residential building energy performance.

"This new 90.2 seeks to deliver residential building energy performance that is at least 50% more efficient than the energy efficiency defined by the 2006 International Energy Conservation Code," she said. "Key to accomplishing this objective is delivery of an accurate, flexible performance-based tool to enable user creativity in meeting the performance objectives. The new standard contains detailed rules governing the energy modeling and analyses needed to determine compliance with the performance objectives."

The standard provides a mechanism by which any residential building design can be easily evaluated against these performance objectives. By establishing a clearly-defined rules set for energy performance modeling, users can easily assess various designs, material options, orientations and other variables to evaluate predicted energy performance, according to Weston. This analytical flexibility also provides users with a tool for helping to establish program targets and ensure program compliance.

The rule set is based on ANSI/ICC/RESNET 301 with specific exceptions and adjustments for building size.

Another key difference in the structure of this standard is that it allows users to develop multiple prescriptions – recipes of construction, systems and equipment – that will deliver the targeted performance. As such, users such as states, utility programs and product manufacturers may seek to build prescriptive "solutions" to assist builders with locally focused, performance-based compliant options.

Weston noted that an array of new building envelope, HVAC, lighting and equipment technologies exist to enable achieving even greater levels of residential energy efficiency. Since this standard is performance-based and focuses on whole building energy performance, all of these new technologies can be evaluated to meet the performance target.

Additional key features in this draft standard include:

- **Title, Purpose and Scope** – The standard now covers manufactured housing, which was not included in the 2007 version. It also addresses renewable and non-renewable forms of energy.
- **Building envelope** - The standard recognizes that long-lived building envelope decisions play a critical role in achieving the targeted building performance. Certified performance of insulation, fenestration and envelope air sealing are prioritized. Testing and verifying the envelope air leakage is mandatory. The standard attempts to addresses several problems in existing residential performance techniques. One major difference is adjustments in building modeling techniques to address the energy use implications of building size.
- **Mechanical systems** – The standard recognizes the importance of HVAC and water heating system performance as essential to achieving the overall building performance targets. Proper sizing and verification of duct system performance, as well as having all ductwork within conditioned space are fundamental to these objectives. Similarly, plumbing system design, insulation levels and controls are prioritized and are fundamentally new. Requirements for HVAC system design, installation, commissioning and verification are integral to 90.2.
- **Lighting systems** – The standard builds on the many recent cost-effective and long-lived advances in lighting technology – from lamps to control systems – to help deliver even greater levels of lighting energy savings than current minimum code. Key improvements include revised modeling rules for quantifying residential lighting energy, credits for the use of vacancy sensors, dimmers and other control devices and revised lighting allowances for interior, exterior, garage and other residential lighting.
- **Onsite power systems** – The standard recognizes the important role of renewable energy and onsite power systems to help achieve the building performance targets. It emphasizes load minimization and HVAC performance strategies first so that any onsite power systems used can have maximum impact toward the overall building performance goals. ■

Modine launches New TeamMate Classroom HVAC Solution

Modine Manufacturing Company, well known in the HVAC industry, has unveiled their latest in classroom HVAC solutions with the TeamMate single packaged vertical unit cooling and heat pump.

Designed with the same footprint as the Modine ClassMate, the TeamMate is a value-priced single package vertical unit engineered to provide efficiency, noise reduction and a small footprint at a budget conscious price.

Features of the TeamMate include:

- The patented CF microchannel evaporator coil technology only found with Modine
- Smart integration capabilities to work with your existing thermostat or Modine Controls Systems
- Meets DOE efficiency requirements
- Decreased sound and power output ■

Website: www.modinehvac.com

Monitran launches MTN/2285STC- A dual-output sensor

Monitran, well known in the development and manufacturer of sensors and condition monitoring systems has launched the MTN/2285STC- a combined velocity and temperature sensor with 4-20mA range outputs for industrial monitoring applications. It is a dual-output sensor ideal for monitoring vibration and temperature levels in the same location and for protecting motors, fans, pumps, compressors and other assemblies with rotating parts.

Both of the sensor's outputs are in the industry-standard range 4-20mA and are suitable for direct connection to a Programmable Logic Controller (PLC), Distributed Control System (DCS) or other industrial controller.

The MTN/2285STC is a stainless steel side-entry transducer, sealed to IP65 and supplied with 5m of integral stainless steel over-braded ETFE cable as standard with other lengths available upon request. Its dynamic range is 50g peak and it has a frequency range of 16Hz to 720Hz ±10%.

The sensor requires a DC supply voltage in the range 12 to 32V. Its Vibration output is proportional to RMS velocity with a range of 0 to 10, 20, 25, 50 or 100mm/S; to be specified when ordering. The sensor's Temperature output sensitivity is 0.106mA/oC across its operating temperature range of -25 to 90oC, and it has an accuracy of 0.08%/oC. ■

Website: www.monitran.com

TEL launches Laboratory Room Space Controller

Global electronic airflow control and monitor manufacturer and consultant, Temperature Electronics Ltd (TEL), has launched the first laboratory room space controller to communicate directly with fume cupboards, affording a supreme degree of control, comfort and energy-efficiency.

The AFA5000 Laboratory Room Space Controller is an intelligent touch screen room controller offering demand-control ventilation for up to 64 fume cupboards without the need for a building management system.

The only such Room Space Controller on the market that can communicate directly with fume cupboard systems, the AFA5000 measures precise airflow requirements of fume cupboards allowing air to be controlled exactly according to need, minimising energy consumption and allowing you the peace of mind to get on with the job at hand. ■

Website: http://tel-uk.com/

Automated Control launches innovative new temperature controller

Automated Control and West Control Solutions has launched an innovative new temperature controller, MAXVU. This compact and easy to use controller offers users a fast setup menu that can be configured in less than a minute. MAXVU is the ideal choice for straightforward applications where only the fundamental control elements are required.

The key to MAXVU's ease of use is the large dual line display. Upper digits of 18mm and lower digits of 10.2mm have been achieved as a result of the 1/16 or 1/8 DIN housing's uniquely designed keypad. Offering increased clarity and visibility, the MAXVU's new display allows vital process information and alarm messages to be easily viewed from a distance.

Combined with its universal input, MAXVU offers a cost effective alternative for providing simple yet efficient temperature control. Typical applications include packaging tray and bag sealing machines, seam sealing and thermal bonding in the textiles industry as well as processes in the food and beverage sector that include fryers, micro-breweries and chocolate tempering. ■

Website: http://www.automatedcontrol.com.au

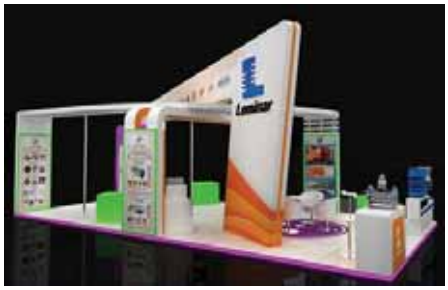
Leminar showcases a complete HVAC system at Big 5 2016

Leminar Air Conditioning Company, a well known distributor and service provider of HVAC and plumbing products in the GCC, showcased a life-size Chilled Water Plant Room system at The Big 5 2016 at the World Trade Centre in Dubai, UAE.

The company's Chilled Water installation features some of the best-in-class products, such as Weicco pipe supports, Hattersley valves, Kimmco fibreglass insulation, Frese pressure independent control valves, General Pumps' chilled water pumps, Alfa Laval heat exchangers and more, to make up all the integral components of a standard system.

Leminar used the platform to create more awareness about Rheem's VRF solution, which was launched a year ago. Spurred by the demand for energy efficiency, Rheem's VRF is designed to offer enhanced degree of sub-cooling and is a cost-effective alternative to traditional systems.

Pramodh Idicheria, General Manager, Leminar Air Conditioning Company, said, "We have been participating in The Big 5 for the last 14 years. It is an ideal platform to showcase our strength to the construction sector and many of our key partners visit the show. We go so far as to schedule our annual review meetings with our brand partners during the show dates." ■



Website: www.leminar.net

FLIR's Imaging Multimeter with Infrared Guided Measurement (IGM)

FLIR DM284 Imaging Multimeter with IGM is a professional, all-in-one true RMS digital multimeter with built-in 160x 120 FLIR thermal imager that can show exactly where an electrical problem is to speed up troubleshooting. The DM284 visually guides you to the precise location of an electrical problem and helping you to pinpoint hot spots faster and more efficiently.

IGM enables you to scan panels, connectors, and wires without requiring any direct contact — so you can do your job from a safe distance. Once you find an issue with IGM, the DM284 can verify and confirm findings with advanced contact measurement features to help solve the most complex electrical issues.

Ideal for field electronics, commercial electric, light industrial, field service and HVAC work.

Key Features:

• Pinpoint problems quickly and safely with IGM; • 18 Functions DMM including True RMS, VFD mode, LoZ, NCV, and more; • Includes high-quality test probes and a Type K thermocouple input; • Simple user interface and various thermal color palettes to choose from: Iron, Rainbow & Greyscale.; • Drop-tested and IP rated for splash and water resistance with 10-year warranty ■

Website: http://www.flir.com/instruments/dm284/

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Forthcoming Events At A Glance

Cooling Technology Institute Annual Conference
Venue: Sheraton New Orleans, New Orleans, LA 70130
Date: 5th to 9th February, 2017
Website: www.cti.org

Aqua-Therm
Venue: IEC Crocus Expo Centre, Moscow
Date: 7th to 10th February, 2017
Website: www.aquatherm-moscow.it

Campus Energy 2017
Venue: The Hyatt Regency Miami, Miami Florida
Date: 20th to 24th February, 2017
Website: www.cvent.com

Acrex India
Venue: India Expo Centre (IEML), Greater Noida, Delhi
Date: 23rd to 25th February, 2017
Website: www.acrex.org.in

Climatización Y Refrigeración 2017
Venue: Feria de Madrid, Madrid, Spain
Date: 28th February to 3rd March, 2017
Website: www.ifema.es/climatizacion_06/

HVACR Vietnman
Venue: Saigon Exhibition and Convention Centre (SECC), Vietnam
Date: 29th to 31st, March 2017
Website: www.hvacrseries.com

index to advertisers

Company Name	Page No.
A. S. Controls Pvt. Ltd.	13
ACREX	29
ALM Engineering & Instrumentation Pvt. Ltd.	Inside Front Cover
C.R.I. Pumps	15
Calpeda Pumps	9
CAREL ACR Systems India Pvt. Ltd.	3
Danfoss Industries Pvt. Ltd.	5
Desiccant Rotors International Pvt. Ltd.	23
Emerson Electric Co. (India) Pvt. Ltd.	17
Flir systems India Pvt. Ltd.	7
Frick India Ltd.	19
Guentner AG & Co.	41
Hira Technologies Pvt. Ltd.	11
Ice Making Refrigeration Pvt. Ltd.	55
S. S. Lifestyle Pvt. Ltd.	21
Sam Products Pvt. Ltd.	33
Sharon Insul India Limited	Inside Back Cover
Ventconf	Back cover

Climaveneta Units Installed at the New Bicentenario De San Juan Theatre

On October 21, with the opening night dedicated to Carmina Burana, the new Bicentenario de San Juan Theatre officially opened its doors. An international stage for operas, ballets, and concerts, this building has been designed with care in all details, starting from the architecture inspired by the mountains surrounding San Juan.

To guarantee the audience's maximum comfort in both the two rooms as well in the internal restaurant, an air conditioning system able to regulate the temperature efficiently during the whole year with minimum noise emissions was installed.

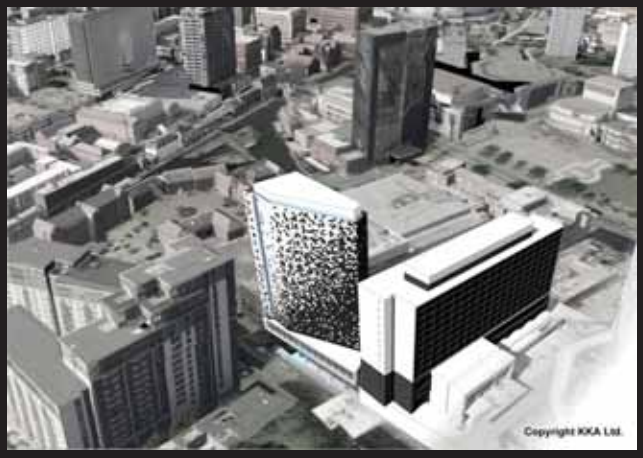
The landlord decided to install an efficient and flexible air conditioning system based on 2 multi-purpose units with Class A efficiency ERACS2-Q, that produce both hot and cold water at same time. They were coupled with 1 air cooled chiller FOCS2-Kwith precise thermoregulation and 23 WIZARD air handling units for optimum air exchange and filtration, thus providing the building with very high comfort requirements expected in this application. ■

Holiday Inn Express utilises innovative hybrid air conditioning

A new 250-bedroom hotel has become the first in the UK to use an innovative hybrid air conditioning technology that removes the need to install leak detection equipment in occupied rooms.

The Holiday Inn Express Birmingham City Centre in central Birmingham is using Mitsubishi Electric's Hybrid Variable Refrigerant Flow (VRF) system to keep guests comfortable in a controllable, energy efficient way, whilst still offering the full flexibility of design and installation that VRF air conditioning is synonymous with.

The design for the air conditioning system was put together by SISK Design and Build Contractors who worked with Building Services Consultancy DW Pointer. Together they committed to providing a VRF system that did not need the significant cost of adding leak detection units in all of the bedrooms.



The 18-storey hotel in Holliday Street, Birmingham, which was designed by Liverpool-based KKA Architecture, will use 16 outdoor condensing units to operate 250 slim ducted indoor units in a clever design that has one outdoor unit serving one wing on each of two floors to minimise the refrigerant pipework within the building. ■

Synecore provides HVAC design and installation for Leon Restaurant

Daikin's new integrated air conditioning system is set to revolutionise the aesthetics of many commercial buildings in high streets throughout London and the UK. For the first time Daikin's VRV IV i-Series was installed by M&E contractor, Synecore, at Leon Restaurant in Fenchurch Street, London.

Air conditioning systems most commonly require an outside space – either an alleyway or roof top – to accommodate the bulky condenser unit, but Daikin have been clever. They have created a unique system that is entirely installed indoors, with only simple grilles visible from the outside, which can be discretely disguised within the existing architecture, or by using signage.

The first application of this all-new patented system was by Synecore for its long standing client, healthy fast food restaurant chain, Leon. Synecore has provided HVAC design and installation for Leon sites for several years, with the majority of the projects taking place across London, where outside space is at a premium.

Through using the all-new Daikin VRV IV i-Series, the new Leon site in Fenchurch Street was able to open sooner.

Not only is the new Daikin integrated system quiet and more aesthetically pleasing, it is also quicker and more cost effective to install, as the unit is split into two elements – the heat exchanger and compressor. ■

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