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Publisher's Letter

The US Is Quite Serious...

HFCs (hydrofluorocarbons) are factory-made chemicals that are primarily used in air conditioning, refrigeration and foam insulation, and they can be up to 10,000 times more potent than carbon dioxide in contributing to climate change. In absence of ambitious actions to limit their use, emissions of HFCs are expected to nearly triple in the US by 2030. How is the world's 2nd most technologically advanced country (the US) working to mitigate this risk?

The US President Obama believes that no challenge poses a greater threat to future generations than climate change, and his administration is committed to taking responsible steps to ensure that we leave our children a planet that is neither polluted nor even damaged. In this context, the White House announced a suite of new private-sector commitments and executive actions that would reduce the use and emissions of the potent greenhouse gases. In addition, it recognised the robust progress that had been made against the private-sector commitments and executive actions that were announced in September 2014 to address HFCs.

In the US in the past year, a series of actions have been taken that will cut consumption of HFCs by the equivalent of more than 100 million metric tons of CO_2 through 2025. Moreover, the private-sector commitments and executive actions announced to-date would slash the US's reliance on HFCs and reduce cumulative global consumption of these greenhouse gases by the equivalent of more than 1 billion metric tons of CO_2 through 2025.

In July, the US Environmental Protection Agency (EPA) finalised a rule under the Significant New Alternatives Policy (SNAP) programme that will prohibit the use of certain HFCs, where safer alternatives are available. The recent commitments and progress demonstrate that the US companies are at the cutting edge of developing the next generation of safe and cost-effective alternatives to HFCs. They are also incorporating these alternatives into American cars, air conditioners, refrigerators etc. Obviously they are quite serious on this issue, what are we doing?

Please send your comments at pravita@charypublications.in

Pravita Iyer
Publisher & Director

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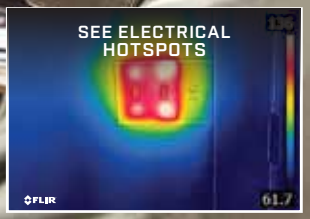

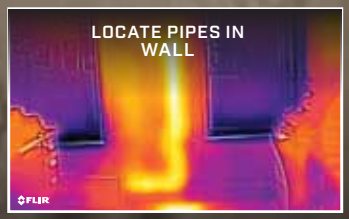

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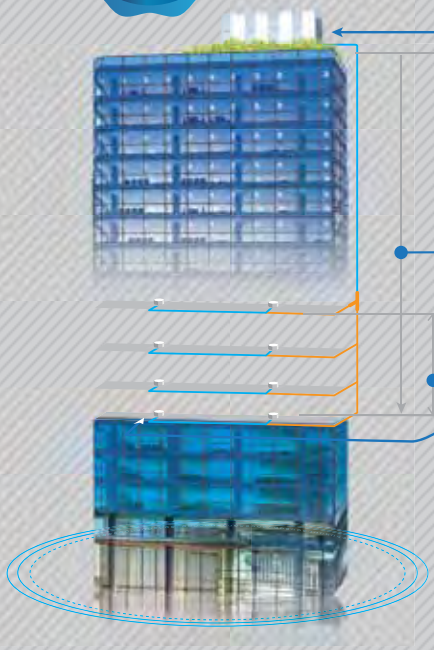
R410A

Diamond Shaped Design

1000m

The solution offers a piping length of 1,000m and level difference of 110m, making it perfect for large projects.



110m

Max.110m level difference between IDU~ODU

175m

Max.175m actual piping length

30m

Max.30m level difference between IDU~IDU

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FROM THE EDITOR

Boosting Faster Innovation

Tropical countries always needed cooling for human comfort as well as preservation of food items. However, global warming has aggravated the process. In today's situation, where many of these countries are developing fast – and the people there are seeing faces of better economies, the need for better and cheaper air conditioning and refrigeration systems is growing apace. Under such circumstances, every player in the field is realising the need for innovation to make its products penetrate the markets beyond the urban areas. Like other developing nations, in India also, innovation is being held with the highest priority.

Recently, the first ever three-day Visitor's Conference at Rashtrapati Bhavan commenced with an interactive session between industry and academia, with an exchange of 44 MoUs. Speaking on the occasion, the President of India, Pranab Mukherjee said, "We cannot aspire to be a world power without having a single world-class university." It has found resonance amongst the institutions, who have now started looking at the international ranking processes in a more proactive and systematic manner. Contextually, for the first time, two Indian institutions have found place in the top 200 positions in QS rankings. IISc Bangalore at 147th and IIT Delhi at 179th place deserve full praise and compliments.

While launching 'IMPRINT India'– a Pan-IIT and IISc joint initiative to develop a roadmap for research to solve major engineering and technology challenges in ten technology domains relevant to India, President Mukherjee has emphasised that it is necessary to develop in our students a scientific temper, which allows the flight of imagination beyond the realm of grades and classrooms. The link between progress and innovation is direct.

Like other developing nations, in India also, innovation is being held with the highest priority...

Pl. send your views at pkchatterjee@charypublications.in

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EPA proposes new rules to reduce potent greenhouse gas emissions

Recently, EPA Administrator Gina McCarthy joined private and public sector leaders for a second annual White House roundtable discussion about the progress made and new steps taken to curb emissions of hydrofluorocarbons (HFCs), potent greenhouse gases used in refrigeration and air conditioning. Administrator McCarthy announced several new actions the agency will take to help support a smooth transition to climate-friendly alternatives to HFCs.

"EPA is working closely with industry leaders to reduce greenhouse gas emissions, transition to climate-friendly refrigerants, and deploy advanced refrigeration technologies. The powerful combination of EPA's regulatory actions and innovations emerging from the private sector have put our country on track to significantly cut HFC use and deliver on the goals of the President's Climate Action Plan," said McCarthy.

Among the actions announced, EPA proposed a rule that would improve the way refrigerant is sold, handled, recovered, and recycled. The proposal would strengthen the existing requirements for handling refrigerants – and apply those rules to ozone-depleting and HFC refrigerants.

EPA estimates that this rule would further reduce enough HFC emissions in 2025 to equal 7 million metric tons of carbon dioxide. EPA will accept comments on the proposal for 60 days following publication in the Federal Register. After reviewing public comments, EPA plans to finalise this rule in 2016.

EPA also announced that it intends to initiate a proposed rulemaking in 2016 under its Significant New Alternatives Policy Program in 2016 – that would change the status for certain high global warming potential HFCs to unacceptable – where safer alternatives are available and also approve several new climate-friendly alternatives for a variety of industry applications. ■

Bloom wins Electrolux Design Lab 2015 award

Image Courtesy: Electrolux

Jordan Lee Martin

United Kingdom's citizen Jordan Lee Martin's concept, 'Bloom' – a concept that bridges the gap between digital and practical education by encouraging good kitchen habits in a fun way, has been announced the winner of Electrolux Design Lab 2015. The winner was selected by an expert jury in front of a live audience comprising 200 international media, bloggers and Electrolux partners at the Kattilahalli Venue in Helsinki, Finland.

"Based on real needs and clever use of existing technology, this aesthetically pleasing concept has potential for multiple use, which will inspire, teach and interact with kids both emotionally, digitally and physically," said Lars Erikson, Senior Vice President Design at Electrolux and Head of Jury.

The 2nd prize was awarded to 'Airshield', by Dominykas Budinas of Lithuania. Third prize went to 'QH', an air purifier and hula hoop in one, by J Seo of South Korea. ■

ACR Show wins major brand backing

UK's only national exhibition for the refrigeration, air conditioning, ventilation, heating and heat pump sectors, the ACR Show 2016, has won the support of all the major trade associations, including the Institute of Refrigeration (IOR), the Building & Engineering Services Association (B&ES), the Federation of Environmental Trade Associations (FETA) and Register of Companies Competent to Manage Refrigerants (REFCOM).

The British Frozen Food Federation (BFFF) has announced its support for the 2016 event, which will see a number of new end users from the food sector attending, many for the first time. The Association of European Refrigeration Component Manufacturers (ASERCOM) and the European Heat Pump Association (EHPA) are also supporting the show for the first, reflecting its growing importance in Europe. ■

Carrier helps 'tegut… supermarket' receive a Blue Angel ecolabel

Carrier CO_2OLtec refrigeration system for medium- and low-temperature refrigeration…

The environmentally sustainable CO_2OLtec system helps improve the store's energy efficiency and reduce its carbon footprint by using the natural refrigerant carbon dioxide (CO_2), which has a Global Warming Potential of one.

Carrier Commercial Refrigeration Europe's CO_2OLtec integral refrigeration system and energy efficient remote cabinets have helped tegut… supermarket in Marburg-Cappel, Germany become the first supermarket to receive a Blue Angel ecolabel for environmental responsibility. Carrier, which operates in Germany as Carrier Kältetechnik Deutschland GmbH, is the world's leader in high-technology heating, air-conditioning and refrigeration solutions, and is part of UTC Climate, Controls & Security, a unit of United Technologies Corp.

Since 1978, the Blue Angel ecolabel has been awarded to more than 12,000 environmentally sustainable products and services from approximately 1,500 companies in Germany. The designation helps consumers make purchasing decisions based on a set of exacting environmental standards. The Blue Angel ecolabel designates that a product or service meets high standards – when it comes to its environmental, health and performance characteristics.

In order to receive this highly regarded environmental label, tegut… had to fulfill numerous criteria including refrigerated display cabinets with glass doors, photovoltaics on the roof, use of natural refrigerants and LED lighting, leaflets made of recycled paper and on-site facilities for bicycles. Carrier was tegut…'s first choice for sustainable, energy efficient refrigeration equipment. ■

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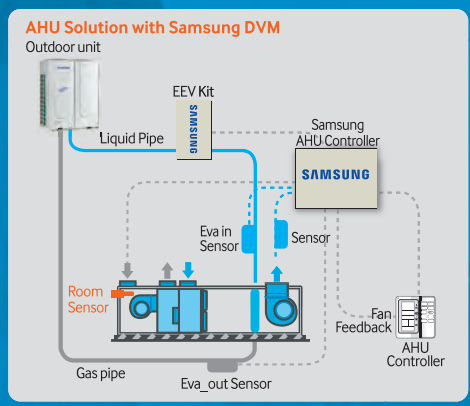

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KL20E offers a comfortable climate inside the bus

The smallest roof top compact unit of Konvekta – a manufacturer of thermo systems, has got a new design. Commenting on the compact and elegant air conditioning unit, an air conditioning specialist from Schwalmstadt says, "We were inspired by customer requirements and the result is visually attractive, efficient and has best installation and service characteristics."

The roof top compact unit KL20E with 4,3 kW has proven for decades. Based on these experiences the concept has been developed and optimised. The KL20E is fast and easy to install or retrofit in maximum three hours. Depending on the bus type, this unit can be placed almost everywhere on the roof, also optionally in the openings of the roof hatches.

The air conditioning system is pre-filled with refrigerant and electrically wired. By the compact design and placement of the compressor inside the unit no refrigerant lines have to be installed in the vehicle. This takes care of the bus operators' budget and additionally contributes to protection of the environment as the system guarantees highest possible tightness.

As usual the technical designers of Konvekta are not only aware of a modern and puristic look but also functionality is taken for granted. That's why the second generation of KL20E is more flat and the cover is designed streamlined for best aerodynamic features. With its weight of only approx. 50 kg an increased fuel consumption is hardly noticeable. By the new soundproofing mounting of the unit noise emission has been reduced considerably.

As important as the economic advantages that this system offers to the bus operator is a comfortable climate inside the vehicle for passengers and driver. For this purpose the air distribution panel got a fresh and new face. The new extremely flat inside housing with titanium effect adapts optimally to the interior of a modern bus. The air is distributed evenly and completely inside the vehicle, a pleasant cooling effect is felt immediately without an uncomfortable draught. ■

Choosing a fan becomes easy

Greenheck's eCAPS Fan Application Suite and CAPS (Computer Aided Product Selection) Design Software have been highlighted in a new brochure. Ideal for the initial building design phase, eCAPS, a new online fan selection program, allows engineers to easily compare multiple fan models simultaneously – based on fan performance, sound levels, operating costs or first costs.

Greenheck's CAPS software includes the industry's widest selection of air movement, control and conditioning equipment.

During later building design phases, HVAC engineers or planners can use CAPS for sizing, fan curves, configuration details and payback analyses, Revit and AutoCAD drawings, and details on options, controls and accessories. Both eCAPS and CAPS are available at no charge. ■

White House recognises Daikin

Recently, at the White House, the Obama administration recognised Daikin Industries, Ltd. – one of the world's well known manufacturers of air conditioner products and fluorochemicals, and some other private sector businesses for their continuing commitment to reduce emissions of hydrofluorocarbons (HFCs), and other powerful greenhouse gases, which can contribute to climate change.

The White House event was hosted by Dr. Ernest Moniz, US Secretary of Energy, and Gina McCarthy, the Administrator of the US Environmental Protection Agency (EPA).

Shinya Okada, Senior Executive Officer of Daikin Industries Ltd., stated, "Daikin is committed to the future development and production of a full product line of HVAC systems that utilise environmentally beneficial technologies designed to have a positive impact on the environment. We are grateful that our efforts have been recognised by President Obama's Administration, and we feel Daikin can contribute to the private sector leadership that is needed for global climate protection." ■

Bombardier chooses Liebherr's thermal conditioning units

E-buses operated in Berlin and Braunschweig will have Liebherr technology on board...

Bombardier Transportation GmbH of Mannheim (Germany) has selected Liebherr-Transportation Systems for delivering a total of nine thermal conditioning units for lithium-ion batteries used in the innovative PRIMOVE drive system.

Electric buses from the Polish manufacturer Solaris operate with these batteries. The Urbino electric buses travel in the Berlin city center between the 'Zoologischer Garten' train station, Hertzallee and Südkreuz, as well as on the route between Braunschweiger Hauptbahnhof and Campestrasse.

Four of the thermal management systems developed and manufactured by Liebherr are used in Berlin, and five in Braunschweig. The cooling systems ensure that the lithium-ion batteries are operated under optimum thermal conditions. This improves both the operating conditions and lifetime of the batteries.

The lithium-ion battery being cooled is a permanently installed component in PRIMOVE, the newly developed inductive battery charging system from Bombardier. This system allows the user to charge the traction battery with a charging device at certain breakpoints within a few minutes without interrupting the driving operation.

The environmentally friendly system using Liebherr technology will help in significantly reducing the CO_2 footprint of urban transport and provide passengers with a quiet ride through city centers. ■

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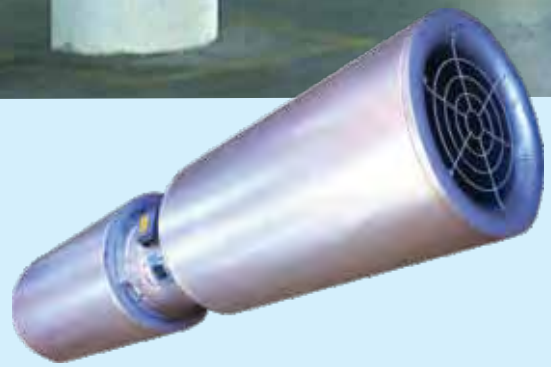

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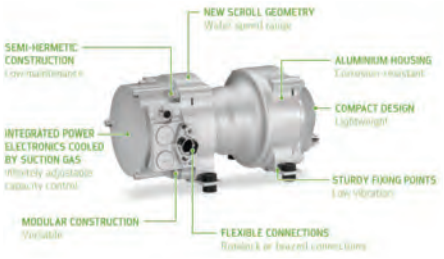
BITZER presents new refrigeration compressors at Busworld



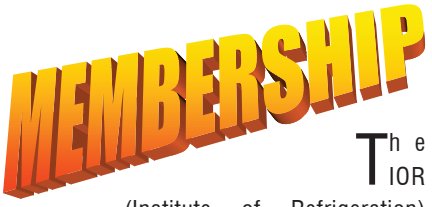
BITZER scroll compressors: SPEEDLITE ELV21...

Recently, BITZER, the well known independent manufacturer of refrigeration compressors, presented its new SPEEDLITE scroll compressors for mobile applications at Busworld. The company driving innovation in the refrigeration and air conditioning sector brought two new series of scroll compressors to the trade fair.

One special feature is that the ELV21 and the ELV51 are significantly more compact and more lightweight – while providing at least as much or even more performance than previous models. At the same time, they offer outstanding efficiency and versatility. This has been made possible by their modern aluminium design and the ideal combination of scroll spiral, electric motor and frequency inverter. All three of these components have now been brought together in one compact system. Just as powerful as their predecessors but much quieter, with less vibration and more compact – that's how the new scroll compressors may be described. The ELV21 is eight kilograms lighter and 17 centimetres shorter than the ECH209Y. The ELV51 is a hit thanks to its low total weight of just 20 kilograms and it is ten centimetres shorter than the EL7 series. This opens up options for completely new applications.

For example, the ELV21 can be used in compact air conditioning systems in construction and agricultural machinery as well as in camper vans. With its low height, the ELV21 is ideally suited for roof-mounted and frontal systems. Despite their compact design, the SPEEDLITE compressors are very powerful. The ELV21 is available in two flow rates, with a cooling capacity from 0.9 kW to 3.5 kW (ELV2109) or from 0.9 to 5.5 kW (ELV2113). The larger ELV51 achieves a cooling capacity of between 7.5 kW and 27 kW. ■

Nominations now open for IOR council trustees



The IOR (Institute of Refrigeration) Council (UK) is inviting the membership to make nominations for individuals to join the council from April next year. Nominations must be made using a Nomination Form sent to the Institute by 31st December 2015.

There will be two vacancies on council from April 2016. In accordance with their constitution, every year two of the six elected members stand down and two new members are appointed by election of the membership.

If anybody would like to get more closely involved in the institute by joining the Executive Council then there is a guidance about the role of elected council members at www.ior.org.uk/executivecouncil. Interested candidates can also speak to one of the existing council members or the IOR Secretary Miriam Rodway to find out more. ■

Shecco releases business directory for China's natural refrigerant industry

As part of its premium GUIDE+ series of in-depth market intelligence publications, market accelerator Shecco has published its first-ever business directory on China's Natural Refrigerant industry that is now available for purchase. Commenting on the release of 'GUIDE+ Directory of Natural Refrigerant Businesses in China,' Nina Masson, Deputy Managing Director, Shecco, said, "The natural refrigerants market is a global one and we are now seeing more multinational collaboration than ever before. With more than 200 companies listed in this directory, we are certain that businesses all around the world can take advantage of the burgeoning natural refrigerant market in China." "China is one of the fastest growing markets for the HVAC&R industry, both in terms of using and producing solutions avoiding the use of fluorinated gases. Launching our first 'business directory' for the dynamic natural refrigerant market made therefore perfect sense," she adds. ■

Panasonic signs solar leasing agreement with Sunseap

A view of the PAPRDSG's Singapore site...

Panasonic Appliances Refrigeration Devices Singapore (PAPRDSG) has signed a new 25-year leasing agreement with Sunseap, the country's largest clean energy provider, on a 2.4 megawatts (MW) photovoltaic (PV) system at the factory.

This brings the factory's total solar capacity to 2.8 MW. At its peak, the factory's PV system is expected to power, on average, 10% of its entire operations.

Nineteen per cent module efficiency marks the largest solar system installation on a single site for the consumer electronics sector in Singapore, covering more than 20,000 square metres of roof area across five factory buildings. PAPRDSG will begin drawing from the 2.4 MW PV system within this year.

Atsunao Terasaki, Managing Director, Panasonic Appliances Refrigeration Devices Singapore, said, "As one of Panasonic's Eco Model Factories in Southeast Asia, PAPRDSG's focus has long been to ensure that we adopt green manufacturing practices and work towards environmental sustainability. We recognise that industries are huge consumers of energy. Through our solar leasing collaboration with Sunseap, we not only hope to reduce carbon footprint, but also we drive uptake of solar energy in businesses and industries." ■

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7 Day Schedule	ETHYLENE	16 °C	16 °C	16 °C	16 °C	16 °C	14 °C	14 °C
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Governments agree for formal negotiations on HFCs

The North American Sustainable Refrigeration Council (NASRC) is shaping a more sustainable, climate-friendly future for supermarket refrigeration. Leading companies from all sectors of the United States' supermarket refrigeration industry have formed an association to promote the transition to 'natural' refrigerants.

Members of the new NASRC include service contractors, systems manufacturers, policy specialists, component manufacturers and supermarket end-users.

The companies involved are Whole Foods Market, Hillphoenix, Danfoss, Carter Retail Equipment, True Manufacturing, Parker Hannifin, KW Refrigerant Management Strategy and Source Refrigeration & HVAC Inc.

The technology, best practices and manpower exist to greatly reduce the impact that supermarket refrigeration has on the environment, but right now lots of hurdles stand in the way. NASRC is an action-oriented non-profit that wants to see natural refrigerants succeed, specifically within supermarket refrigeration.

Natural refrigerants have orders of magnitude less impact on the climate system than traditional fluorocarbon refrigerants. NASRC aims to prove how forward-looking thinking can lead to favourable outcomes for industry and the environment. "The purpose of the organisation is to bring together stakeholders who believe that advancing natural refrigerants is a win-win for the environment and business," said NASRC's Executive Director Liz Whiteley. ■

Companies covered in this issue

New Zealand's authority approves Beijer Ref's acquisition of Realcold

Beijer Ref's acquisition of Realcold has been cleared by the Commerce Commission in New Zealand. The approval of the acquisition means that the integration of Realcold into Beijer Ref´s existing business, Patton, can be started in both New Zealand and Australia. Realcold will be included in the accounts of Beijer Ref as of the fourth quarter of 2015.

Beijer Ref AB is a technology-oriented trading group, which, through added-value products, offers its customers competitive solutions within refrigeration and climate control. Beijer Ref is one of the largest refrigeration wholesalers in the world, and is represented in Belgium, Denmark, Estonia, Finland, France, Ireland, Italy, Latvia, Lithuania, Poland, Holland, Norway, Romania, Switzerland, Slovakia, Spain, United Kingdom, Sweden, the Czech Republic, Germany, Hungary, South Africa, Mozambique, Zambia, Botswana, Namibia, Malaysia, Thailand, India, Australia and New Zealand. ■

AMCA, CCCA sign MoU in Port Douglas

The Air Conditioning and Mechanical Contractors' Association of Australia (AMCA) and the Climate Control Companies Association (CCCA) entered into a Memorandum of Understanding in a formal ceremony conducted at the AMCA National Conference held in Port Douglas.

The memorandum was signed off by the Chair of CCCA – Matthew Darby and President of the AMCA – Chris Wright.

The agreement recognises the opportunities for both organisations in the mechanical services and air conditioning industry, in their respective countries. The Memorandum of Understanding was read out to an assembled audience of over sixty mechanical services contractors, conference sponsors and other AMCA member delegates, who witnessed the signing ceremony.

The Memorandum of Understanding reflects the similar intent of a range of international cooperation agreements that exists between the Australian and New Zealand governments, professional bodies and industry associations.

It is being established to: encourage information exchange between both organisations; assist in the development of policy responses to key industry issues; extend and expand member services; take up any opportunities for economies of scale in member service delivery; and build on the existing intent of other inter-government economic agreements between Australia and New Zealand. ■

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Jamshad Padanchery

Jamshad will provide technical and commercial support to the manufacturer's business partners and clients...

Airedale appoints Padanchery in Dubai Airport Freezone office

British cooling expert, Airedale International has appointed one more engineer to its Dubai Airport Freezone office, which was opened in early 2014. The new Sales Application Engineer, Jamshad Padanchery, joins Airedale with two years' experience gained at HVAC and building services specialist, Gulf Engineering System Solutions (GESS).

In line with increased demand for Airedale products in the gulf region, Jamshad will provide technical and commercial support to the manufacturer's business partners and clients in all six countries of the Gulf Co-operation Council (GCC) countries, in co-ordination with Sales Application Engineer, Nissar Rahman, and Regional Manager Andrew Walker.

In the words of Commercial Director, Mark Viner, "Airedale's precision cooling expertise and British engineering are highly regarded within the GCC territories – and the Middle East, and have seen us win some very high profile projects including the prestigious World Trade Centre development in Dubai – and the contract for the supply of computer room air conditioning units to the recent redevelopment of the Royal Saudi Air Force complex in Riyadh. Airedale has a terrific pedigree in developing innovative technology solutions for the global marketplace." ■

John Lanier

"John Lanier's expanded role at AHRI will help us meet the many challenges that come with the growth and success..." said Stephen Yurek ...

AHRI appoints Lanier as Chief Operating Officer

The Air-Conditioning, Heating, and Refrigeration Institute (AHRI) has announced that John Lanier, Chief Operating Officer (COO) of North American Technician Excellence (NATE), will perform the same role for AHRI, overseeing Public Affairs, Technical Services, Regulatory & International Policy, and Information Technology, while continuing to lead NATE.

"John Lanier's expanded role at AHRI will help us meet the many challenges that come with the growth and success we have seen and expect to experience in the coming years," said AHRI President and CEO Stephen Yurek. "I'm excited that he has agreed to take on this challenge, and I look forward to having him apply his many skills and his focus to some of our most important programmes."

Lanier will manage AHRI's certification programmes, as well as standards, software development, regulatory and international policy, communications and IT. Lanier, who was named COO of NATE in 2013, oversees the management and execution of all of NATE's programmes. He has held a variety of executive leadership roles, most notably as Senior Vice President of Operations at the National Federation of Independent Business.

He will report to Yurek, who will continue his role as President and Chief Executive Officer of AHRI. ■

Marc Bitzer

"Marc is an exceptional leader at Whirlpool Corporation with broad global experiences..." said Jeff M. Fettig...

Whirlpool Corporation promotes Bitzer

Marc R. Bitzer of Whirlpool Corporation has been promoted to the rank of President and Chief Operating Officer. In this new role, Bitzer will be responsible for all global operations. Bitzer has also been appointed to the Whirlpool Board of Directors.

Whirlpool Chairman and CEO, Jeff M. Fettig said, "Marc is an exceptional leader at Whirlpool Corporation with broad global experiences and unique qualifications to assume his new position. Marc has consistently demonstrated that he is an outstanding leader who has delivered strong results in his previous roles in both North America and Europe. During the past year he and our European team have done an excellent job in integrating our major acquisition in Europe."

Bitzer was named Vice Chairman in November 2014, with accountability for the company's North American and European businesses. Prior to this assignment, he served as President of Whirlpool North America (NAR) and Whirlpool Europe, Middle East and Africa (EMEA). He joined Whirlpool Europe in 1999 as Vice President of the company's Bauknecht brand group. He became Senior Vice President of Marketing Sales and Services for Whirlpool Europe in 2000, and was named President of Whirlpool Europe in January 2006. ■

Asia Pacific Holds High Potential For Growth Of The RDC Market

Owing to the demand from medium-sized and small stores that involve small budget floor space and power, demand for the plug-in RDCs is predicted to rise faster in comparison with that of the remote RDCs...

Refrigerated Display Cases/Cabinets (RDCs) are refrigerators or freezers that have been particularly designed for displaying as well as storing temperature-sensitive food products – and products that require to be stored frozen or chilled. Owing to the increasing number of cafes, bakery outlets, restaurants, and retail stores, there has been a shift in the food habits of people, which has stimulated the market for RDCs. Additionally, increase in disposable incomes has also augmented the demand for RDCs.

According to a new Transparency Market Research report, titled 'Refrigerated Display Cases Market (Plug-in and Remote) - Global Industry Analysis, Size, Share, Growth, Trends and Forecast 2013 – 2019,' the global RDCs market will expand at a CAGR of 9.6% from 2013 to 2019. In 2013, the market stood at US$8,780.3 million, and is anticipated to reach US$16,283.4 million by 2019.

In terms of product types i.e., on the basis of the refrigeration system, the RDCs market is segmented into plug-in RDCs and remote RDCs. Owing to the demand from medium-sized and small stores that involve small budget floor space and power, demand for plug-in RDCs is predicted to rise faster in comparison to remote RDCs. Additionally, benefits such as low installation time and portability of plug-in RDCs, due to which they can be moved according to a store plan, are amongst the factors further fuelling the demand for plug-in RDCs.

In terms of product designs, the RDCs market is segmented into horizontal-top open, vertical- front open, and others including semi-vertical and hybrid RDCs. Amongst these, the vertical-front open RDCs are predicted to witness higher demand in comparison to all the other designs owing to the fact that these RDCs, just like plug-in RDCs, are more portable. The unique feature of vertical RDCs in displaying the items in a vertical fashion, by occupying relatively less space and without compromising on the number of items being displayed, is amongst the top reasons for the increase in their demand from small stores.

In terms of geography, the RDCs market is segmented into Europe, North America, Asia Pacific and Rest of the World (RoW). Amongst these, Asia Pacific holds high potential for growth of the RDC market, as this region's economic growth is on the rise. Here, the commercial sector, particularly restaurants, catering, hotels and retail, is expanding swiftly, resulting in the increased demand for RDCs from this region. On the other hand, Europe and North America are witnessing huge competition owing to these regions having a great dominance of brands, namely Omega Refrigeration, Arctica Showcase Canada Ltd., and ISF Group, among others. ■

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Smart Preventative Maintenance

Manufacturers, especially in times of increasing energy costs, need to respond to global competition and manufacturing sourcing. Therefore, they need to look for lean manufacturing solutions based on justifications to reduce cost, eliminate risks, improve system design and help manage maintenance to maximise reliable production...

Mitsubishi Electric's Smartcheck solution helps prevent unplanned shutdowns, and so, saves downtime costs...

Condition Monitoring on the shop floor together along with Energy Monitoring should therefore be integrated with the Enterprise system. To optimise maintenance service there must be complete transparency throughout the enterprise, from shop floor to top floor.

Mitsubishi Electric's Smart Check solution is an independently operating, compact, modular measurement system for the permanent monitoring of machines / systems with mechanical bearings. The solution is available in the market for use as an individual monitoring device for smaller standalone units as well as for integrated concepts such as comprehensive condition monitoring of machines and manufacturing processes. According to Mitsubishi Electric, it takes intelligent machine monitoring to a new level. Compact, easy to operate and at a unique price/performance ratio, it makes the online monitoring of compressors, pump sets and gearboxes very cost-efficient.

This innovative real time monitoring system employs ground-breaking technologies and trend-setting functions, which include the combination of information provided by the measurement of classic parameters and vibration based process parameters. The measuring system detects potential damage to machines early and reliably helps in avoiding unplanned shutdowns and costly secondary damage.

The scalable monitoring system provides high system availability and contributes towards ensuring trouble-free, continuous operation. The overall system efficiency and energy efficiency are also very closely linked. Furthermore, the solution allows predictive maintenance to be carried out. This not only reduces lifecycle costs but also plays a role in reducing energy consumption thanks to its ability to detect early signs of wear.

Completed by a unique full service around machine diagnosis and rolling bearings, the Mitsubishi Electric's SmartCheck solution makes a valuable contribution to optimize processes and reduce Life Cycle Cost (LCC) as well as Total Cost of Ownership (TCO).

Case Report

One recent successful application involved a sewage treatment plant with the capacity to serve 34,000 residents. At the secondary sedimentation tank three pumps are connected to the return-activated sludge pumping station. Within one year, one of the three screw pumps failed due to bearing damage. This resulted in costly, time-consuming repair work and loss of service. A Mitsubishi Electric's SmartCheck solution was installed on the three pumps to help solve the problem re-occurring in the future. Now the SmartCheck devices measure the vibrations and temperature of the gearboxes. In the event of changes in vibration, the system provides data at an early stage about these deviations, which can be the initial signs of potential damage. In the event of irregularities, a detailed error message is sent to the customer's control system via the Mitsubishi Electric control unit. This ensures that the problem can be rectified quickly and in a target-oriented manner.

Advantages

Smartcheck supports the concepts of transparency through different levels of measurement. Information can be automatically transferred to multiple information levels. This allows Mitsubishi Electric to provide a holistic approach to assess the condition of the building or plant. ■

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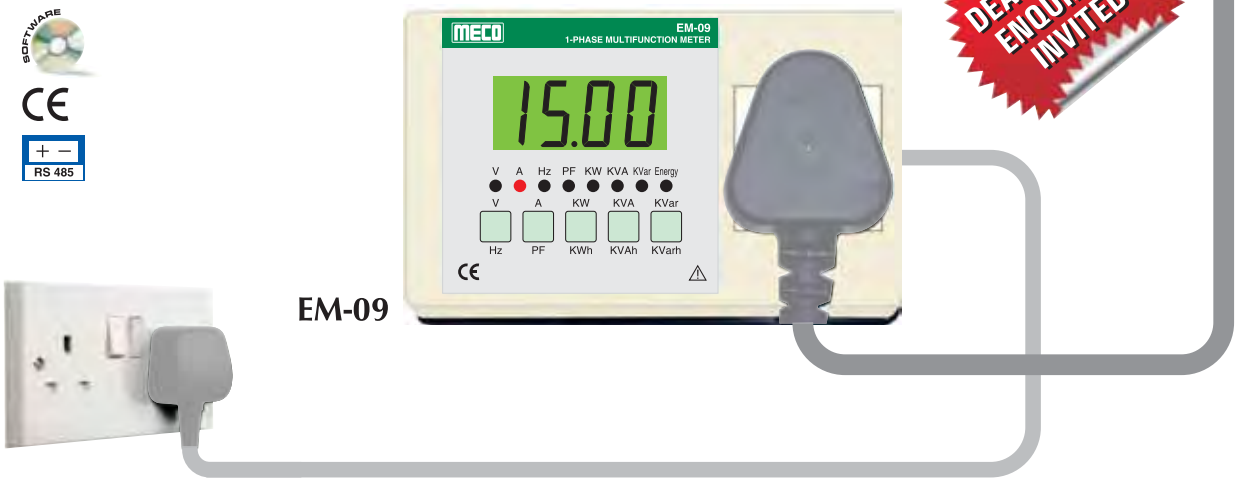

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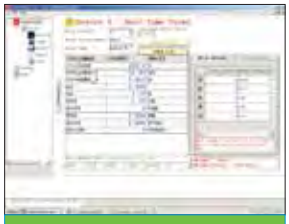
- Quality Check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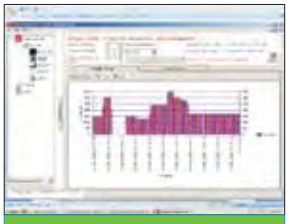
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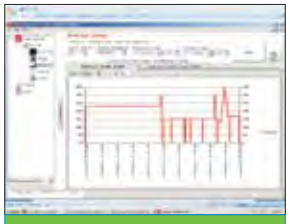
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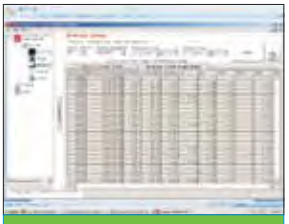
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Cooling Pallet Shipper Frizbox

A Temperature-Controlled Multi-Purpose Solution

The field players look for the most optimised solutions in terms of performance and cost to secure the cold chain. Depending on the transportation means, logistical constraints and costs, several systems are used to ship temperature-sensitive products...

Subject to strict regulations and to stringent requirements, the distribution of temperature-sensitive health products is experiencing strong growth and considerable progress. The field players look for the most optimised solutions in terms of performance and cost to secure the cold chain. Depending on the transportation means, logistical constraints and costs, several systems are used to ship temperature-sensitive products:

- Dynamic system (actif), equipped with a refrigeration unit requiring a power source during transport
- Static system (passive) in the form of insulated containers equipped with eutectic plates or other phase change material, or dry ice
- Other systems: thermo-chemical refrigeration, semi-dynamic refrigeration using dry ice and a fan operates with a power source.

The temperature-controlled container 'Pallet Shipper Frizbox' presented in this article is a static solution suitable for all transportation means. It allows to ship a full pallet of products between +2 and +8°C or between +15 and + 25°C or also below -35°C.

Description of the Pallet Shipper Frizbox

Insulating material

The walls of the container are made from closed cell, high density, rigid polyurethane panels (32 kg.m^{-3}), without CFC and HCFC. With low thermal conductivity (less than 0.023 W.m^{-1}) and good mechanical strength, the panels offer good insulation, a sufficient strength and an optimised weight/volume ratio. Both faces of the panels are coated with a multilayer aluminium coating constituting an effective radiation and a vapour barrier. The outer face of the coating can be aluminised or kraft paper. The wall thickness varies according between 40 and 80 mm. The good assembly of the container allows avoiding of thermal bridges.

With an internal volume of more than 1900 litres, the container can carry an entire Europe or US pallet. It simplifies the loading procedure...

Internal arrangements

Internal compartments are arranged on the lateral sides and on the top to insert the gel or PCM trays (the cold source) before or after loading the product palette (Figure 1). These arrangements allow to maintain the location of the cold source and to ensure the temperature homogeneity. To prevent that the product pallet damages the walls, the floor is completely covered with wood and the sides are also partially covered. The box is equipped with internal straps to attach the product pallet. For dry ice application, the inside of the container is equipped with a double wooden structure, completely covering the polyurethane. This structure protects the insulation and forms compartments to insert dry ice trays (Figure 1).

Outer packaging & opening of the container

The outer packaging is a double corrugated cardboard. The container is provided with a door allowing a full frontal opening. This ergonomic design facilitates operations and reduces loading times.

Pallet and external dimensions

The container is fixed on a specific pallet and it is designed to be shipped by air or truck. The external dimensions are 1520 x 1200 x 1600 mm (±5 mm). With an internal volume of more than 1900 litres, it can carry an entire Europe or US pallet. It simplifies the loading procedure and the logistics management. It can also be tailor-made.

(a) Gel/PCM version

(b) Dry ice version

Fig. 1: Pallet Shipper Frizbox, gel/PCM and dry ice version...

Cold source

The cold source is suited and adjusted according to the required temperature of the products to be transported. For the same insulated container, 0°C eutectic gel, +5°C and +21°C Phase Change Materials (PCM) and dry ice can be used.

+2/+8°C temperature range

To maintain products between +2 and +8°C, eutectic gel packs 'Rigid Snowgam' with 0°C melting temperature are used. The composition of the eutectic gel provides a melting duration 33% higher than water. The gel packs are distributed on trays and inserted in specific compartments to ensure the homogeneity of the temperature and to avoid cold shock. The trays of gel packs are inserted frozen for hot external temperature profiles and inserted liquid stabilised at +5°C for cold external temperature profiles. The location of gel packs ensures reproducible thermal performance. Trays of PCM with a melting temperature of +5°C can be used alone or in combination with 0°C gel packs for mixed hot/cold external temperature profiles.

+15/+25°C temperature range

To maintain products between +15 and +25°C, PCM packs, Rigid Snowgam with a melting temperature of +21°C are used. As in the previous case, the PCM packs are distributed on identical trays and inserted in the same compartments. They are inserted frozen at +15°C for hot external temperature profiles and inserted liquid at +25°C for cold external temperature profiles.

Working principle

As with all refrigerating equipment, the container is sized on the basis of a heat balance. The insulation thickness and the gel/PCM packs are determined according to the heat exchange with the surrounding environment and inside the container. The thermal performance tests allow the validation of the configuration for the required conditions. The principal design parameters are:

- **Product requirements:** The product temperature range is the primary factor to define the need. The container is designed to transport an entire pallet of products, for the most requested temperature ranges: + 2/+8°C, +15/+25°C and below -35°C.

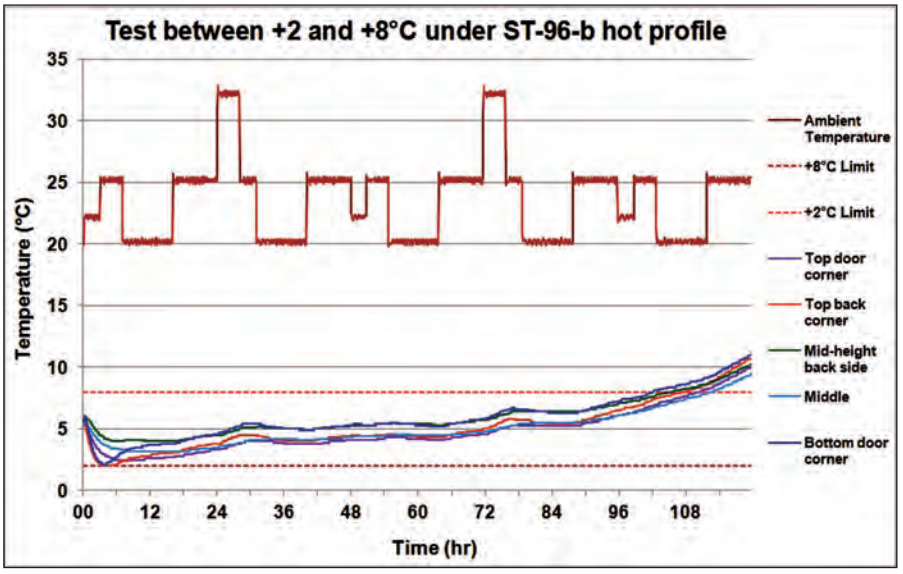


Fig. 2: Test between +2 and +8°C: 102 hours under ST-96-b profile...

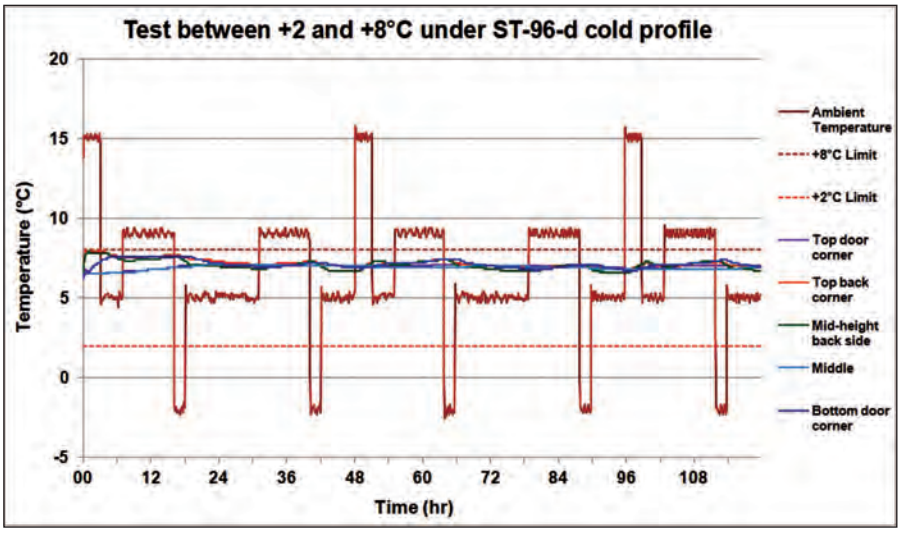


Fig. 3: Test between +2 and +8°C : minimum 120 hours under ST-96-d profile...

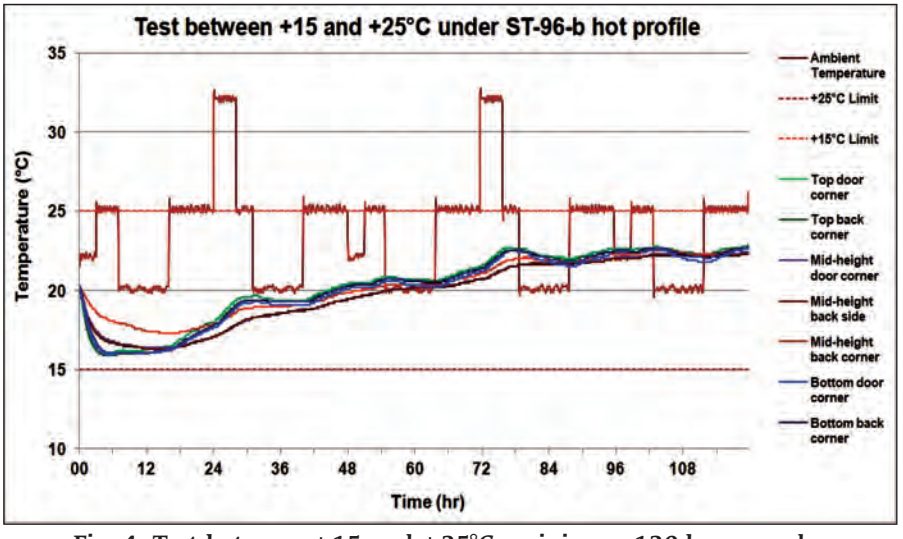


Fig. 4: Test between +15 and +25°C : minimum 120 hours under ST-96-b profile...

- **Logistics constraints:** The logistics circuit is a series of open and closed environments. Each segment is characterised by its temperature and its duration. The required performance of the container corresponds to the total time from the loading of the box to arrival at its destination. The duration is calculated for the worst case of the shipment.

The 'Pallet Shipper Frizbox' is qualified to maintain the products between +2 and +8°C and between +15 and +25°C for 100 to 120 hours, under standard temperature profiles required by the 'NF S 99-700' standard. It is also qualified to maintain the products below -30°C for at least 120 hours under a specific profile.

Performance Qualification Tests

The 'Pallet Shipper Frizbox' has successfully passed the mechanical and the thermal performance tests.

Mechanical tests

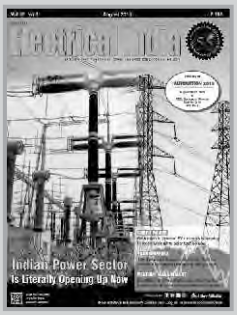
The mechanical tests are performed according to ASTM D4169 and ISTA 3E, for loads of 500 kg and 1000 kg. Simulating impacts during handling and transport, these tests consist of the following sequences:

- Thermal pre-conditioning test (temperature and humidity): The container is tested with only dry ice and with dry ice and the product pallet. This test lasts 2 hours and precedes the other mechanical tests sequences.
- Shock tests and impact on an inclined plane: They are performed to simulate the impact on various sides during handling of the container.
- Drop rotational tests on various edges of the container.
- Random vibration tests.

The results of these tests showed that the container provides a sufficient level of mechanical security for products at air or road transport.

Thermal performance tests de between +2 and +8°C

To maintain health products between +2 and +8°C, the container is equipped with 15 trays of eutectic plates 'Rigid Snowgam', inserted in the lateral compartments and on the top. The thermal performance tests are performed according to the NF S 99-700 standards, for ST-96-b and ST-96-d the temperature profiles. The eutectic plates are



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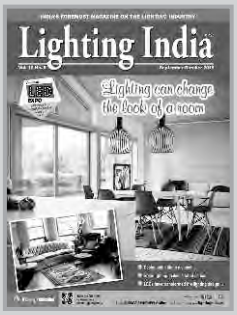

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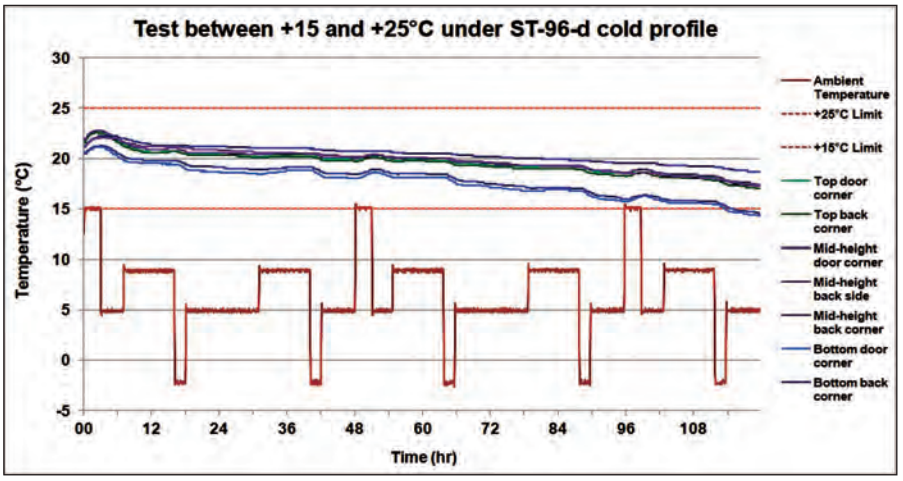

Fig. 5: Test between +15 and +25°C : 100 hours under ST-96-d profile...

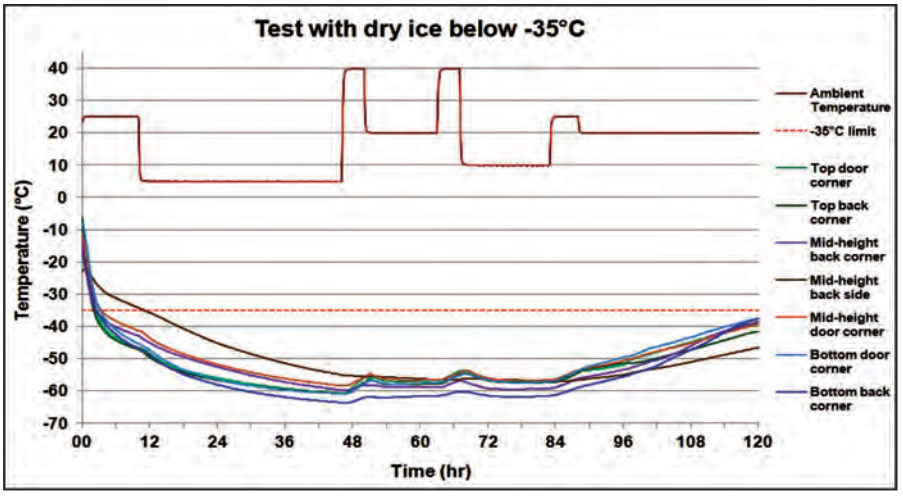

Fig. 6: Test below -35 °C : 120 hours under a specific profile...

inserted frozen at à -20°C for the hot profile and inserted stabilized at +5°C for the cold profile. The figures 2 and 3 show that the 'Pallet Shipper Frizbox' keep products between +2 and +8°C for 102 hours under the ST-96-b hot profile and for minimum 120 hours under the ST-96-d cold profile.

Thermal performance tests de between +15 and +25°C

The container is equipped with 15 trays of +21°C PCM 'Rigid Snowgam' to maintain health products between +15 and +25°C under the hot profiles. The trays are inserted solidified at +15°C, in the lateral compartments and on the top. For the cold profiles, 19 trays of +21°C PCM are inserted with liquid at +25°C, in the lateral compartments, in the bottom under the products and on the top. The thermal performance tests are performed according to the NF S 99-700 standards, for ST-96-b and ST-96-d the temperature profiles. The figures 4 and 5 show that the "Pallet Shipper 'keep products between +15 and +25°C for 120 hours under the ST-96-b hot profile and for 100 hours under the ST-96-d cold profile.'

Thermal performance test below -35°C

The test below -35°C is performed with 200 kg of dry ice, which corresponds to the maximum weight allowed in air transport. This test simulates the extreme conditions expected during the transportation of frozen health products between Europe and the United States. The container is first loaded with dry ice trays and then transported in freezer truck to warehouse where the products are loaded. The qualification test is performed for a specific 120 hours temperature profile, variable between +5 and +40°C. This profile starts after the loading of the product pallet. The cool products and then keep them below -35°C. It should not present any physical damage at the end. Thermal and mechanical acceptance criteria are determined. Figure 6 shows the results of thermal performance.

Logistics advantages

The container 'Pallet Shipper' offers logistics, economic & ecological advantages.

- **Economic aspect:** Compared to the dynamic and semi-dynamic systems, it is an energy independent solution and does not require complicated logistics. Compared to small boxes, it offers more space and a better ratio between the payload and the external volume. It is a cost-effective compromise reducing the overall logistics cost including the price of the container and the cost of use, especially for air transport.
- **Ergonomic aspect:** the loading an entire product pallet avoids the repackage of products and minimises the handling operations. It reduces the preparation space & facilitates the logistics organisation.
- **Ecological aspect:** The high volume of the container reduces the consumption of energy and materials needed for the manufacture and the use of the solution, which is part of an eco-design approach.

Conclusion

The temperature-controlled container 'Pallet Shipper Frizbox' can carry a full pallet (Europe or US) of products. It is an ergonomic, cost-effective and ecological solution. It facilitates the logistics management and reduces the preparation time, the total logistics cost and the impact on the environment. The high thermal inertia of the load increases the thermal performance. The 'Pallet Shipper Frizbox' is also a versatile solution suited for air or road transport. Depending on the configuration, it is used to ship health products between +2 and +8°C or between +15 to +25°C or also below -35°C, for up to 120 hours. It also maintains the physical integrity of the products. ■

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Industry Utility Can Utilise Ambient Wet Bulb To Improve Efficiency

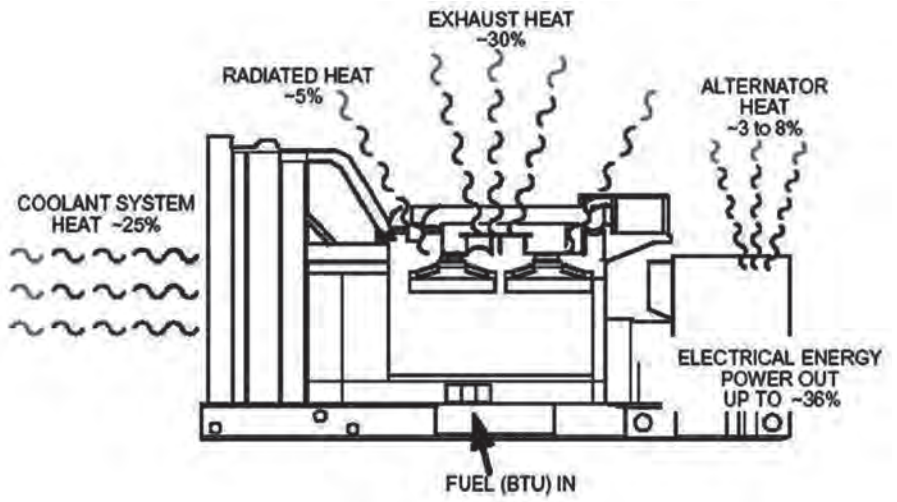
DG house, compressor house etc. need excess amount of air changes and positive cross ventilation – whereas it is not there now and energy experts tolerate 5°C above ambient is max allowable temperature inside as one of the better DG house-keeping practices...

Any industry utility can make use of the surrounding 'Ambient Wet Bulb' temperature and improve its heat transfer energy efficiency in its sub systems. Irrespective of any location, in the utility house like the compressor house, DG shed, HVAC outdoor condenser etc..., the localised heat surrounding the machines is always higher than the ambient temperature and there's low RH in any season of the year in India. The heat transfer across any HX can be improved by retrofitting this evaporative mist cooling retrofit.

Existing Utility's Heat Exchangers' Working Condition Now

- We can see the sankey energy flow diagrams of DG set, screw air compressor utility now. The heat rejected/exhausted by the DG set/ compressor is revolving inside the DG house only making the house hotter as DG/ compressor runs for more hours.
- This is why the industry is running practically, with open doors, their compressor- in-hood/ DG set-in-hood and keep the area fully open ventilated on all sides. In spite of that, the engine's hotter skin air is only reaching the skid-mounted finned radiator. So many industries have opted for remote coil cooler/ water cooled heat exchanger like cooling tower etc to improve the DG set efficiency drastically and in turn better UPL.
- Why has the same industry not taken up this HX relocation from their existing compressor packages? And why is the compressor OEM

Courtesy: Cummins DG manual



DG radiator heating the surroundings inside...

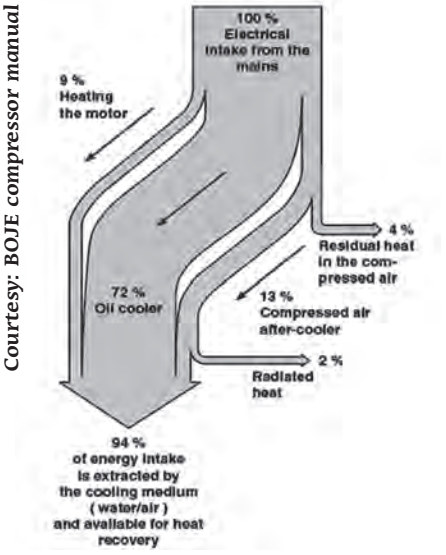
not suggesting this relocation as site option for their healthy compressor workings? Any compressor house, wherein the screw compressor kept in acoustic hood and the refrigerated dryer, their hot exhaust air is short circuited to air intake suction and as suction to the finned heat exchangers and thus, reducing the compressor and dryer efficiency due to higher temperature air inlet and poor heat transfer.

- The reason for the above is that as well, the radiator/air operated heat exchangers are kept inside the hood and this condition heats up the inside-hood further and the totally the utility house.
- DG house, compressor house etc. needs excess amount of air changes and positive cross ventilation – whereas it is not there now and energy experts tolerate 5°C above ambient is max allowable temperature inside as one of the better DG house-keeping practices.
- Since the above is not possible, many industries started putting Turbo vents on Compressor, DG shed roofs. This definitely improves the house inside ambient parameters.
- The HOC i.e., the Heat of Compression liberating from the air compressor element is as such, heating up the compressor element inside and outside in the compressor hood and house. The same HOC happens in DG set combustion chamber and hence the heat dissipation is more from the engine.
- For sustainable efficiency in compressor or DG set, the heat transfer across the finned HX is a critical parameter. If the heat transfer is not done effectively, the compressor / DG performance will be affected and their health will deteriorate – and de-rating too will happen earlier than their life cycle.

How to address the internal heat generation in compressor house?

- Inside the screw compressor hood, the air operated HX/finned Radiator must not take hood-inside air as suction as compressor inlet and to cool the post-compressed air/lub oil cooling.
- The finned radiator surface needs to sit on hood side wall and to face outside ambient surrounding.
- Provide a physical barrier or insulated partition so that the hot exhausted air from top is prevented to enter back to the air intake suction side and as well not to enter the air & oil cooler Radiator fins.
- Now the air surrounding compressor has always low RH and high temp and it's dry.
- Provide Box type Pre-filter on the HX outer face for daily scrub cleaning the same inside & outside.
- Now we can think of adiabatic mist cooling of HX so as to utilise ambient wet bulb at that location.
- Fix water supply piping along with few nozzles near the bottom of HX facing the finned outer surface.
- Make use of SS impulse piping for water and air supply from air receiver to this nozzle piping.
- Now we can provide mist using pneumajet concept i.e., water and compressed air mixed at the nozzle that can spread water mist on the finned faces and cool the fins by evaporative cooling.
- This is simple zero cost in-house implementable exercise which can be done instantly now.
- Other alternatives are costly retrofits like mist fogging on HX, adiabatic cooler retrofit outside house.
- Water supply either can be RO /DM water from outside or the air receiver drain & filtered water.

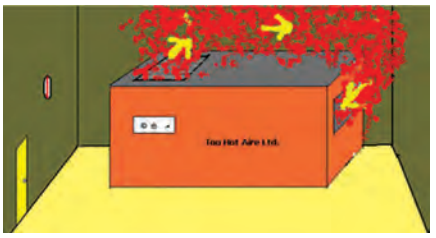
Courtesy: BOJE compressor manual



The heat balance of a compressor station...

We can provide mist using pneumajet concept i.e., H_2O and compressed air mixed at the nozzle that can spread H_2O mist on the finned faces and cool fins...

Courtesy: Imported Compressor manual



- The same water can be cooled before; using spiral SS tubing immersed in a water vessel at cooler location before misting through nozzles to achieve better heat transfer across the HX.
- This can be done on ref. dryer as well and this will reduce Freon compressor discharge pressure quickly.

How to address the internal heat generation in DG house?

- The DG shed too needs to be addressed like this adiabatic mist cooling retrofit...
- First, completely removing the hot exhausted air from the DG set and not to short circuit to inside.
- Secondly isolating radiator within the house by physical barrier from engine heat not to reach HX.
- Thirdly provision of ambient surrounding air to HX by providing barrier and ducting to fresh air.
- Fourth provision of adiabatic cooling to the Engine HX and to the Diesel Return line HX radiator cooling by air and water (Industry has understood now that Diesel input to engine when maintained at 40°C < neither at 30°C or at 50°C> gives optimum viscosity to diesel to engine and thus, in giving better UPL)

How to address the internal heat generation in coil cooler / HVAC outdoor?

- Please think of the old window AC where

Remote coil cooler to DG 1000 KVA size...

Courtesy: Evaporative cooling Retrofit by Manik Enggrs

the OEM gives a splash ring to the condenser fan blade so as to collect and throw water on the fins to provide Ambient wet bulb cooling. The same working we are trying to put in all the utilities to utilise the Ambient Wet Bulb parameter.

- Now few utility OEMs are providing professional evaporative cooling retrofit to the coil cooler utility.
- Some industries achieved huge water savings by converting their coil cooler with this retrofit.
- Triplex plunger water pump type can be used to achieve mist fogging through nozzles, alternately.

Conclusion

The industry can run the utility efficiently by providing the breathing space in between the equipments, orientation of the equipments such that equipments' exhaust is smoothly driven out of the utility house with minimum restrictions in between. Raise trees around the industry not only for greening purpose but also to reduce the Solar Heat on & around the sheds. Added to that, Heat reflective paint on the existing shed reduces Solar Heat gain. Ultimately, comforting the utility and improving the heat transfer efficiency of the machine's sub systems will improve the overall efficiency and increase the healthy life of utility. We must keep in mind that the individual sub system efficiency when multiplied will reduce the overall efficiency say, the kW/CFM or UPL when calculating the efficiency of compressor or DG set. ■

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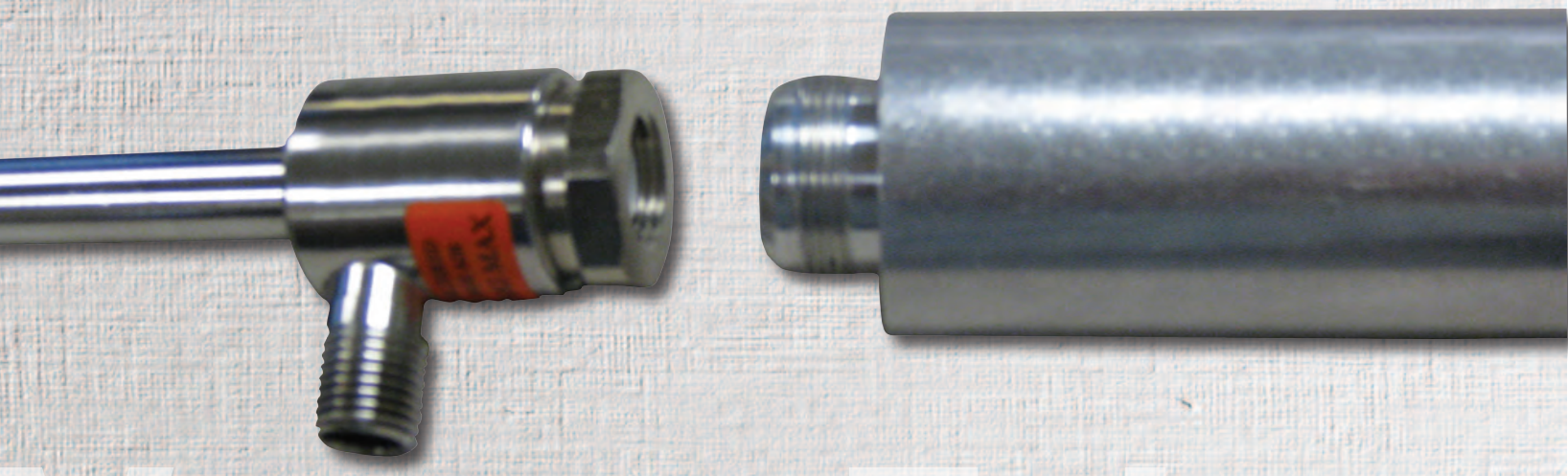

Vortex Tube

An alternative cooling solution

The vortex tube is interesting for new energy and refrigerating engineering as an experimental object with high development potential...

Vapour compression and vapour absorption refrigeration systems are two commonly employed conventional systems in almost all the major applications of refrigeration and air-conditioning. However, environmental problems such as ozone depletion and global warming caused due to CFC refrigerants have compelled us to look for other non-conventional systems. Vortex tube is one of the non-conventional systems where a natural substance like air is used as the working medium to achieve refrigeration. The experimental investigation shows that the carbon dioxide gives higher temperature drop than air and nitrogen. Maximum cold temperature drop is obtained at cold mass fraction of 60%. And the optimum geometrical parameter are L/D = 17.5 and diameter of cold end D_c = 4 mm.

Background

The refrigeration and air-conditioning industry is in an unprecedented transition phase, caused by environmental concerns with the impacts of refrigerant emission. To combat the twin menace of ozone layer depletion and global warming caused by synthetic refrigerants, there is increasing interest in environmentally safe alternative cooling solutions, based on the natural substances.

Vortex tube is one of the non-conventional systems where natural substance such as air is used as working medium to achieve refrigeration. Vortex tube has been used for many decades in various engineering applications. The vortex tube is interesting for new energy and refrigerating engineering as an experimental object with high development potential and as industry product with a quickly widening, unique combination of technological and operation properties because of its compact design and little maintenance requirements, it is very popular in heating and cooling processes.

Vortex tube refrigeration system

The vortex tube is a device without moving mechanical parts, which converts a gas flow initially homogeneous in temperature, into two separate flow of differing temperatures. The vortex tube contains the following parts: inlet nozzle, a vortex chamber, a cold-end orifice, a hot end control valve and

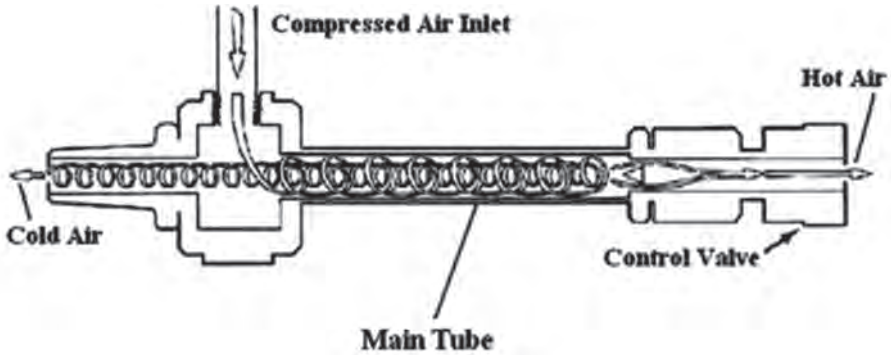

Fig. 1: Schematic diagram of Vortex tube...

a tube (Fig 1). It separates compressed gas stream into a low total temperature region and a high one. Such a separation of the flow into regions of low and high total temperature is referred as the temperature (or energy) separation effect.

When high-pressure gas is tangentially injected into the vortex chamber via the inlet nozzles, a swirling flow is created inside the vortex chamber. When the gas swirls to the centre of the chamber, it is expanded and cooled. In the vortex chamber, part of the gas swirls to the hot end, and another part exits via the cold exhaust directly. The part of the gas in the vortex tube reverses for axial component of the velocity and move from the hot end to the cold end. At the hot exhaust, the gas escapes with a higher temperature, while at the cold exhaust, the gas has a lower temperature compared to the inlet temperature. This was first discovered by Ranque in 1933 and by Hilsch in 1947. In memory of their contribution the vortex tube is also known as Ranque Vortex Tube (RVT), Hilsch Vortex Tube (HVT) and Ranque-Hilsch Vortex Tube (RHVT).

The use of vortex tube for small capacity applications is always justified if the compressed air is readily available. The vortex tube has number of features that make it attractive for industrial applications. Firstly, it has no moving parts and also quite reliable. Secondly, it requires no external power such as electricity or flames in order to operate, making it a comparatively safe system to achieve heating or cooling. The vortex tube is therefore ideal for use in environments where maintenance is difficult or where safety is critical.

A RHVT has the following advantages compared to the normal commercial refrigeration device: simple, no moving parts, no electricity or chemicals, small and lightweight, low cost, maintenance free, instant cold air, durable (because of the stainless steel and clean working media), adjustable temperature. But its low thermal efficiency is a main limiting factor for its application. Also, the noise and availability of compressed gas may limit its application. Therefore, when compactness, reliability and lower equipment cost are the main factors and the operating efficiency becomes less important, the RHVT becomes a nice device for heating gas, cooling gas, cleaning gas, drying gas, and separating gas mixtures, deoxyribonucleic acid (DNA) application, liquefying natural gas and other purposes.

Vortex tubes are categorised by their main technological and design features: flow configuration, the method of heat supply (removal), and how removal of low-pressure gas streams is organised. For the positioning of the cold exhaust, there are two different types: counterflow vortex tubes and parallel flow (uniflow) vortex tubes. Vortex tubes are classified as uncooled (adiabatic) and cooled (nonadiabatic) according to the method of heat supply (removal). On the other hand according to how removal of low-pressure gas streams is organised vortex tubes are called as dividing vortex tubes, self-evacuating vortex tubes and vortex ejectors.

An in-house facility is developed to carry out the experimental investigation of the vortex tube using different working substances; air, carbon dioxide and nitrogen. Vortex tubes of three different configurations i.e. 12.5, 17.5, 22.5 are selected and also the cold orifice diameter is 3mm, 4mm and 5mm are tested. A series of experiments are carried out to evaluate the performance of the system and to optimise the geometrical parameters.

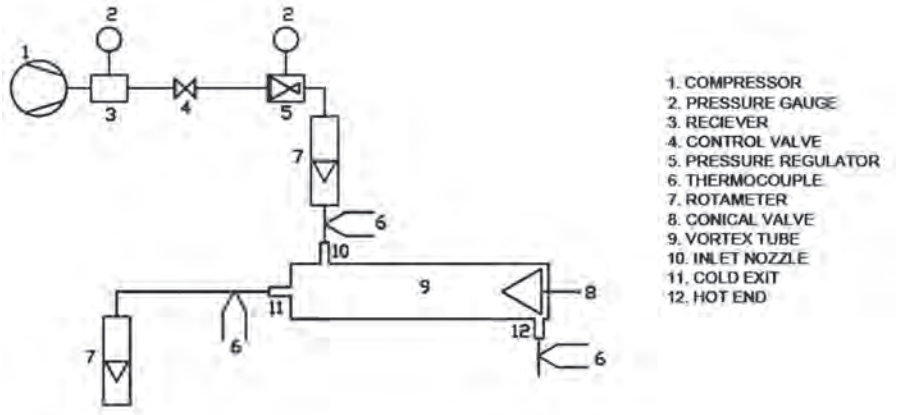

Fig. 2: Schematic diagram of experimental setup...

The schematic diagram of the experimental test facility is shown in Fig. 2. Compressed air from the compressor (1) passes through the control valve (4) and pressure regulator filter section (5) and enters in the vortex tube (9) tangentially. To ensure the tangentially entry of the compressed air in the vortex tube to have proper swirling of the air special care was taken. The compressed air expands in the vortex tube and divides in to cold and hot streams. The cold air leaves the cold end orifice (11) near the inlet nozzle (10) while the hot air discharges the periphery at the far end of the tube i.e., hot end (12). The control valve (needle valve) controls the flow rate of the hot air (8). Two rotameters (7) measures the mass flow rates of the hot and cold air. Thermocouples numbered (6) measure the temperature of the leaving cold and hot air in the vortex tube. The pressure of inlet gas is measured by pressure gauge (2) and the temperature of inlet gas is measured by thermocouple (6). To investigate the effect of geometrical parameters on the operational characteristics of vortex tube, vortex tubes with different tube sizes and different cold end sizes has been constructed and tested. Photograph of the experimental test facility

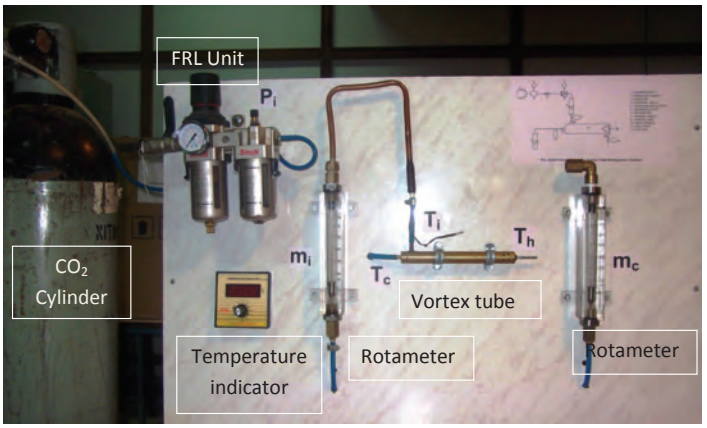

Fig. 3: Photographs of Experimental Setup and vortex tube...

and the three vortex tubes of having different configurations are shown in Fig. 3.

It is observed that for each L/D ratio, initially cold end temperature drop increases to maximum at an optimum value of cold mass fraction of 60% (Fig. 4). Maximum value of cold end temperature 29°C is obtained for L/D ratio 17.5 at 60 % cold mass fraction while with L/D ratio 12.5 and 22.5, maximum cold end temperature drop values are about 26°C and 24°C, respectively.

The highest temperature drop is experienced is 32°C at the inlet pressure 5 bar while 29°C and 26°C temperature drop were obtained at 4 bar and 3 bar pressure supply, respectively. The result shows that CO_2 produces higher cold end temperature drop than air and nitrogen. At pressure of 4 bar cold temperature drop for CO_2 , nitrogen and air are 23°C, 18°C and 20°C, respectively (Fig. 5).

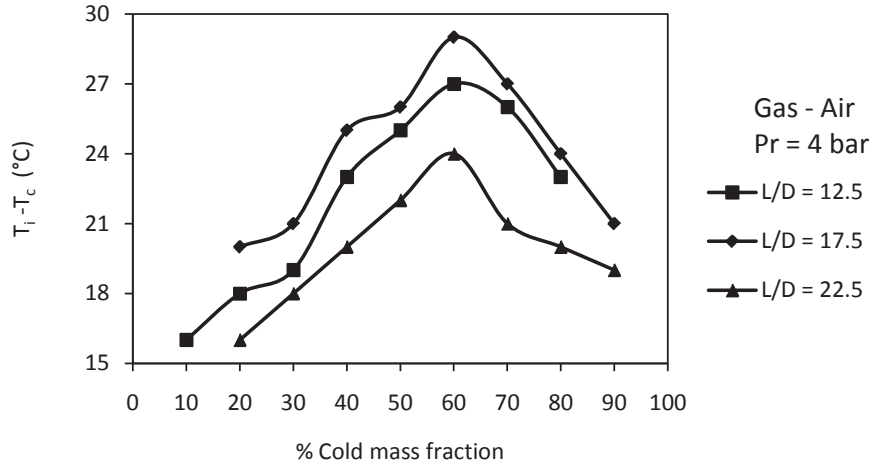

Fig. 4: Variation of cold temperature drop with cold mass fraction at various L/D ratios...

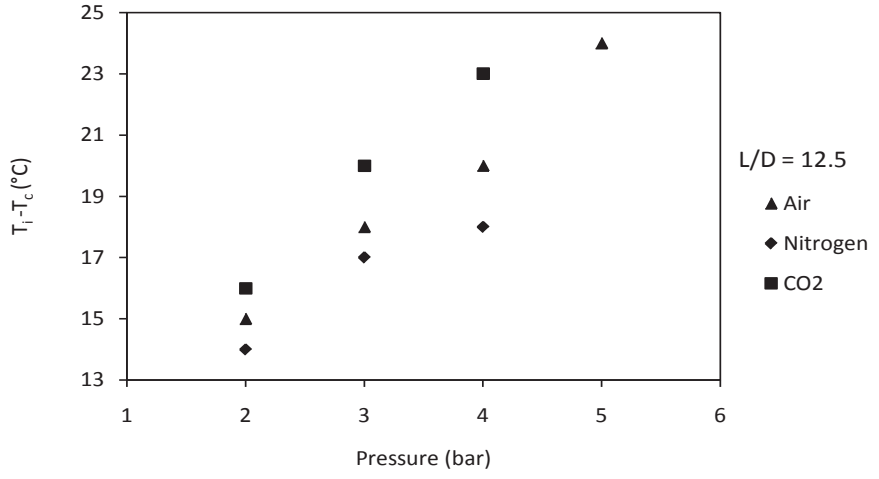

Fig. 5: Cold temperature difference comparison between air, nitrogen and CO_2...

Conclusions

Vortex tube refrigeration can be an effective non-conventional cooling technique to develop cooling effect. The vortex tube has a number of features that make it attractive for industrial applications – and ideal for use in environments where maintenance is difficult or where safety is critical. It is observed that the cooling effect produced by the vortex tube depends on properties of the gas, molecular weight and specific heat ratio. ■

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Design Of Cold Storage For Potato In India

The present status of India shows that it does not have a comprehensive cold chain network, However, it is estimated to grow to ₹ 32,000 Cr by the end of year 2015...

India has a unique geographical site and a wide diversity of soil, thus producing variety of fruits and vegetables like apples, grapes, oranges, potatoes, chillies, ginger, etc. Marine products are also being produced in large quantities due to large coastal areas. The present production level of fruits and vegetables is more than 100 million MT and keeping in view the growth rate of population and demand, the production of perishable commodities is to be increased every year. The atmosphere and rain is affected crop production so good quality and adequate production is a risk to the farmers.

The cold storage facilities are the prime infrastructural module for such perishable commodities. Cold storage is the modern method of food preservation over a considerable period at ambient conditions. The preservation of food due to refrigeration, which involves the use of low temperature to eliminating or retarding the movement of spoilage agents. The degree of low temperature required for adequate preservation varies with the type of product stored and with the length of time the product is to be kept in storage.

The cold storage is initially specified by its application for the preservation time of the product as short term and long term storage.

The present status of India shows that it does not have a comprehensive cold chain network. It is estimated to grow to ₹ 32,000 Cr by the end of year 2015.

As per the Report on Development of Cold Chain in India, the all India capacity utilisation is around 48%. The highest capacity of cold chain utilisation up to 92% is seen in Andhra Pradesh. Other states are Karnataka (60%), Maharashtra

...In your cold chain even if produce is only kept for few hours in cold storage...

Continent/ country	Area harvested (Million ha)	Production (million toones)	Yield (Tonnes/ha)	Seed production (Million tones)
Europe	8.29	140.40	16.94	25.48
China	4.60	75.05	16.31	2.80
Russian federation	3.15	37.00	11.75	9.50
India	1.40	25.00	17.86	2.10
Africa	1.15	13.74	11.91	1.27
USA	0.47	20.42	43.19	1.10

Table 1: Potato production in the year 2004...

(55%), Gujarat (51%) and Rajasthan (52%). Uttar Pradesh (46%), West Bengal (29%), Bihar (35%) and Punjab (43%) are lower than the national average. This is due to significant number of potato stocking cold storages in these states (which remain closed during the lean seasons). The capacity utilisation in Andhra Pradesh is higher due to storage of red chilies, usually stored round the year.

Potato production scenario of India

Potato is food securing crop like rice and wheat because of its contribution. Systematic potato research in India spanned over the last half-a-century of the 20th century in the past millennium. The Central Potato Research Institute (CPRI), which was established in 1949, has been mainly responsible for tremendous growth of potato production in the country.

The global scenario of top potato producing countries is shown in table 1. It indexed that the India is the fourth potato production country and Europe, China and Russia produced higher than India.

The table 2 shows statewise potato production in the year 2013-14. And the total production is increased by 41.55 million tones by 1.27 million tones (year 2004). The cold storage will provide the whole year availability and quality preservation of potato.

This article deals with the mathematical modeling for cold storage design and sample data required for design. This article also design the cold storage for various capacities in Agra location. The assumed data may not be correct up to the standard but it gives all the staires for design calculations.

Principle of refrigeration

Vapour Compression Refrigeration (VCR) cycle is used for cold storage. If the cooling

S. No.	State	Production	Share (%)
1	Uttar Pradesh	13,808.76	33.23
2	West Bengal	9,030.00	21.73
3	Bihar	6,536.00	15.73
4	Madhya Pradesh	2,322.40	5.59
5	Gujarat	2,267.38	5.46
6	Punjab	2,189.16	5.27
7	Assam	700.14	1.68
8	Haryana	696.51	1.68
9	Jharkhand	653.12	1.57
10	Chhatisgarh	556.4	1.34
11	Karnataka	539.7	1.3
12	Uttarakhand	409.62	0.99
13	Maharashtra	370	0.89
14	Odisha	249.76	0.6
15	Himachal Pradesh	243.26	0.59
16	Meghalaya	181.81	0.44
17	Tripura	153.8	0.37
18	Jammu & Kashmir	127.24	0.31
19	Tamil Nadu	115.63	0.28
20	Rajasthan	113.25	0.27
21	Telangana	98.58	0.24
22	Nagaland	65.1	0.16
23	Andhra Pradesh	51.06	0.12
24	Sikkim	49.86	0.12
25	Delhi	15.72	0.04
26	Kerala	8.11	0.02
27	Mizoram	3	0.01
28	Orissa	0	0
29	Manipur	0	0
30	Daman & Diu	0	0

Table 2: Potato production in India in the year 2013-14...

Potato is a food securing crop like rice and wheat. Systematic potato research in India spanned over the last half-a-century of the 20th century in the past millennium...

load is small then Freon based VCR cycle is applicable, and Ammonia based VCR cycle is used for large capacity and high load. Ammonia refrigerant is cheaper, easily available and is of high latent heat of evaporation but it has certain disadvantages like being highly toxic in nature. It also forms explosive mixture when mixed with oil containing high percentage of carbon. Rooms of different temperature must be separated by insulation and should be protected from moisture. Whenever possible, one coating of foam glass with vapour proof material should be used against the outside wall.

Figure 1 shows the schematic diagram and T-S diagram of a simple VCR cycle and it has four components as Compressor, Condenser, Expansion Valve and Evaporator. It is working between two pressure ranges named as follows: condensor pressure and evaporator pressure.

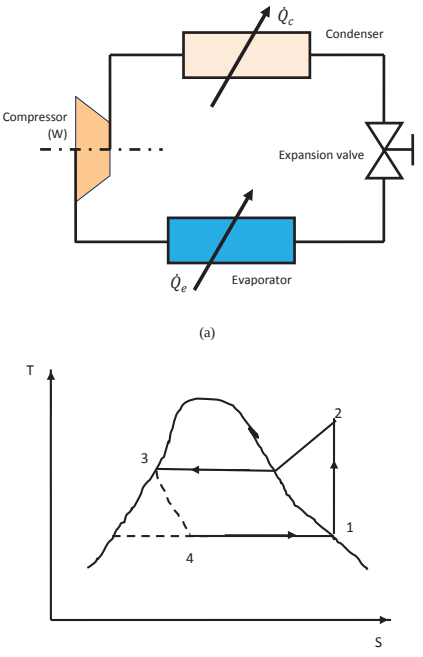

Fig. 1: Simple vapour compression refrigeration cycle...

Design procedure

Heat load calculations

The heat load for a cold storage is the total load of (a) heat loss through wall, floor, roof (ceiling), and doors (b) equipment load (lighting etc), (c) cooling load for preserved material, (d) respiration load, and (e) human occupancy load. The sample structure and potato storage in cold storage is shown in Fig. 2.

Fig. 2: Cold storage for potato and potato inside the cold storage...

The mathematical modeling for individual load calculation to design a cold storage is given as follows:

The heat load through cold storage wall

Let the wall of the cold storage is built through brick and plaster both inner and outer side. Whereas the wall brick masonary thickness is δ_b and thermal conductivity is K_b, the inner side plaster thickness and thermal conductivity is δ_{pi} and K_{pi} respectively, the outer side plaster thickness and thermal conductivity is δ_{po} and K_{po} respectively and the thickness and thermal conductivity of insulation is δ_{ins} and K_{ins} respectively.

Let the heat flow in one direction only and it follows fourier law, so equation for heat flow is given by,

$$Q = UA\Delta t \qquad (1)$$

Where U is the overall heat transfer coefficient, A is the cross section area of the wal perpendicular to the heat flow and Δt is the temperature difference between ambient (outside) temperature and innser side cold storage temperature.

The overall heat transfer coefficient of the wall can be calculated by,

$$U_w = \frac{1}{\frac{1}{h_i}+\frac{\delta_{pi}}{K_{pi}}+\frac{\delta_b}{K_b}+\frac{\delta_{po}}{K_{po}}+\frac{\delta_{th}}{K_{th}}+\frac{1}{h_o}} \qquad (2)$$

Where i represents the innerside, o outerside, b brick, p plaster. The h is represented for convective heat transfer coefficient.

The heat transfer through floor is given by equation 1 but the overall heat transfer coefficient for the floor depends upon the floor construction. Here, let the floor is built with layers of the sand (s), rubble (r), cement concerete (cc), thermocol (th) and cement plaster at floor (pf) and the overall heat transfer coefficient can be calculated by,

$$U_f = \frac{1}{\frac{1}{h_i}+\frac{\delta_s}{K_s}+\frac{\delta_r}{K_r}+\frac{\delta_{cc}}{K_{cc}}+\frac{\delta_{th}}{K_{th}}+\frac{\delta_{pf}}{K_{pf}}} \qquad (3)$$

The overall heat transfer coefficient for roof (R) is given by:

$$U_R = \frac{1}{\frac{1}{h_i}+\frac{\delta_a}{K_a}+\frac{\delta_{th}}{K_{th}}+\frac{1}{h_o}} \qquad (4)$$

Where, asbestos sheet (a) is used at the place of roof and thrmocol sheet is used to reduce the heat transfer through roof.

Equipment load (lighting etc)

Let the 10kW /1000 ton light and pump energy is required. Then total energy can be calculated in ton of refrigeration (TR) based on this requirement.

$$Q_{eq} = 10\left(\frac{M}{1000}\right)C \qquad (5)$$

Where C is the constant of conversion in to TR.

Cooling load for preserved material

When the cold storage is working then the initial cooling is required or energy required to cool down to freezing point can be calculated by simple formula given as follows:

$$Q_i = \dot{m}MC_p\Delta t \qquad (6)$$

Where, $\dot{m}$ is the mass flow rate, C_p is the specific heat of preservative item at above freezing point, and the Δt is the temperature difference between ambient (Outside Environment) and freezing point temperature.

The heat evolved in storage can be calculated by the multiplication of heat evolved constant (q_{ec}) (standardised for particular item) and mass of the stored item (M).

$$Q_{se} = Mq_{ec} \qquad (7)$$

Respiration load

The respiration rate is approximately 10kW/ton of Potato, than the Respiration load can be given by,

$$Q_{res} = 10\,M \qquad (8)$$

Human occupancy load

The human occupancy load depends on the the total woker and working time in a day, by which we can calculate the amount of heat dissipated by them. For this calculation, 430 kcal/hour per person is used, and minimum 3 persons per 1000 ton are required for proper operation of the cold storage.

$$Q_{hu} = 430\,n\,T \qquad (9)$$

Where n is number of person and T is the time of woking per day in cold storage.

The total refrigeration load on the cold storage is the sum of all loads described above.

$$Q_{total} = Q_w + Q_f + Q_R + Q_{eq} + Q_i + Q_{se} + Q_{res} + Q_{hu} \qquad (10)$$

Design of components

There are four main components in the VCR cycle. The design of these parts according to the capacity and assumed condition and parameters is given as follows:

Compressor design

The volume flow rate through the compressor depends on the specific volume of the refrigerant and the MFR. From the assumption of volumetric efficiency of the compressure, the actual displaced volume. And if number of cylinders involved in the diplacement, calculate the actual displacement for single cylinder compressor. Which is given by :

$$Actual\ diplace\ volume\ per\ second = \pi D^2\ x\ L\ x\ \left(\frac{N}{60}\right) \qquad (11)$$

Where D is the diameter of the piston and L is the length of stroke, the N is RPM. The length of stroke is generally taken as 1.5 time of piston diameter.

Design of condenser

The condenser design depends upon the amount of heat removed by the condenser. The total quantity of heat load on the condenser is the sum of refrigeration load and

compressor work. In the cold storage water cooled condensers are generally used. It requires lot of water to heat transfer.

$$Q_C = Q_E + W \qquad (12)$$

The amount of water required to be calculated by,

$$Q_C = \dot{m}_w C_{pw} \Delta t_w \qquad (13)$$

Pump design for cooling tower is given by the HP required or Hp of the pump :

$$Hp\ of\ the\ pump = \rho g Q H \qquad (14)$$

Design of throttling device

The throttling device must be expand MFR per hour and must operate between the range of two pressure ranges and evaporative pressure and condenser pressure.

Evaporator design

The capacity of evaporator is eaqual to the refrigeration effect. In the actual practice, the number of set of evaporator depends on the number of set of compressor used in the cold storage. It must be one evaporator for one set of compressor.

Calculation for Coefficient of Performance (COP)

The ideal COP of the cycle is calculated by the end temperatures and it is given by,

$$COP_{ideal} = \frac{T_e}{T_c - T_e} \qquad (15)$$

The theoretical COP of the cycle can be calculated by :

$$COP_{theoretical} = \frac{h_1 - h_4}{h_2 - h_1} \qquad (16)$$

Where, h is the enthalpy at different point as 1 indicates the entry to the compressor, 2 indicates the exit of compressor, and 4 indicates the entry to the evaporator.

The horse power required to operate the cycle is given by:

$$Horse\ power\ required = \frac{Capacity\ \ in\ TR\ x\ 3000}{COP\ x\ 630} \qquad (17)$$

Taking 20% more of the calculated HP for safe design.

The refrigeration effect is given by:

$$Refrigeration\ Effect\ (R_E) = (h_1 - h_4) \qquad (18)$$

The mass flow rate of refrigerant (MFR) is given by:

Saturated Temperature, °C	Pressure, bar	Specific Volume, m^3/kg	Specific Enthalpy, kJ/kg		Specific Entropy, kJ/kg.K	
			Saturated Liquid	Saturated vapour	Saturated Liquid	Saturated vapour
5	5.1687	0.242745	225.185	1466.84	1.08353	5.5545
15	7.2979	0.174475	270.053	1475.88	1.24769	5.4322
25	10.046	0.128037	317.687	1483.18	1.40843	5.3175
45	17.843	0.724716	415.362	1491.58	1.72005	5.1036

Table 3: Saturated properties of ammonia...

Design of cold storage for various capacities

Assumptions for sample design calculation are given as follows:	
Location	Agra (U.P.) (27.18° N, 78.02° E)
Product	Potato
Outside temperature	45°C DBT (Average for the year); 30°C WBT
Product loading temperature	25°C
Weight of each bag	50kg
Chamber size	21m x 16m x 13.7m
Loading rate	4% of total capacity/day
Pull down temperature	15°C in 24 hours
Compressor running hours	20 hrs during pull down
Ventilation rate	4 Air change per day (Average)
Thermocole insulation	$K_{thermocole} = 0.023 W/m^2 K$ Density = 32 kg/m^3; Thickness = 10cm
Thickness of wall/roof/floor	100 mm; $_{Kbrick} = 0.25 W/m^2 K$
Plaster thickness	15 mm; $K_{plaster} = 0.65 W/m^2 K$
Specific heat of potato	0.82 kJ/kgK
Air density	0.85 kg/m^3
Heat evolved in storage	450kcal/ton/day at 5°C
For asbestos ceiling	$K_a = 2.7 W/m^2 K$; 3 mm thickness
For floor	Sand 6 cm thickness $K_s = 0.6 W/m^2 K$; $K_r = 9.2 W/m^2 K$ 10 m rubble thickness $K_{cc} = 0.7 W/m^2 K$; 8 cm Cement concrete
Respiration rate	10 kW/ton (Average)
Electrical lighting	10 kW/chamber
Amount of heat dissipated by each human being	430 kcal/hrs
Volumetric efficiency of compressor	80%
Length/dia. Ratio for cylinder	1.5

Storage Capacity, MT	Each room storage MT	Volume required, m^3	Load from wall / roof/ floor per day, kW	Product load, kW	Heat load in storage, kW	Respiration load, kW	Infiltration load, kW
5000	1250	4250	9.31	75.92	26.04	90	33.10
10000	1250	4250	9.31	151.85	52.08	180	66.20
15000	1250	4250	9.31	227.78	78.13	270	99.30
20000	1250	4250	9.31	303.70	104.17	360	132.40
25000	1250	4250	9.31	379.63	130.21	450	165.51
30000	1250	4250	9.31	474.54	156.25	540	206.88

Lighting load, kW	Human Occupancy, kW	Total Load, kW	COP	Actual CPR	Piston diameter, cm	Water required, kg/hr	Power of Cooling tower pump, kW
40	4	278.3828	3.18	104.88	7.37	27434.08	373.78
80	8	547.452	3.18	206.26	9.19	53950.33	735.07
120	12	816.5212	3.18	307.64	10.48	80466.57	1096.35
160	16	1085.59	3.18	409.01	11.51	106982.82	1457.64
200	20	1354.66	3.18	510.39	12.38	133499.06	1818.92
250	25	1661.986	3.18	626.18	13.36	163785.45	2231.57

Table 4: Design Data for various capacity cold storage...

$$MFR = \frac{TR}{R_E} \quad (19)$$

Freon and NH_3 are two important refrigerants for the simple vapour compression refrigeration cycle. The Ammonia (NH_3) is the most applicable refrigerant for large cooling capacity plants like cold storage. The cold storage are to be built far from the residential area because of its toxic nature. The saturated properties at different applicable temperatures are presented in table 3. The storage conditions of potato decided the type of fresh potato e.g., early crop, seed and table potato. The storage temperature, storage period and the relative humidity are varying according the above mentioned type. The early crop required storage temperature 4-10°C, storage period 0-3 months and RH 95% similar to that the seed potato and table potato required 3°C and 4°C, 5-10 months both and 90-95% RH respectively.

The cold storages are designed for storing 5000MT, 10000MT, 15000MT, 20000MT, 25000MT and 30000MT potato at Agra, U.P. In this regard, equation 1 to 19 are used for design calculations at different levels. The final data after calculation is shown in table 4 as below.

Conclusions

From this method, the approximate calculation can be done for cold storage design. The method also shows its simplified equations and assumptions. It helps the reader in understanding the number of factors taken into account in the design calculations of cold storage for potato and others. ■

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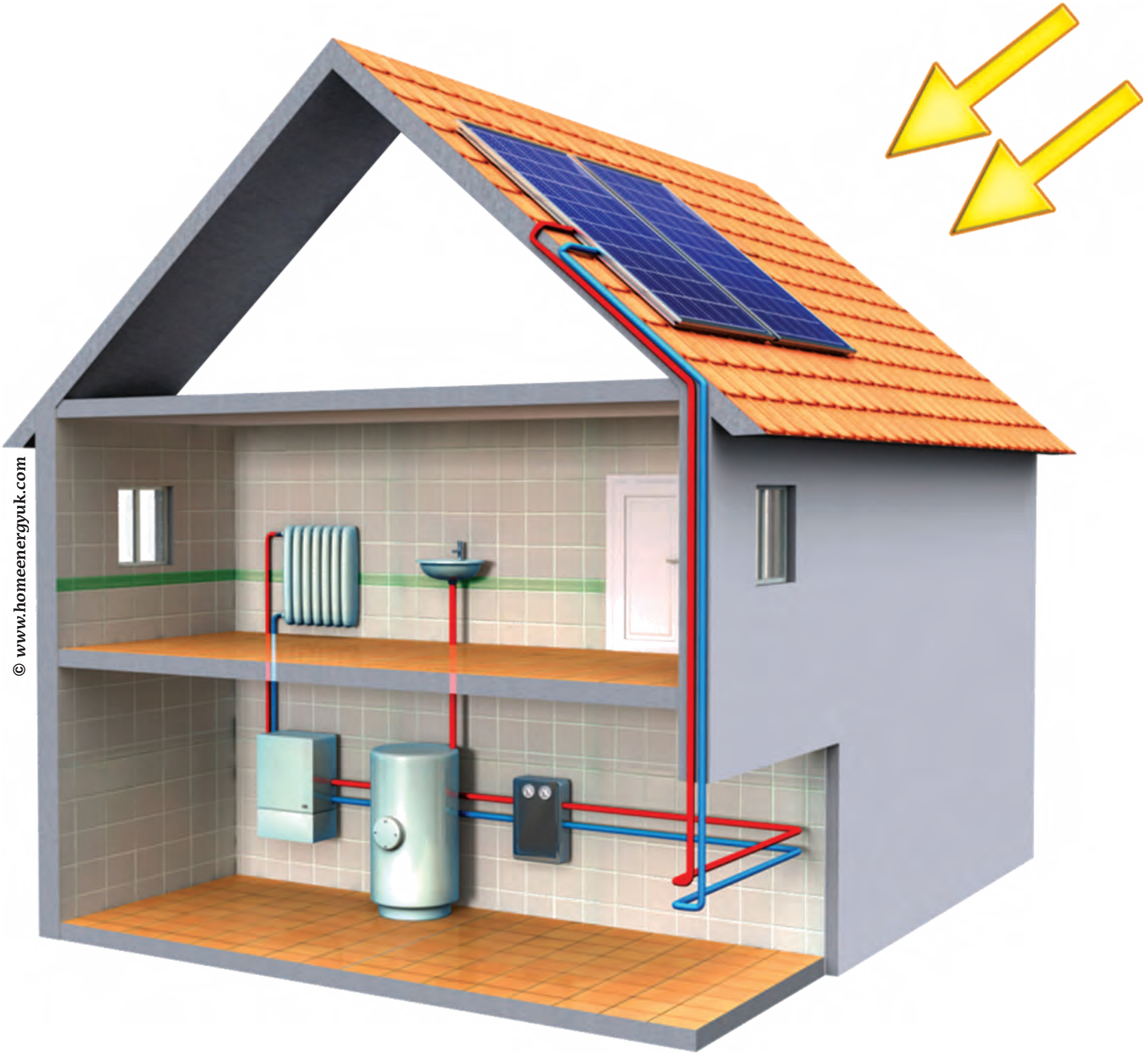
Solar Heating & Cooling, Cold Chain
(Warehouse Transport, Logistics & Refrigeration)

Solar energy has become not only a better option for more traditional applications, such as domestic hot water production, but also an attractive alternative for new and more advanced applications such as industrial process heat...



The future of the energy system will have a dramatic impact on our life and that of coming generations, be it for its impact on climate or on economic growth.

Renewable heating and cooling technology will play a vital role among the available options in the sustainable energy system. This has been identified by the Indian Government as 'no-regret' option in its energy roadmap 2030 as it can provide 'locally produced' energy. Besides being a decentralised and widely available energy source, it has also an important economic impact: approximately half the investment is allocated to the lower end of the value chain, generating jobs and economic growth at the local level.

Today, about 50% of the final energy demand is used for heating and cooling purposes. Solar thermal energy, together with biomass and geothermal energy, can be a major source of heating and cooling. It is an extremely convenient heating source, based on a simple concept enhanced by cutting edge technology. Thanks to technological progress, solar thermal has become not only a better option for more traditional applications, such as domestic hot water production, but also an attractive alternative for new and more advanced applications such as industrial process heat.

Challenge	Objective
Increase the competitiveness of solar heating and cooling	Price reduction of solar heat by 50% (in comparison with 2014)
Simplification of the entire heating system including the solar thermal part	Development of easy-to-install compact solar hybrid heating systems with increased reliability and user-friendliness
Major role of solar energy to the heating demand	Increase the solar fraction (share of solar energy on the overall heat demand) from about 25% to 60%.
Extend the use of solar heat to new market Segments	Adapted solar thermal technology for industrial processes and vice versa

Challenges and objectives for solar heating and cooling...

Solar heating and cooling today

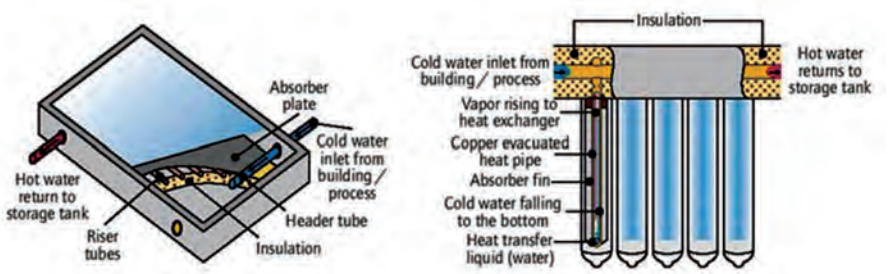
Development of solar heating and cooling:

Solar heating

Solar heat can be captured by a variety of technologies and utilised in a wide number of applications. The most mature technology, the solar domestic hot water system.

Two types of solar heater technologies are popular viz., flat plate collectors & evacuated glass tube collectors. Evacuated gas tube solar water heaters are quite popular.

Solar cooling technology uses heat in a thermally-driven cooling process. Within solar cooling, there are 2 main processes: Closed cycles and Open Cycles...



Flat plate collector (left) and evacuated tube collector (right)...

Evacuated tube collectors, where the housing is a glass tube with vacuum inside, so that the heat losses to the environment are very low. Evacuated tube collectors can be classified as direct flow tubes and heat pipe tubes.

However, we have a bad habit of following the technology for years together. Solar water heaters were first deployed in the year 1960 in Australia, Japan and Israel. The same design is being replicated even today in India, even though we have different solar radiation patterns. We have developed nice art of copying the technology as it is without any logic. A typical 125 litres solar water heater commonly used in India is the same as that was few years back. It will be more logical to use heated water up to 70^0C by 12 noon by transferring to sub-tank (say 20 litres) by a small DC pump to kitchen for number of application for hygienic lifestyle.

Solar air heating systems capture the energy from the sun in an absorbing medium and use it to heat air. Solar air heating systems can also be used in process heat applications, e.g., for crop drying, and in buildings for space heating or air conditioning.

Concentrating solar technologies

Concentrating solar technologies focus sunlight from a large aperture area onto a small area by means of lenses or mirrors. When the concentrated light is converted to heat, very high temperatures can be produced: higher the concentration ratio more is the maximum temperature. So far, high concentrating, sun tracking, solar technologies are mainly used to produce high-temperature heat to drive steam turbines and produce electricity.

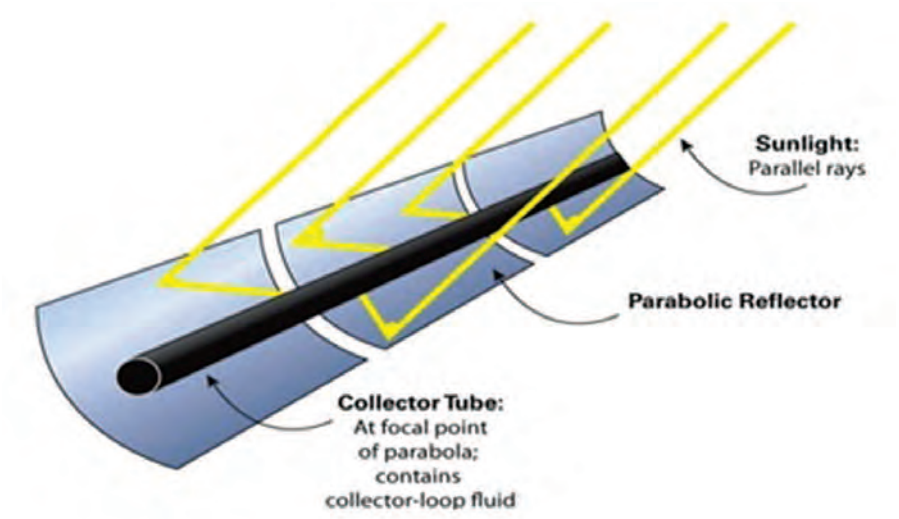
However, they can also be used in heat applications; or waste or surplus heat can be utilised in Combined Heat And Power (CHP) installations. Concentrating solar thermal collectors generally need to track the sun (with one or two axis tracking). Only devices with very low concentration can be mounted stationary or with simply seasonal tracking.

Solar cooling technology

Solar cooling technology uses heat in a thermally-driven cooling process. Within solar cooling, there are two main processes: Closed cycles, where thermally driven adsorption chillers produce chilled water for use in space conditioning equipment (air handling units, fan-coils, chilled beams, etc.). Open cycles, also called Desiccant Evaporative Cooling systems (DEC), typically use water as the refrigerant and a desiccant as the sorbent for direct treatment of air in a ventilation system. But, solar cooling is still in the early stages of market development; costs need to be reduced through further development.

Solar heat for cooling applications

An interesting application of solar heat use is building space cooling due to the convenient coincidence between the availability of maximum solar irradiance and the peak



Parabolic Trough Reflector...

Peltier-effect based portable vaccine enclosure...

Solar-powered cold-chain for fruit / vegetables / food...

demand for cooling, particularly in commercial buildings. Some technologies, like desiccant cooling, can extend comfort by also managing humidity levels. Industrial refrigeration is also an attractive candidate for solar thermal AC technology.

Solar powered cold chain (warehouse transport, logistics & refrigeration)

The importance of keeping the cold chain cold mainly divided into two sections:

- Solar-powered COLD-CHAIN for effective vaccine management
- Solar-powered cold-chain for effective storage of perishable fruits / food etc.

Today, more than 80% of children around the world receive a complete routine of life-saving vaccines during their first year of life.

To a large extent, the evaluation of this decade's success will be based on the degree to which vaccines reach the people who need them. A strong end-to-end supply chain should adapt to the resource constraints of these communities to ensure that delivery is complete: from the point of production of the vaccine at the manufacturing unit to the point of immunisation.

Vaccines are highly thermo-sensitive biological substances, which have a fixed shelf-life and lose viability over time. The loss of viability is irreversible and accelerated if proper storage and temperature conditions are not maintained. A vaccine vial must remain between 2 and 8 degrees Celsius throughout the entire cold chain system – when it is transported, when it is stored in a refrigerator or cold store, and when it is used at an immunisation session. Solar-powered cold-chain using latest technology plays a major role in this field.

Establishing reliable solar-powered cold-chain for vaccine management for healthy generation all over the world is a challenging task, and is being thought-of & has gathered momentum on ground. Simultaneously, solar-powered COLD-CHAIN to feed the generation the right food / fruits at the right-time at the right-cost is equally important.

Technology for solar-powered cold-chain

Solar-powered cold-chain for vaccine management

A technology based on Peltier-effect is being used all over the world for portable cold-chain vaccine management application, and it is quite successful.

100% Solar-powered cdompressor based cooling or solar – powered heater / chiller technology is commonly used in this field. ■

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Microgroove Copper Tube Heat Exchangers

For Air Conditioners

Natural refrigerants such as carbon dioxide and propane are fast becoming more attractive to OEMs and end-users for ACR and heating applications as technology advances...

Many factors are contributing to a climate of innovation in the ACR industry today, including:

- Phase out of high-ODP and high-GWP refrigerants & use of eco-friendly refrigerants
- Energy efficiency standards and sustainable development
- Computer simulation of components and system performance
- Responsiveness to needs and wants in the marketplace.

The phasing out of popular CFC and HCFC refrigerants has been a major factor in spurring innovations in cooling technology in the past 20 years. Likewise, energy efficiency and sustainability have necessitated invention. End-users have their eyes on energy efficiency ratings and OEMs are highly motivated to use less material in their products.

Natural refrigerants

Natural refrigerants such as carbon dioxide and propane are fast becoming more attractive to OEMs and end-users for ACR and heating applications as technology advances. Also known as R744, carbon dioxide is used as a refrigerant in a growing number of applications ranging from vending machines and refrigerated supermarket display cases to ice-skating rinks.

Another natural refrigerant under consideration for use in air conditioning systems is propane. Known as R290, propane is an eco-friendly hydrocarbon (chemical formula C_3H_8) with outstanding thermodynamic properties that make it well suited as a refrigerant for residential air conditioners. The advantages of copper tubes in these applications include high thermal conductivity, corrosion resistance and strength. Smaller diameter copper tubes have even higher burst strengths and they allow for lower overall refrigerant volumes.

Copper is a proven technology with a well-established supply chain, including a network of trained installers with the know-how to ensure safety and reliability.

The most important factor

Perhaps the most important factor driving the development of new products is a better understanding of attitudes toward comfort and refrigeration in different climates and cultures. ACR product developers are responding better to the real needs and wants of end users in the built environment. They are right-sizing air conditioning and refrigeration products to allow for precise temperature and humidity

control in specific zones without waste. The result is that end-users will enjoy healthy, eco-friendly products that deliver cooling capacity with high energy efficiency when as well as where it is most desirable. Computer modelling is now commonly used to simulate total system design. Decisions about refrigerants, coils and components are now made with the assistance of increasingly accurate performance simulations.

Advances in coil design

Redesign of the coil has seen the use of smaller diameter copper tubes with inner-grooves increasing the internal heat transfer coefficient and raising COPs. Such improvements in coil performance may also be favourable for the use of new refrigerants, less materials, higher operating pressures (due to the smaller diameter tubes) and variable refrigerant flow (due to the increased number of branches). System design is dramatically changed for the better by using smaller diameter, inner grooved copper tubes in the coil designs.

Smaller diameter, inner grooved copper tubes have been proven to be well suited for the high-volume production of residential air conditioners. Now it is time to show that the same benefits that make Micro Groove so attractive for room air conditioners also apply to commercial and industrial systems. We would like manufacturers and mechanical systems engineers to come to realise the same benefits in commercial applications that OEMs of residential products already enjoy. The Micro Groove concept is applicable across the boards: residential, commercial and industrial refrigeration and air conditioning; and for evaporators and condensers. There are benefits in every case.

Traditional copper tube/ aluminium fin coil manufacturing technology when modified for smaller diameter copper tubes of 7mm to 5 mm, can achieve significant improvements in heat transfer. When coupled with internal enhancements to the copper tubes such as higher strength, thinner walls and internal micro-grooves, newer optimised heat exchanger designs can be smaller, more efficient, and lower cost compared.

A major innovation of small diameter copper tube technology enhances heat transfer by rifling or grooving the inside surface of the tube. This increases the surface-to-volume ratio, mixes the refrigerant, moves the refrigerant into contact with the interior surface of the tube, and homogenizes refrigerant temperature across the tube, resulting in more efficient conductive and convective heat transfer. The high efficiency of the inner grooved tube stimulates and promotes the development of energy-saving, high efficiency and miniaturisation for air conditioning systems. Typically, such surface enhancement can significantly increase overall heat transfer performance, with different inner groove geometries available for optimisation under various refrigerants and conditions.

System design is dramatically changed for the better by using smaller diameter, inner grooved copper tubes in the coil designs...

Making coils with microgroove tubes

Manufacturers are using familiar equipment to make coils with smaller-diameter round copper tubes.

Performance simulations and prototype designs of heat exchangers with smaller diameter copper tubes are indeed impressive. The savings in materials and reduction of refrigerant volume cannot be denied.

Fortunately, microgroove copper tube technology is compatible with production methods and equipment already familiar to the HVAC industry. Equipment makers have made the necessary adjustments for producing smaller-diameter tubes and assembling them into coils. Such manufacturing equipment has proven production-worthy at major companies in China such as Haier, Midea, Kelon, Chigo and Goodman who have mastered the manufacturing and now are marketing products globally.

Typical processes

The principles of tube insertion and tube expansion have been utilised in the industry for decades. The equipment used today expands the tubes circumferentially, i.e., the circumference of the tube is increased without changing the length. This 'non-shrinkage' expansion allows for better control of tube lengths in preparation for subsequent assembly operations. Tubes are inserted, or laced, into the holes in a stack of precisely spaced fins. Specially designed expanders are inserted into the tubes and the tube diameters are increased slightly until mechanical contact is achieved between the tubes and fins. The high ductility of copper allows for this process to be performed accurately and precisely. Heat exchanger coils made in this manner have excellent durability and heat transfer properties.

Modern manufacturing

Modern designs of the tube expansion equipment allow for tight tolerances and exact specifications using smaller diameter copper tubes. Otherwise the equipment and production lines closely resemble the existing equipment lines that have a long and successful history.

Manufacturing in general has become more precise and accurate and the equipment for working with smaller diameter tubes is no exception and manufacturers can quickly recoup the costs of equipment upgrades because the use of smaller diameter coils allows them to make higher value products with less material.

Antimicrobial materials

Another factor influencing the design of air conditioning and refrigeration systems is new published research on copper's efficacy against the spread of fungi in air conditioning systems. OEM companies such as the Chinese air-conditioning giant Chigo and Hydronic in France have already developed all-copper products expressly for their antimicrobial properties. The use of all copper coils is not new, but their use expressly to inhibit the growth of fungi and bacteria is a recent development that is expected to be an important factor in the development of innovative air conditioning and refrigeration products. Bio build up on the coil may be reduced by using all copper coils, helping in maintaining high levels of energy efficiency for longer times and avoiding energy efficiency drop off over time. ■

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Chief Manager HVAC - International Copper Association India

Heat Pump

In electrically powered heat pumps, the heat transferred can be three or four times larger than the electrical power consumed, giving the system a Coefficient of Performance (COP) of three or four...

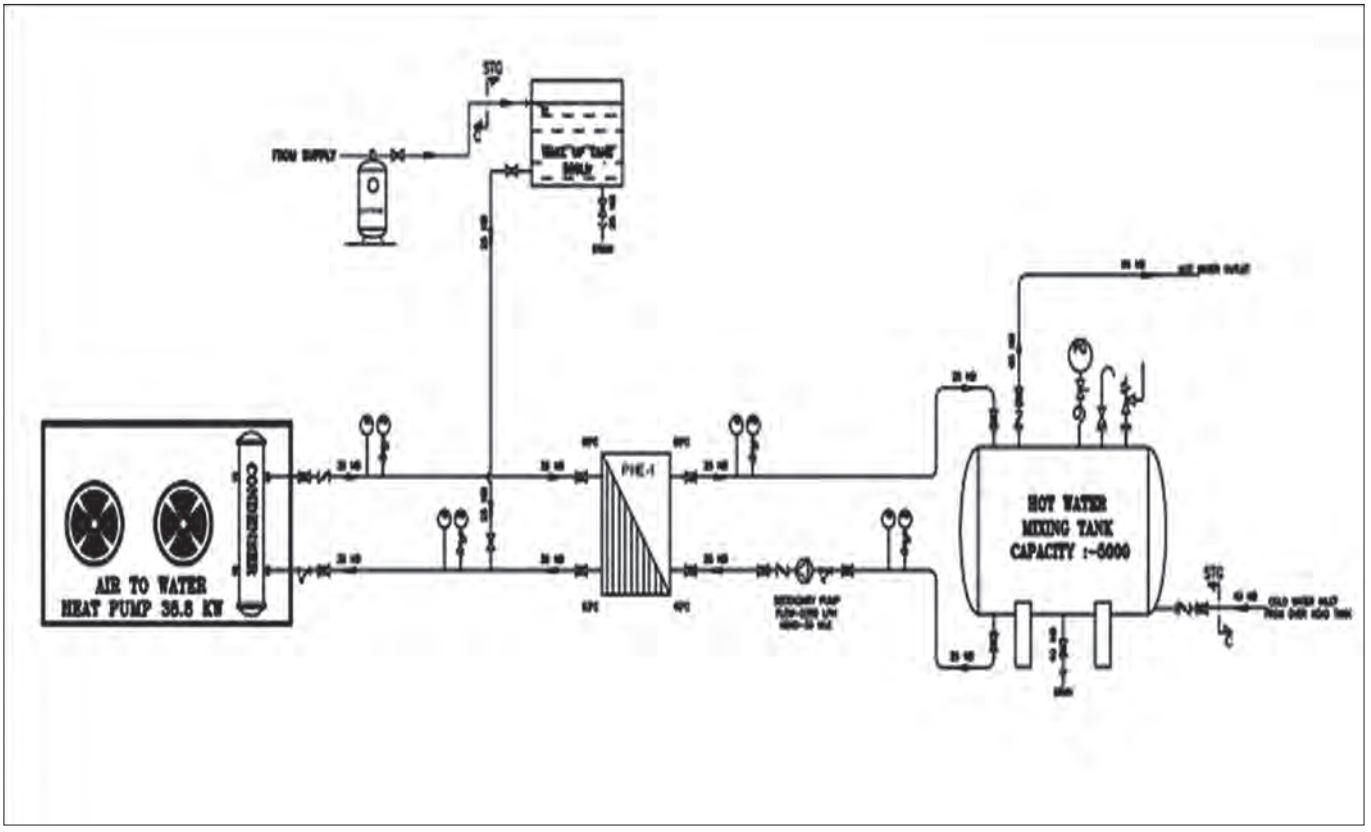
A heat pump is a device that provides heat energy from a source of heat to a destination called a 'heat sink.' Heat pumps are designed to move thermal energy opposite to the direction of spontaneous heat flow by absorbing heat from a cold space and releasing it to a warmer one. A heat pump uses some amount of external power to accomplish the work of transferring energy from the heat source to the heat sink.

Principle of working of a heat pump

While air conditioners and freezers are familiar examples of heat pumps, the term 'heat pump' is more general and applies to many HVAC (Heating, Ventilating, and Air Conditioning) devices used for space heating or space cooling. When a heat pump is used for heating, it employs the same basic refrigeration type cycle used by an air conditioner or a refrigerator, but in the opposite direction releasing heat into the conditioned space rather than the surrounding environment. In this use, heat pumps generally draw heat from the cooler external air or from the ground. In heating mode, heat pumps are three to four times more efficient in their use of electric power than simple electrical resistance heaters.

In Heating, Ventilation and Air Conditioning (HVAC) applications, the term heat pump usually refers to easily reversible vapour compression refrigeration devices optimised for high efficiency in both directions of thermal energy transfer. Heat spontaneously flows from warmer places to colder spaces. A heat pump can absorb heat from a cold space and release it to a warmer one. Heat is not conserved in this process, which requires some amount of external high grade (low entropy) energy, such as electricity.

Most of the energy for heating comes from the external environment, and only a fraction comes from electricity (or some other high grade energy source required for running a compressor). In electrically powered heat pumps, the heat transferred can be three or four times larger than the



electrical power consumed, giving the system a Coefficient of Performance (COP) of 3 or 4, as opposed to a COP of 1 for a conventional electrical resistance heater, in which all heat is produced from input electrical energy.

Air source heat pump (extracts heat from outside air)

- Air–air heat pump (transfers heat to inside air)
- Air–water heat pump (transfers heat to a heating circuit and a tank of domestic hot water)
- Water to water heat pump
- Reversible heat pump

Applications in industry

- Hospitals
- Hotels
- Canteens
- Hostels religious centers
- Residential
- Retail outlets

Heating of water for canteen application

There are two fold applications for water heating, which is done by PNG and Electrical Storage Geysers.

- Cooking: wherein there are large Pot-Boilers wherein the water is boiled by means of Piped Natural Gas (PNG). (Temp. requirement for Cooking @ 80-100°C)
- Washing and cleaning:

i. Soiled dishes are washed in automatic dish washing machine wherein hot water is required at temp @ 50°C. Hot water is obtained from storage geysers.

ii. Soiled vessels are washed manually, wherein storage geysers are used for hot water application.

Alternative means of heating was explored viz. solar hot water system, which is purely renewal and clean energy. However, on a practical note, it was not viable. The reason being the 'demand of hot water at a particular interval of time was phenomenal.'

To manage the demand one has to install solar system of very large generation and storage capacity, which requires large amount of footprint and also the investment. Maximum output of solar water heating system is available during 11AM to 4PM.

Heat pump seemed to be the most viable option, as it can operate 24 x 7. However, it uses electrical energy. Compared to electrical and PNG, a heat pump is much more efficient.

Heat pump details:

- Make : STG (RC Group)
- Model : SMART HP T-33
- Type : Air to hot water
- Capacity : 38.8 kW
- Max. Hot water leaving temp. : 50°C
- Water Entering Temp. : 10 to 40°C

Savings calculation:

- Savings in PNG energy cost: ₹ 4.8 Lacs
- Investment towards Heat Pump Project: ₹ 19 Lacs
- Payback period: 4 Yrs. ■

	UOM	Heat Pump	Conventional (Electricity & PNG)
Hot Water Consumption	LPD	17,500	17,500
Electrical Heating Rate	₹ / kWh	11.5	11.5
PNG Heating Rate	₹ / SCM	NA	39
Hot Water Temp.	°C	50	80 - 100

Rumi Engineer
Head - Energy Management - Greener India, Godrej & Boyce

Use Of Solar Energy In Refrigeration Systems

Research has demonstrated that solar energy is an ideal source for low temperature heating applications such as space and domestic hot water heating. The use of solar energy to provide refrigeration is rather less intuitive...

The negative environmental impacts of burning fossil fuels have forced the energy research community to seriously consider renewable sources, such as naturally available solar energy. Solar refrigeration technologies harness the energy of the sun and use it to run a cooling system. This type of solar application is an attractive option for the preservation of food and the refrigeration of vaccines and medicines in areas with a high intensity of solar radiation and no electricity supply. Refrigeration systems those use environment-friendly refrigerants provide a sustainability advantage when compared to other refrigerant selections. However, the energy use associated with refrigeration system operation and the environmental impacts associated with its generation and distribution often outweighs the choice of refrigerant. To minimise environmental impacts associated with refrigeration system operation, it is wise to evaluate the prospects of a clean source of energy such as solar energy.

Solar energy

Direct use of solar energy is attractive because of its universal availability, low environmental impact, and low or no ongoing fuel cost. Research has demonstrated that solar energy is an ideal source for low temperature heating applications such as space and domestic hot water heating. Solar heating applications are intuitive since, when solar energy is absorbed on a surface, the surface temperature rises, providing a heating potential. The use of solar energy to provide refrigeration is rather less intuitive. The power from the sun intercepted by the earth is approximately 1.8 ×1011 MW, which is much larger than the present consumption rate on the earth of all commercial energy sources. Thus, in principle, solar energy could supply all the present and future energy needs of the world on the continuing basis. Also, solar energy is a clean source of energy, free and available in adequate quantities in almost all parts of the world.

Types of refrigeration systems

The refrigeration effect can be obtained using different principles and accordingly different refrigeration systems have been evolved. Each refrigeration system has its own merits and demerits, and also, specific use. The most common refrigeration systems that can be used for multipurpose applications are vapour compression refrigeration system and sorption refrigeration system. Moreover, solar energy can be used here in different forms.

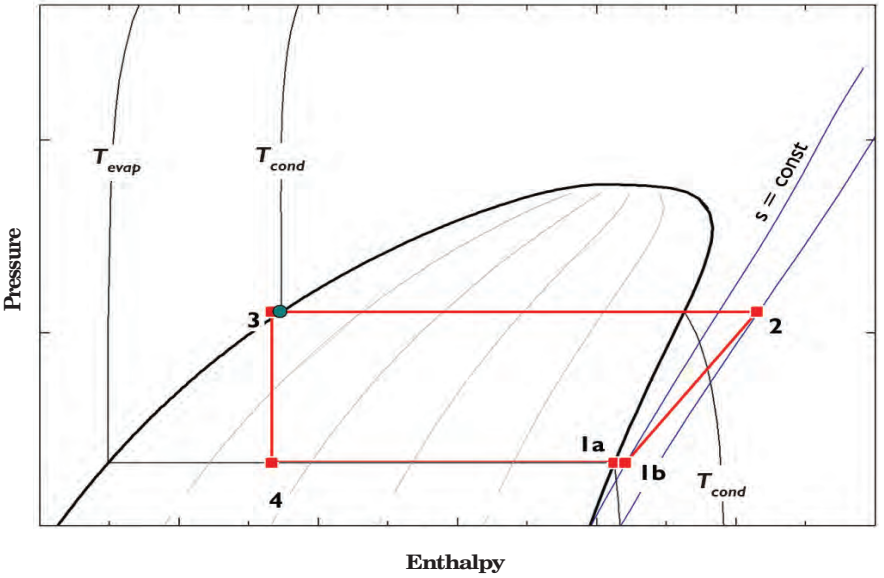


Fig. 2: Pressure enthalpy diagram of VCR cycle...

Vapour compression refrigeration cycle

The basic operating principle of vapour compression refrigeration cycle that forms the foundation for nearly all conventional refrigeration systems is discussed here. A schematic diagram of the vapour compression refrigeration system is shown in Figure 1 and the corresponding pressure-enthalpy (p-h) diagram for the refrigerant is shown in Figure 2.

In the vapour compression cycle, cooling or refrigeration effect is obtained in the evaporator as low temperature refrigerant entering the evaporator as a mixture of liquid and vapour at state 4 is vapourised by thermal input from the load. The remaining equipments in the system reclaim the refrigerant and restore it to a condition in which it can be used again to provide cooling or refrigeration effect. The vapour leaving the evaporator at state 1 in a saturated (1a) or slightly superheated (1b) condition enters a compressor that raises the pressure and, consequently, the temperature of the refrigerant. The high pressure hot refrigerant at state 2 enters the condenser (a heat exchanger) that uses ambient air or water to cool the refrigerant to its saturation temperature prior to fully condensing to a liquid at state 3. The high pressure liquid is then throttled to a lower pressure, which causes some of the refrigerant to vaporise as its temperature is reduced. The low temperature liquid that remains is available to produce useful refrigeration. The performance of the system is expressed by a term called COP (Coefficient of Performance) which is defined as the ratio of refrigeration effect and the power input into the compressor.

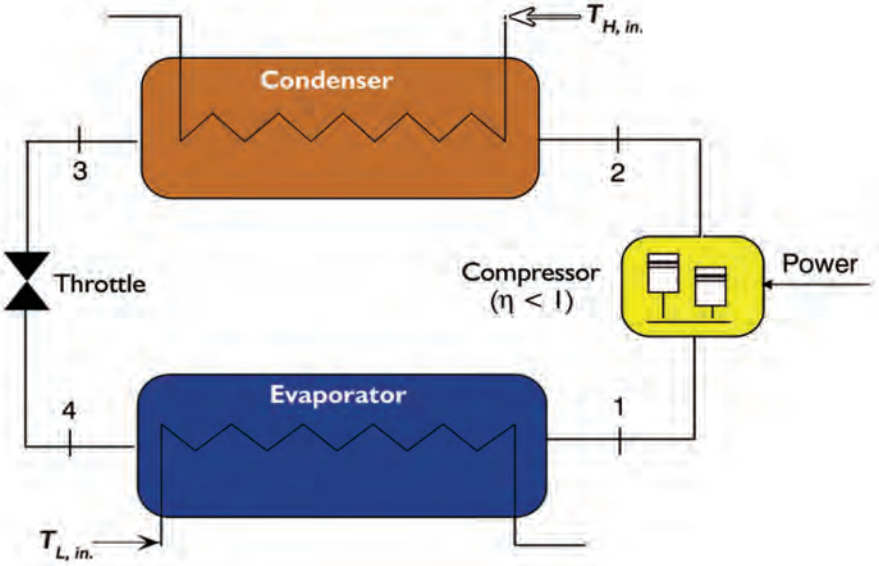


Fig. 1: Schematic diagram of mechanical VCR system...

Photovoltaic cell operated refrigeration cycle

Photovoltaic (PV) cell directly converts solar radiation to Direct Current (DC) electricity using semiconducting materials. Solar photovoltaic panels produce DC power that can be used to operate a DC motor that is coupled to the compressor of a vapour compression refrigeration system. The major considerations in designing a PV-refrigeration cycle involve appropriately matching the electrical characteristics of the motor driving the compressor with the available current and voltage being produced by the PV array.

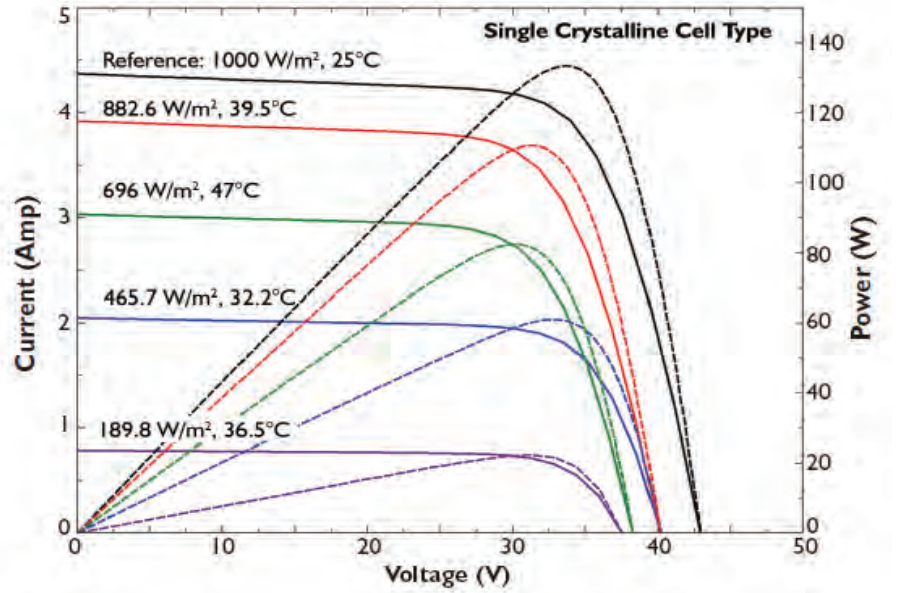


Fig. 3: Current (solid lines) and power (dotted lines) vs. voltage for a single crystalline PV module for different rating conditions...

Unfortunately, PV modules will operate over a wide range of conditions that are rarely as favourable as the rating condition. In addition, the power produced by a PV array is as variable as the solar resource from which it is derived. The performance of a PV module, expressed in terms of its current voltage and power-voltage characteristics, principally depends on the solar radiation and module temperature. Figure 3 shows current and power vs. voltage plots for a 1.32 m^2 single crystalline PV module at the reference condition and four operating conditions.

Solar mechanical refrigeration

Solar mechanical refrigeration uses a conventional vapour compression system driven by mechanical power that is produced with a solar-driven heat power cycle (Rankine cycle). A storage tank can be included to provide some high temperature thermal storage. The vapour flows through a turbine or piston expander to produce mechanical power as shown in Fig. 4. Efficiency is significantly lower and solar mechanical systems are competitive only at higher temperatures for which tracking solar collectors are required. Because of its economy-of-scale, this option would only be applicable for large refrigeration systems.

Sorption refrigeration technologies

Sorption refrigeration uses physical or chemical attraction between a pair of substances to produce the refrigeration effect. A sorption system has the unique capability of transforming thermal energy directly into cooling power. Among the pair of substances, the substance with a lower boiling temperature is called the refrigerant and the other is called the sorbent. Figure 5 shows a schematic diagram of a closed sorption system.

The component where sorption takes place is denoted as absorber Ab, and the one where desorption takes place is denoted as generator G. The generator receives heat Qg from the solar collector SC to regenerate the sorbent that has absorbed the refrigerant in the absorber. The refrigerant vapour generated in this process condenses in the condenser C, rejecting the condensation heat Qc to the ambient. The regenerated sorbent from the generator is sent back to the absorber, where the sorbent absorbs the refrigerant vapour coming from the evaporator E, rejecting the sorption heat Qa to ambient. In the evaporator, the liquefied refrigerant coming from the condenser and expansion valve evaporates, removing the heat Qe from the cooling load. Absorption refers to a sorption process where a liquid or solid sorbent absorbs refrigerant molecules into its interior and changes physically and/or chemically in the process.

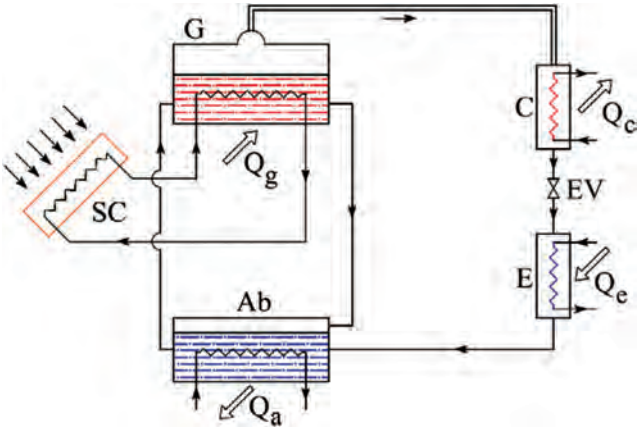


Fig. 5: Schematic diagram of solar sorption refrigeration system...

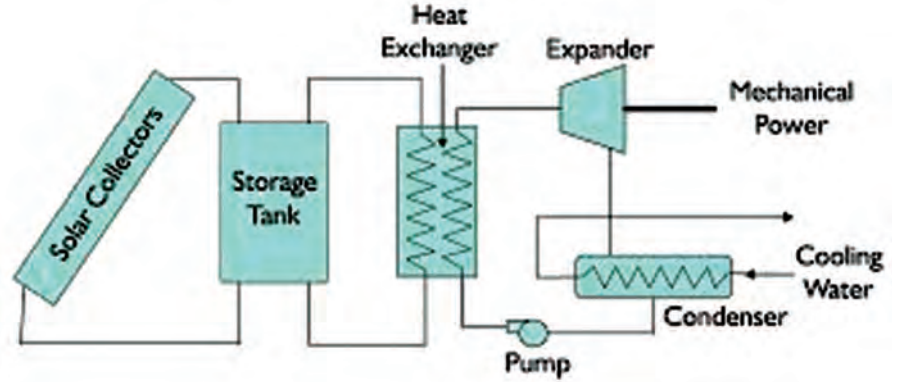


Fig. 4: Schematic diagram of solar driven mechanical power cycle...

Adsorption involves a solid sorbent that attracts refrigerant molecules onto its surface by physical or chemical force and does not change its form in the process.

Absorption systems

The absorption system is one of the oldest refrigeration technologies and began in 1700s. It consists of a generator, a pump and an absorber that is collectively capable of compressing the refrigerant vapour. The evaporator draws the vapour refrigerant by absorption into the absorber. The thermal

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energy (may be solar or heat recovered from exhaust gases) supplied to the generator separates the refrigerant vapour from the rich solution. The refrigerant is condensed by rejecting the heat in a condenser, and then the cooled liquid refrigerant is expanded in the expansion valve before entering the evaporator to complete the cycle. The refrigerant side of the absorption system essentially works under the same principle as the vapour compression system. However, the mechanical compressor used in the vapour compression cycle is replaced by a thermal compressor in the absorption system. NH_3/H_2O and H_2O/LiBr are typical refrigerant/absorbent pairs used in absorption systems. Each working pair has its advantages and disadvantages as listed in table 1.

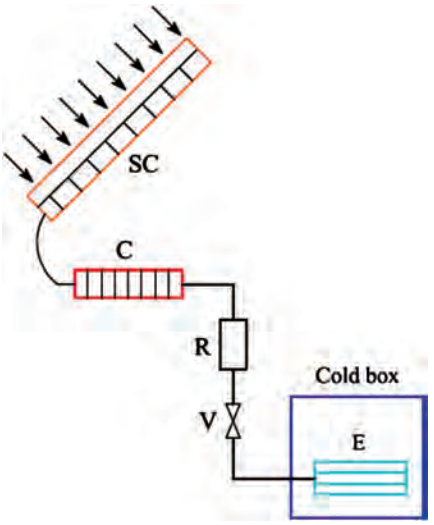

Fig. 6: Solar adsorption cooling device: schematic diagram...

Working pair	Advantages	Disadvantages
NH_3/H_2O	Evaporative at temperatures below 0^0C	Toxic (NH_3), Need of a column of rectifier operation at high pressure
H_2O/LiBr	High COP, Low operation pressure. Environment-friendly, Large latent heat of vapourisation	The risk of congelation, Anti-crystallisation device is necessary, LiBr is relatively expensive

Table 1: Comparison between the absorption system with NH_3/H_2O and H_2O/LiBr...

The absorption systems can be divided into three categories namely single, double and triple effect solar absorption cycles. Typical cooling COPs of the single-effect, double-effect, and triple-effect absorption systems are 0.7, 1.2, and 1.7, respectively. For single effect absorption system with generator temperature of around 85^0C, flat plate collector may serve the purpose. But for multi-effect with generator temperature 130^0C and above, compound parabolic and evacuated tube collectors are needed.

Adsorption systems

Adsorption technology was first used in refrigeration and heat pumps in the early 1990s. Solar energy is the energy source of most adsorption systems operating with the basic cycle. A solar adsorption cooling system based on the basic adsorption refrigeration cycle does not require any mechanical or electrical energy. It just needs thermal energy and it operates intermittently according to the daily cycle. This refrigerator is a closed system consisting of a solar collector SC containing the adsorbent bed, a condenser C, a receiver R equipped with a 2-way valve V, and an evaporator E as shown in Fig 6.

Comparison between absorption and adsorption Systems

Solar solar-assisted absorption and adsorption systems may be more attractive in future due to pollution-free working fluids

System	Absorption	Adsorption
Sorbent type	Liquid	Solid
Working pair	H_2O/LiBr, NH_3/H_2O	H_2O/silica-gel
COP	0.50–0.73 (single-stage)	0.59
Advantages	Only one moving part (pump)	No moving part (except valve)
Disadvantages	Cannot achieve a very low evaporating temperature, System is quite complicated	Very sensitive to low temperature, It is an intermittent system

Table 2: Comparison between solar absorption and adsorption systems...

Adsorption involves a solid sorbent that attracts refrigerant molecules onto its surface by physical or chemical force and does not change its form...

(instead of chlorofluorocarbons) being used as refrigerants. A comparison between the absorption and adsorption refrigeration systems is presented in table 2.

The adsorption cycle can be operated at lower heat source temperatures than the absorption cycle, but its COP is also lower. Based on the coefficient of performance, the absorption cooling systems are preferred to the adsorption cooling systems. Solar thermal with single-effect absorption systems appear to be the best option, closely followed by solar thermal with single-effect adsorption systems.

Prospects of solar based refrigeration systems

Solar-powered adsorption refrigeration devices can meet the needs for refrigeration, air-conditioning applications and ice making, with great potential for the conservation of various goods (medicines, food supplies) in remote areas.

Another possibility is to use adsorption systems as thermal energy storage devices. For solar sorption systems, considerable reduction in unit cost or significant improvements in its performances at present costs are still required to increase their competitiveness and commercialisation potential. Additionally, the search for new working fluids those are environment friendly and require low operating temperatures is required. ■

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Heat Pumps

An air-source heat pump can deliver two-and-a-half to five times more heat energy to a home compared to the electrical energy it consumes. This is possible because a heat pump moves heat rather than converting it from a fuel, like in combustion heating systems...

A heat pump is an environmental energy technology that extracts heat from low temperature sources, upgrades it to a higher temperature and releases it where it is required for space and water heating. Heat pumps can also be operated in a reverse mode for cooling purposes.

There are two common types of heat pumps: air-source heat pumps and Geothermal Heat Pumps (GHPs). Either one can keep your home warm in the winter and cool in the summer. An air-source heat pump pulls its heat indoors from the outdoor air in the winter and from the indoor air in the summer.

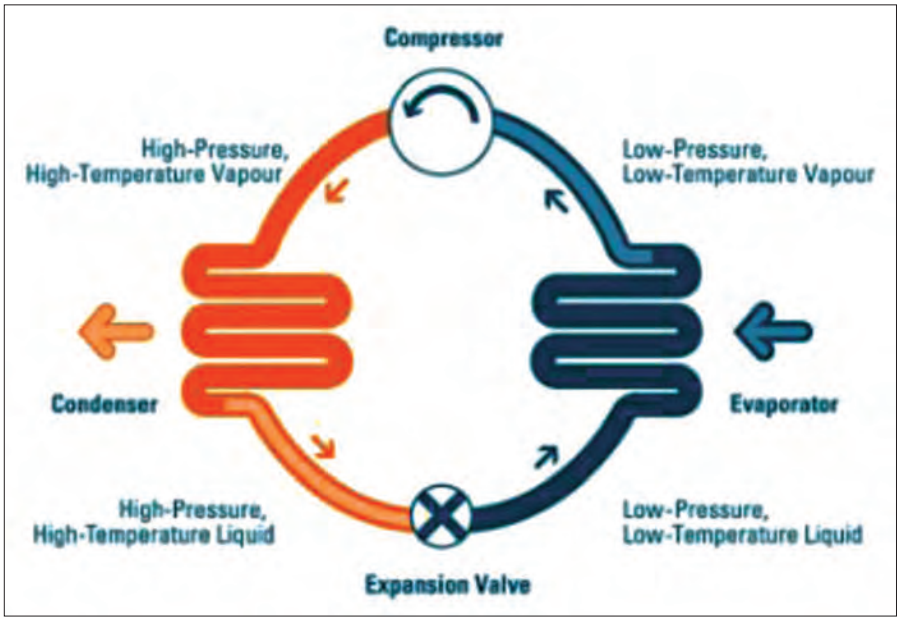
An air-source heat pump can provide efficient heating and cooling for your home, especially if you live in a warm climate. When properly installed, an air-source heat pump can deliver two-and-a-half to five times more heat energy to a home compared to the electrical energy it consumes. This is possible because a heat pump moves heat rather than converting it from a fuel, like in combustion heating systems.

The heat pumping cycle can be divided in three steps:

Step 1. A fluid with a boiling point lower than the heat source temperature serves as a medium for heat transport. It is called the working fluid or refrigerant. As the working fluid extracts the heat from the source through a heat exchanger, its temperature rises and it evaporates.

Step 2. Then a compressor compresses the evaporated fluid. Consequently, the pressure and the temperature of the vapour increase. When pumping up a bicycle tyre, you can also observe this phenomenon. The lower side of the pump – where the pressure is highest – is getting very hot.

Step 3. Finally, heat is being transferred from the evaporated fluid to the heat distribution fluid (water or air) in the condenser. As it releases its



heat, the working fluid temperature decreases to such a degree that it condenses. After passing through the expansion valve, the fluid regains its initial liquid, low-temperature and low-pressure state. It then flows back to the evaporator where the process starts all over again.

Applications

In the residential sector

A heat pump does not look very different and can perform the same functions as a conventional gas or oil boiler i.e., space heating and sanitary hot water production.

But it does it much more efficiently, using most of its heating energy from free renewable sources. Renewable heat pumps for space heating are best suited in new houses where high levels of insulation and low temperature heating systems result in low heating demand. In retrofit situations, the heat pump should be installed in parallel with the existing heating system to provide a large proportion of the annual heating needs at reduced operating temperatures.

Water heating is often provided in addition to space heating. The heat pump can provide indirect heating in the domestic hot water cylinder via an internal or external heat exchanger. Because of the high output temperature required, (minimum 55°C) the efficiency for water heating may be reduced. A desuperheater can also be installed between the compressor and the reversing valve of a space conditioning heat pump. It is a refrigerant hot gas-to-water heat exchanger, which is sized to remove the superheat from the compressor discharge gas prior to entry into the refrigerant condenser.

In the commercial sector

A heat pump is really a three-in-one HVAC system. It combines heating, cooling and air-conditioning in an economical and eco-friendly machine. They are particularly suited for buildings with a high demand for space heating and sanitary hot water production, extensive work-in times and a simultaneous need for cooling.

In large buildings, several individual heat pumps can be placed in different zones and each can be sized to meet the needs of the space it conditions. Some zones of the building may need heating at the same time as other zones need cooling. When properly integrated, a heat pump system can recover excess heat in one zone (sunny side, computer rooms, etc.) and transfer it via a water pipe loop to areas of the building requiring heating. It is, therefore, possible to achieve a balance between heating and cooling needs during a good part of the year.

How is their performance measured?

Energy is needed to activate the heat pump cycle and to compress the vapour for the production of useful heat. The efficiency of this process is expressed by the ratio between the useful heat delivered by the condenser and the driving energy used by the compressor. This ratio is called the Coefficient of Performance (COP).

A heat pump is really a three-in-one HVAC system. It combines heating, cooling and air-conditioning in an economical and eco-friendly machine...

As environmental heat is free and available in very large quantities, it is not included in the COP. That is why the COP is bigger than 1. The COP of the current generation of heat pumps varies from 2.5 to 5. Since the COP shows performance at a steady state only, a second parameter is usually used to show the performance of the heat pump over an entire year. It is called the Seasonal Performance Factor (SPF), which is the ratio of annually delivered useful heat over annually used driving energy. When calculating the SPF, it is common to include the annual electricity requirements of auxiliary equipment, such as circulation pumps, fans, etc.

The performance of a heat pump system is affected by several factors, which include:

- The climate (annual heating and cooling demand and peak loads)
- The temperature of the heat source and the heating distribution system
- The auxiliary energy consumption
- The heat pump control.

Heat sources

The choice of the heat source is of vital importance for the heat pump, as it will directly influence its application, efficiency (COP & SPF) and initial and operating costs. Heat sources that can be used by heat pumps are air, water and ground.

The main factors that will affect this choice are:

- Its availability: quantity, location relative to need and coincidence with need;
- Its cost: installation, operation and maintenance;
- Its temperature: level (the higher the better) and variation.

Ambient air, the most common heat source for heat pumps, is free and widely available. However, air-source heat pumps achieve on an average 10 to 30% lower seasonal SPF than ground-source or water-source heat pumps. This is mainly due to the

Heat Source	Examples	Advantage	Disadvantage	Remarks
Outside Air	Ambient Air (10 to 30^{0}C)	Unlimited availability Low Investment	• Low Temp. in winter lower COP • Additional heating required • No storage effect, no 'free' cooling in summer • Noise pollution	Suitable source for gas absorption heat pump as small source capacity required
Ground	• Shallow ground • Horizontal Collectors • Vertical Collectors	• Potentially unlimited availability • Constant temperature higher COP • Possibility 'free' cooling in summer • Needs only a small amount of ground area	• Relatively high investments due to ground collector • Output dependent on thermal properties of the soil and collector area • Available ground area for horizontal collectors can be limitative • Cost of well drilling prohibitive • Might need permission from authorities	• The ground collector is generally close-looped and can be horizontal or vertical • The heat reserve of the ground can be regenerated by solar collectors or by heat disposal during summer.
Surface Water	Pond & Rivers, Sea, Wastewater	• Usable temperature for circulating or flowing water • Unlimited availability if source in the vicinity	• Low temperature with dead water in winter • Permission of the water board may be required • Water needs to be filtered	

rapid fall in capacity and performance with decreasing outdoor temperatures.

A ground-source heat pump uses the earth or ground water or both as sources of renewable heat. The temperature of the ground doesn't vary very much over the year. This ensures a relatively stable supply of heat for the heat pump and higher performances than air-source ones. Heat is removed from the ground through a collector and transferred to the heat pump via a liquid (water or antifreeze solution).

Open water can also be used as a low temperature heat source. Rivers, streams and lakes, when available, are ideal sources of energy. They have the advantage of needing much less collector surface area than for a ground-source heat pump.

The table above presents the advantages and disadvantages of the most common heat sources:

Refrigerants

The working fluid in a heat pump must be chosen with consideration of a number of different aspects. Some of the working fluids that have been used extensively in heat pumps have been discovered to have severe impact on the environment and have therefore, been subject to international phase out schemes and strict regulation. The refrigerant must fulfil a number of requirements, of which the most essentials are reviewed below.

Chemical stability

The refrigerant has to be completely stabile within the system and ideally quickly decompose to harmless substances in the atmosphere.

Environmental impact, health and safety

Environmental impact due to direct emissions (leakage) must be kept at minimum level. The use of flammable and toxic refrigerants is limited due to regulation and reluctance from the industry.

Thermodynamic properties

- Freezing temperature: well below normal operating conditions
- Critical point and boiling point temperatures have to be appropriate for the application
- Reasonable operating pressures are preferred in order to keep costs at a minimum. High volumetric refrigeration capacity is beneficial.

Practical characteristics

- High oil solubility is in general preferred
- Compatibility with common construction material
- Low cost.

Maintaining and servicing

Heat-pump performance will deteriorate without regular maintenance and service. The difference between the energy consumption of a well-maintained heat pump and a severely neglected one ranges from 10 to 25%.

Regular maintenance

Either the homeowner or service technician can perform the following routine maintenance tasks:

- Clean or replace filters regularly (every 2 to 6 months, depending on operating time and amount of dust in the environment).
- Clean outdoor coils as often as necessary (when dirt is visible on the outside of the coil).
- Remove plant life and debris from around the outdoor unit.
- Clean evaporator coil and condensate pan every 2 to 4 years.
- Clean the blower's fan blades
- Clean supply and return registers and straighten their fins. ■

Kapil Singhal
Proprietor
B P Refcool

Rising Carbon Intensity In India

India has taken several steps to control emissions and carbon intensity, including stringent emission standards, nationwide energy conservation programme, a recent four-fold increase in carbon tax, establishing smart cities and building additional forest cover…

According to PwC's seventh annual Low Carbon Economy Index, which models major economies' carbon intensity – the measure of energy related greenhouse gas emissions per million dollars of GDP, India's energy emissions rose at 8.2% on-year in 2014 – highest in the world, driven by a double-digit growth in demand for coal, as power consumption increased in line with the rapid 7.4% growth in GDP. Global emissions rose just 0.5%, albeit on a much lower world GDP growth of 3.3%.

The country's carbon intensity grew 0.7%, as renewable energy adoption remained slow. However, its share in India's energy mix remained unchanged at 7%, despite high growth in coal-fired power generation. By comparison, global carbon intensity fell 2.7%, recording steepest decline in seven years of the PwC analysis. India's carbon intensity, despite rising in 2014, is about half that of China, and is still less than the global average.

India has taken several steps to control emissions and carbon intensity, including stringent emission standards, nationwide energy conservation programme, a recent four-fold increase in carbon tax, establishing smart cities and building additional forest cover.

In the words of Arvind Sharma, Executive Director, Sustainability, PwC India, "India's Intended Nationally Determined Contribution (INDC) unveiled ambitious 2030 plan. There is a strong focus on renewable energy, energy efficiency, smart cities and stringent emission standards for coal fired power plants among others. With this ambitious plan, which cuts across thematic areas ranging from mitigation to adaptation, we believe that India is in a good position to access low cost finance and clean technology."

Over a longer period, India has reduced its carbon intensity by 1.4% per year between 2000 and 2014. Its rate of reduction in carbon intensity is slightly better than the global average of 1.3% per year during 2000-2014.

However, that's short of the targeted 2.1% yearly reduction by 2030, as outlined in its INDC plan, in the lead up to Paris. India committed to reduce its carbon intensity by 33 to 35% by 2030, from 2005 levels, in its INDC plan.

Being the 4th largest emitter and expected to be the world's fastest growing major economy, India's carbon intensity management will play an important role in determining world's ability to limit the global temperature rise to 2°C by the year 2100.

Coal and oil are large parts of India's energy consumption, and GDP growth is expected to slow. This will make it hard for India, but it has still left a large gap between its target and the decarbonisation rate needed to achieve the target of limiting warming to two degrees.

The global carbon reduction of 1.3% per year in 2000-2014 also fell short of the 3% annual cut needed as per the Paris target. Moreover, globally, carbon intensity needs to be cut 6.3% per year, far more than the 3% Paris target, if the warming is to be limited at two degrees. ■

	2013-2014				Trend this century	
Country	Change in carbon intensity 2013 – 2014	Carbon intensity (tCO2/$m GDP) 2014	Change in energy related emissions 2013 – 2014	Real GDP growth (PPP) 2013 – 2014	Annual average change in carbon intensity 2000 – 2014	Annual average change in GDP 2000 – 2014
World	-2.7%	306	0.5%	3.3%	-1.3%	3.7%
G7	-3.1%	266	-1.5%	1.6%	-2.0%	1.4%
E7	-3.4%	378	1.8%	5.4%	-1.1%	6.7%
UK	-10.9%	173	-8.7%	2.6%	-3.3%	1.7%
France	-9.1%	124	-8.9%	0.2%	-2.7%	1.1%
Italy	-7.8%	151	-8.2%	-0.4%	-2.2%	-0.1%
Germany	-7.1%	201	-5.7%	1.6%	-2.0%	1.0%
EU	-6.7%	187	-5.4%	1.3%	-2.4%	1.2%
China	-6.0%	515	0.9%	7.4%	-2.0%	9.8%
Australia	-4.7%	342	-2.3%	2.5%	-2.4%	3.0%
Mexico	-3.5%	219	-1.5%	2.1%	-0.2%	2.1%
Korea	-3.1%	419	0.1%	3.3%	-1.3%	4.0%
Japan	-3.0%	273	-3.1%	-0.1%	-0.7%	0.7%
Canada	-2.4%	366	0.1%	2.5%	-1.7%	2.0%
Russia	-2.2%	409	-1.6%	0.6%	-3.6%	4.1%
Argentina	-1.7%	191	-1.2%	0.5%	-0.9%	3.6%
US	-1.6%	317	0.8%	2.4%	-2.3%	1.8%
Indonesia	-1.4%	193	3.5%	5.0%	-0.6%	5.4%
South Africa	0.2%	612	1.7%	1.5%	-1.6%	3.1%
India	0.7%	268	8.2%	7.4%	-1.4%	7.2%
Brazil	3.6%	155	3.8%	0.1%	0.0%	3.2%
Saudi Arabia	4.0%	386	7.6%	3.5%	0.0%	5.2%
Turkey	4.4%	224	7.4%	2.9%	-0.6%	4.0%

Key: Top 5 | Bottom 5

Wireless Remote Monitoring

This article explores the wireless options and availability of temperature monitoring and control mechanisms for reefer containers through the wireless mode. It may be necessary for the charterer or shipper to not only be able to monitor the operation of reefer containers being carried on ships, but also be able to make certain changes in operating conditions like temperature settings, fresh air vent openings, humidity settings etc...

Until recently, 'remote monitoring' and 'control of temperatures' and other parameters were perceived to be an expensive proposition, warranted by only very expensive reefer cargo. However, the scene today has changed. This is attributed to two reasons. First: the arrival of fully functioning Low Earth-Orbiting satellites (or 'LEOs' for short). For the international multimodal transport industry this has been a change of the highest significance. Up till now, communication options have severely limited any sort of end-to-end tracking service for multimodal transit. The second change is the increasing presence and accessibility of the Internet. Its low cost, increasing use by those engaged in international transportation and worldwide access make it a key delivery means for cross-domain information. There have been many communication options available to the shipper. Wireless transmission can be using one or many of the multiple

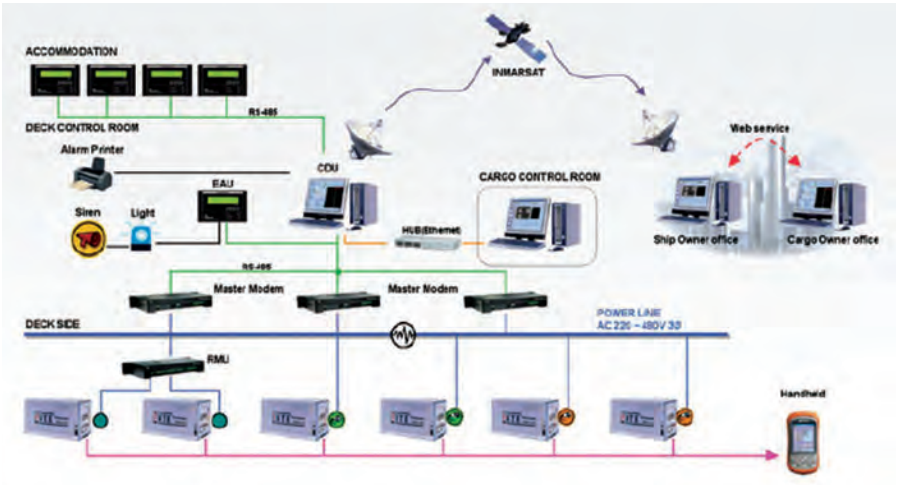


Fig. 1: Wireless remote monitoring of reefer containers...

Fig. 2: A Zigbee module...

transmission methods (Zigbee, GSM, satellite, Wifi). VHF radio has many offerings but is limited by national licensing arrangements and the need to build terrestrial stations: thus there is no viable multi-country option.

Zigbee

ZigBee was conceived in 1998, standardised in 2003, and revised in 2006. The name refers to the waggle dance of honey bees after their return to the beehive. ZigBee is a specification for a suite of high-level communication protocols used to create personal area networks built from small, low-power digital radios. ZigBee is based on an IEEE 802.15.4 standard. Though low power consumption limits transmission distances to 10–100 meters line-of-sight, depending on power output and environmental characteristics ZigBee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones. ZigBee is typically used in low data rate applications that require long battery life and secure networking (ZigBee networks are secured by 128 bit symmetric encryption keys.) ZigBee has a defined rate of 250 kbit/ s, best suited for intermittent data transmissions from a sensor or input device. Applications include wireless light switches, electrical meters with in-home-displays, traffic management systems, and other consumer and industrial equipment that require short-range low-rate wireless data transfer. The technology defined by the ZigBee specification is intended to be simpler and less expensive than other Wireless Personal Area Networks (WPANs), such as Bluetooth or Wi-Fi.

ZigBee is a low-cost, low-power wireless mesh network standard targeted at wide development of long battery life devices in wireless control and monitoring applications. Zigbee devices have low latency, which further reduces average current. ZigBee chips are typically integrated with radios and with microcontrollers that have between 60-256 KB flash memory. ZigBee operates in the Industrial, Scientific And Medical (ISM) radio bands: 2.4 GHz in most jurisdictions worldwide; 784 MHz in China, 868 MHz in Europe and 915 MHz in the USA and Australia. Data rates vary from 20 kbit/s (868 MHz band) to 250 kbit/s (2.4 GHz band).

ZigBee network layer natively supports both star and tree networks, and generic mesh networking. Every network must have one coordinator device, tasked with its creation, the control of its parameters and basic maintenance. Within star networks, the coordinator must be the central node. Both trees and meshes allow the use of ZigBee routers to extend communication at the network level. ZigBee builds on the physical layer and media access control defined in IEEE standard 802.15.4 for low-rate WPANs. The specification includes four additional key components: network layer, application layer, ZigBee Device Objects (ZDOs) and manufacturer-defined application objects which allow for customisation and favour total integration. ZDOs are responsible for a number of tasks, including keeping track of device roles, managing requests to join a network, as well as device discovery and security.

ZigBee is one of the global standards of communication protocol formulated by the relevant task force under the IEEE 802.15 working group. The fourth in the series, WPAN Low Rate/ZigBee is the newest, and provides specifications for devices that have low data rates, consume very low power and are thus characterised by long battery life. Other standards like Bluetooth and IrDA address high data rate applications such as voice, video and LAN communications.

GSM

GSM (Global Standard for Mobile telephony) is an improvement on VHF radio but is still not good enough. It has three (900, 1800 and 1900 megahertz) standards, and it is expensive when used cross-border owing to international gateway charges. In any case, it covers less than 6% of the land-mass of the world and, of course, none of the sea. By comparison, satellites have been in use for over three decades. But the traditional, or geostationary, options have had only very limited use in cargo transportation. This is because their costs have been high and the equipment used has needed large antennae with high power requirements. This is inconvenient to say the least if installed on containers with no power source, which then cannot make intermodal moves because of the large antenna!

Low Earth Orbiting Satellites

Launch of the first commercially available LEOs changed the scenario drastically. These in effect provide GSM-type digital messaging, but over a global footprint and at much more competitive rates. A key advantage of LEO usage is the small antennae used and their low power requirements. These mean that the devices can be battery-supported and are not reliant on ship or vehicle power supply. Just as importantly, the flat antenna used does not interfere with intermodal movement or container stacking.

The most successful of these new LEO operators is Orbcomm, which was started up by Orbital Science Corporation Inc of Dulles, Virginia, in the US, and went live to its customers at the beginning of 1999. Orbcomm is now a worldwide consortium with representatives in every major country. Already most of the world has high-availability coverage and future launches will improve this even further.

ORBCOMM is a company that offers Machine to Machine (M2M) global asset monitoring and messaging services from its constellation of more than 30 LEO communications satellites orbiting at 775 km.

ORBCOMM provides satellite data services with control centres in the United States, Brazil, Japan, and Korea, as well as U.S. ground stations in New York, Georgia, Arizona, and Washington State, and international ground stations in Curaçao, Italy, Australia, Kazakhstan, Brazil, Argentina, Morocco, Japan, Korea, and Malaysia. This is best suited for users who send very small amounts of data. To avoid interference, terminals are not permitted to be active more than 1% of the time, and thus they may only execute a 450ms data burst twice every 15 minutes. The latency inherent in its network design prevents it from supporting certain safety-critical applications.

On July 14, 2014, SpaceX successfully launched 6 OG2 satellites. The launch of the remaining 11 satellites is expected to be completed shortly.

Fig. 3: Temperature monitoring in refrigerated transportation...

Tracking and monitoring solutions

ORBCOMM's dual-mode, ruggedized ReeferTrak device provides visibility, control and decision rules to dispatch and operation centres, maintenance organisations and operational managers of transportation companies worldwide via a web platform. Using a unique direct interface to every reefer's microprocessor, it provides comprehensive temperature, fuel management, maintenance, and logistical applications services to revolutionise refrigerated transportation operations.

Application of LEOs

Tri-mex, an Anglo-Norwegian company, was one of the first to recognise the potential of using LEO communication in the movement of perishable cargoes. Its cargo-tracker service is designed specifically for the requirements of the transportation of temperature-regulated cargo. It integrated its Windows-based tracking and monitoring technology with Orbcomm LEO communicators, and has generated a service where a cargo can be tracked and monitored anywhere in the world - whether on land or at sea. The information generated is shown on its dedicated website 'www.cargo-tracker.com' that can be accessed via any internet-connected terminal, anywhere in the world.

From the beginning, Tri-mex Noticing that its customers wanted more than just tracking and monitoring - they wanted a service that would respond and provide direct action if required, Tri-mex, in 1999, opened a control centre in Oslo, dedicated to monitoring cargo in transit worldwide, 24X7, providing direct, multi-lingual responses in the event of problems. This is equipped with electronic maps and charts covering the world, linked to databases on emergency services and with feeds that update information on transportation conditions, minute by minute, across the world. The Tracar 2 consortium appointed Tri-mex to provide the Cargo-Tracker service for its project. Tracar 2 is a project partly funded by the European Union and managed by Cable & Wireless with major transport companies such as K-Lines, Bluewater Shipping and Scan Shipping. The project is aiming to test the tracking and monitoring of dry containers and reefers moving dry and perishable goods between Aarhus in Denmark and Oporto in Portugal. Tri-mex is installing the technology needed on each container and then providing the tracking and monitoring service through www.cargo-tracker.com. For perishable cargoes, if temperature-tolerance bands are breached, the control centre will respond by making calls to the ship or port and summon manual assistance. This process will take only a few minutes, wherever the cargo is in Europe. Integration of low-frequency tags with the Tri-mex service has allowed precise tracking of containers in port areas. Another innovation being tested live for

Fig. 4: Wireless Reefer Data Acquisition Device (WRAD) developed by RTE...

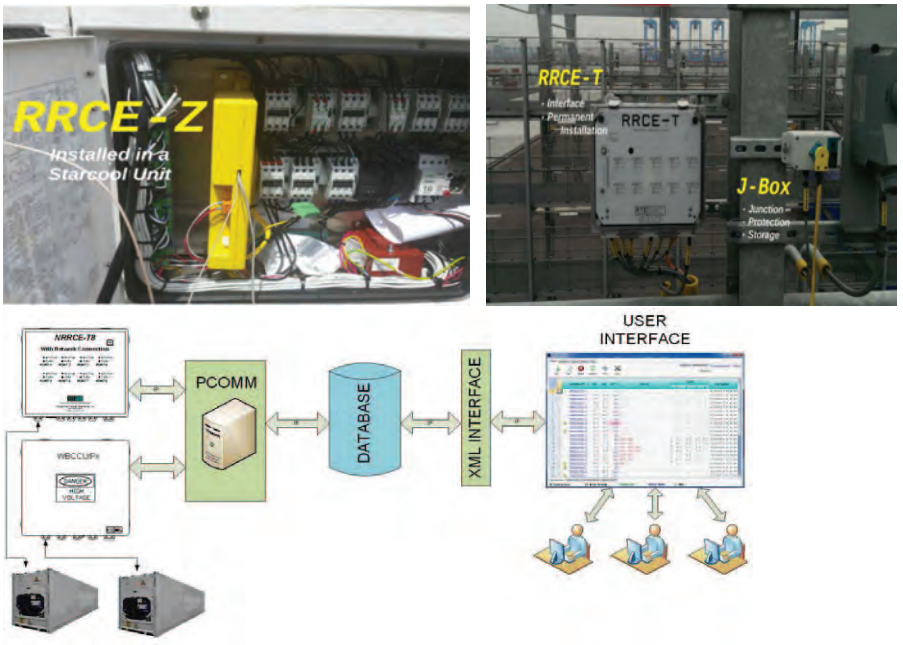


Fig. 5: Reefer Remote Communication Engine (RRCE) developed by RTE...

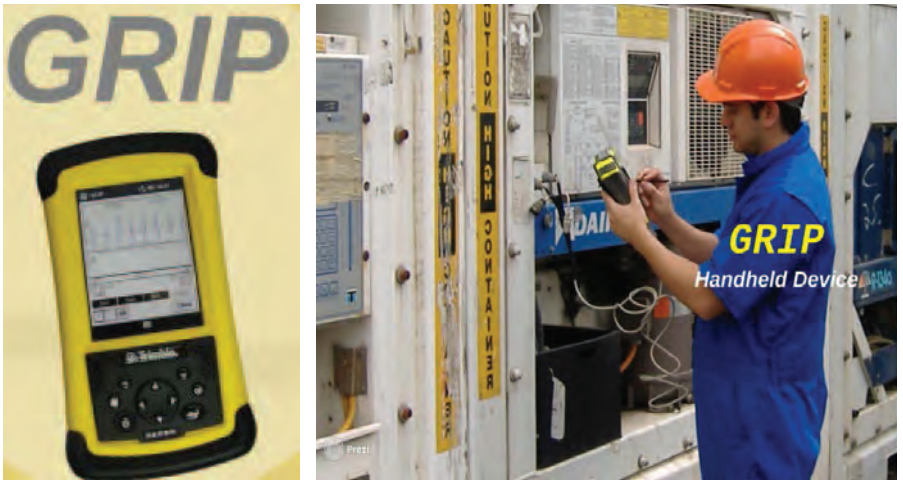


Fig. 6: GRIP- A hand held device developed by RTE...

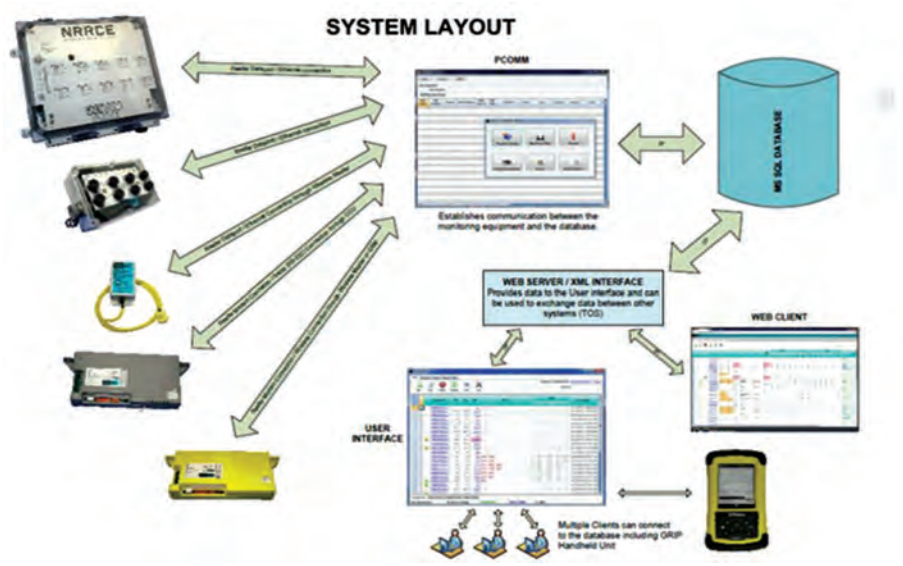


Fig. 7: RTE system options...

the first time will be the capability to 'interrogate' a container wherever it is loaded on the ship - be it above or below deck. This will allow genuine end-to-end monitoring of an intermodal transit through the sea passage, a movement phase that, to date, has been 'blind' or in which containers have had to be pre-positioned on deck to communicate.

Tracar 2 went live in October 1999 and ran through to the end of the year. In addition to this, a capability that leading shippers of perishable goods are looking to test is direct intervention across the network. This involves correcting a temperature variance by an electronic message communicated directly to the instrumentation of the reefer.

Other applications

In 2011, Refrigerated Temperature Electronics Inc. based in USA, had launched the first Wireless Reefer Acquisition Device (WRAD). WRAD provides wireless monitoring option for reefer containers on board the ship. It consists of a hardware device which attached magnetically to the container and connects to the data port of the containers. It is powered with a rechargeable battery. It connects to GRASP 3.0 Reefer Monitoring System developed by RTE.

GRASP 3.0 is a Software which is available as both Microsoft and Web based application. It generates accurate connection and disconnection times, reducing the likelihood of a reefer container not getting plugged in. Data is stored in electronic format, which can be retrieved on demand in the event of a claim. RTE has developed Reefer Remote Communications engines (RRCE) of which one consists of a Modem (RRCE-Zigbee) which is fitted inside the Reefer Container's Control Box. It provides local Wireless Monitoring while the container on board a vessel or a terminal.

It uses short range RF to transmit data. 802.15.4. Another member of RRCE family is (RRCE-T), which can take up to 10 inputs per unit. It is ideal for vessels and terminals with Rack systems. It can work on LAN or Wi-Fi connection. It has a permanently mounted hardware with IP66 enclosure. It has a networked switchover in case of a power loss.

In addition to the above, in 2006, RTE has also developed GRIP, a handheld Data Acquisition device which connects to reefer container's data port. It facilitates users to manually monitor temperatures, download trip records, and operating data from various reefers. It is compatible to all reefer container makes and models. It is enclosed in a rugged waterproof enclosure (Trimble). Information downloaded is synchronised with GRASP 3.0 using standard cradle or Wi-Fi.

In addition to the above, all major reefer container manufacturers have developed hand held data downloading devices suitable for their models of machinery.

Most of them are wired devices. RTE and Psion had held devices are suitable and can be used for downloading data from all makes and models of Reefer Container machinery.

Conclusion

For the perishables transportation industry a new age is dawning. Low-cost technology is allowing tracking, monitoring and intervention for the first time on all classes of cargo. This increases the information available to the client and improves the delivered quality of the goods. For the first time conditions being experienced by cargoes in reefers can be monitored remotely and responded to in minutes in many cases electronically. This will improve the service record of movements of perishables and will bring down operational costs – to the benefit of shipper and customer alike. There is also a good possibility of insurance rates going down with the advent and availability of this new technology. ■

Chilukuri Maheshwar
Senior Training Superintendent – Engg
Anglo Eastern Maritime Academy

Automating Temperature & Humidity Monitoring In The Cold Chain

Testo, one of the world leaders in measurement technology, now offers professional solutions for wireless data logging and monitoring for cold chain management...

Be it food products such as dairy, fruits, vegetables, frozen food or pharmaceutical goods such as vaccines, the cold chain between the manufacturer and the final consumer may under no circumstances be interrupted. Quality deficits, financial losses or even serious damage to the health of the consumer or patient can be the consequence.

The measurement technology manufacturer Testo offers cold chain management professionals an efficient solution for automatic monitoring and documentation of temperatures and humidity values in all refrigerated rooms and across the cold chain. The innovative monitoring system testo Saveris 2 saves the work of reading out and documenting the individual measurement data, simplifying the assurance of high product quality.

In order to guarantee the quality and shelf-life, and to comply with legal hygiene standards, perishable products such as food or also pharma products need to be stored and processed under constantly perfect climatic conditions. Thanks to a Cloud-based application, the WiFi data logger system-testo Saveris 2 that allows to monitor the temperatures and humidity values in all refrigerated rooms and displays if the climatic conditions are under control everywhere at all times – without any ongoing work procedures.

Once the system is installed, it monitors and documents the ambient temperatures

fully independently. The measurement data are directly transmitted to the online data store – the Testo Cloud – by wireless LAN, where they can be called up, managed and analysed online by the user via smartphone, tablet or PC absolutely anywhere and anytime. This uninterrupted and exact documentation allows the stringent HACCP standards to be adhered to. Another important advantage of the system: if an upper or lower temperature or humidity limit is exceeded, the user is immediately provided with an alarm by e-mail, or optionally by SMS. The system can be easily and quickly installed. For the use of the Cloud, customers can choose between the free basic or the more comprehensive advanced functionality, depending on their requirements.

This new WiFi data logger system – Testo Saveris 2 has replaced time-consuming manual data monitoring and documentation.

Reliable cold chain monitoring during transport

Testo also offers a solution for reliable cold chain monitoring during transport.

With the new data loggers testo 184, you can monitor every step of the cold chain. The loggers travel on your behalf in freight and loading rooms, monitoring temperatures during the transport of sensitive goods on rail, in the air or on the road. At their destination, your see at a glance whether the configured limit values have been adhered to. In order to obtain detailed information, you just need to connect the logger to a PC – a PDF report is immediately generated with all relevant data.

These loggers are preconfigured and operated with just a 'Start' and a 'Stop' button. No measurement experts are required for their operations. A simple logistic operator can also manage the start & stop of a measurement cycle.

Furthermore, it requires no software download, no installation for accessing the data. The sender of the package is geographically at a different location than the receiver of the package. In such cases, just plug in any USB cable to the computer and the data can be accessed. A PDF/A report with the transport data is created immediately on connection of the testo 184 data logger to the USB interface of a computer. All testo 184 data loggers can be read out on site also with an NFC-capable Android smartphone.

Use & throw version of these loggers further eliminate the trouble of sending the logger back to the sender, especially during exports. Testo also offers a special data logger for dry ice applications - testo 184 T4. Dry ice (-80°C) is used for transport especially in the pharmaceutical industry, for example when transporting blood plasma, organs, virus, scientific material, etc. testo 184 T4 logger housings are made out of a special ABS polymer that can survive in such low temperatures. The extremely cold conditions are also very harsh for the batteries. Nevertheless testo 184 T4 batteries can hold for 100 days at -80°C.

testo 184 data loggers are compliant to the most important standards for the transport of pharmaceuticals and food products, namely, GxP (GMP, GLP & GDP), 21 CFR Part 11, HACCP and EN 12830.

Write back to us at info@testoindia.com to know more about testo WiFi data loggers and the transport loggers. ■

Airedale launches new SmartCool DX inverter-driven PAC

Airedale International has launched a new air-cooled, mechanical direct expansion (DX) inverter-driven variant of its popular SmartCool Precision Air Conditioning (PAC) system. The SmartCool SV DX i-drive PAC (5-83kW) delivers very precise supply air temperature up to 26°C under variable heat loads and wide outside ambient conditions of between -20°C to +50°C. A unique feature, an optional segregated evaporator coil allows a high level of control over dehumidification and cooling capacity, when operating under constant pressure control, helping to manage air distribution and prevent hot spots. Designed for use in high density applications using elevated return air temperatures, hot and cold aisle containment as well as perimeter cooling environments, the SmartCool SV range is available with the option of high capacity compressors for extreme temperature applications. ■

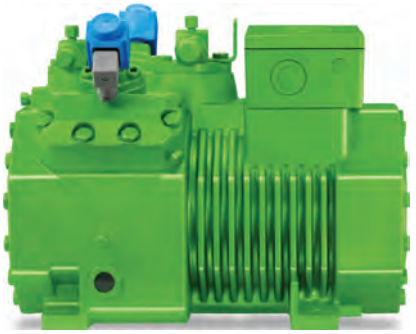
Website: www.airedale.com

BITZER supplies reciprocating compressors

Reciprocating compressors belong to BITZER's most important product areas and, in tandem versions, some can offer flow rates of up to about 300 m3/h (50 Hz). One of the BITZER highlights for China Refrigeration 2015 is the family of ECOLINE reciprocating compressors designed for supermarket applications, air conditioning systems and heat pumps as well as the compatible CRII capacity control system.

This new control system allows cylinders to be switched off at optimal times, a wide range of control between 10 and 100 per cent and high reliability. Other advantages of the CRII system include being able to lower operating costs and protect the environment thanks to the high switching frequency. In the VARISPEED version, the ECOLINE has an ideal, factory-integrated frequency inverter cooled by the suction gas, which permits the cooling capacity to be smoothly adjusted. This lowers energy costs as the variations in suction pressure are reduced, as is the frequency of switching. ■

Website: www.bitzer.de



Hansen Technologies Corp presents standard gas sensor

For operating temperature down to 0ºF (-17ºC). The standard sensor comes in a NEMA4 (IP65) watertight enclosure. Mountable indoors or outdoors (out of direct sunlight)... Enclosure is ABS material with a gasketed ABS cover; single ½" conduit knockout is provided. ■

Website: www.hantech.com

Dometic Marine presents cup cooler

Dometic Marine offers the marine industry's first thermoelectric refrigerated cup holder for pleasure and work boats. Developed to keep drinks chilled - even while enjoying them in very high temperatures, the Dometic Cup Cooler ensures canned or bottled drinks are refrigerator cold until the final drop. ■

Website: www.dometic.com

Extech offers AC/DC magnetic field meter/datalogger

Extech's SDL900 measures and datalogs both AC and DC Magnetic Field in Gauss and mT (milli Tesla) with a uniaxial Hall effect sensor and built-in ATC. Internal memory stores up to 99 readings, while SD memory card (included) allows continuous data logging and readings can easily be exported to an Excel format for further analysis. The product may be used in fields like: Electric transmission equipment, Power line, Microwave oven, Air conditioner, Refrigerator, Computer monitor, Video/audio device, Particle accelerators, MRI, Industrial & research labs, Transportation Systems, Elevators, Battery power and Wind power etc.

Features:

- Utilises Hall effect sensor with ATC (Automatic Temperature Compensation)
- Adjustable data sampling rate: 1 to 3600 seconds
- Memory stores 99 readings manually
- Datalogging feature records readings with date and time stamp on an SD card (included) in Excel format
- N pole/S pole indicator
- Zero button for DC measurement
- Data Hold and Min/Max
- Auto power off with disable
- RS-232 interface with optional software
- Complete with uniaxial magnetic probe sensor with protective cover, SD memory card, 6 AA batteries, and hard carrying case. ■

Website: www.extech.com

MECO presents infrared thermometers

MECO infrared thermometers are used to measure the amount of heat present in the measuring object from a distance. These thermometers are available in three models:

Features

IRT380P: Temperature ranges from -50°C to 380°C with the accuracy of ± 1.5°C and emissivity 0.95. Temperature can be measured with the Distance to Spot ratio of 12:1. It has seven special functions namely Max function, Min function, °C/°F Selection, Laser Switch, Auto Power Off, Low Battery Indication and Backlight Display.

IRT550P: Temperature ranges from -50°C to 550°C with the accuracy of ± 1.5°C and emissivity 0.95. Temperature can be measured with the Distance to Spot ratio of 12:1. It has seven special functions namely Max function, Min function, °C/°F Selection, Laser Switch, Auto Power Off, Low Battery Indication and Backlight Display.

IRT1050P: Temperature ranges from -50°C to 1050°C with the accuracy of ± 1.5°C and emissivity 0.10 – 1.00 (Adjustable). Temperature can be measured with the Distance to Spot ratio of 50:1. It has special functions namely Max function, Min function, °C/°F Selection, Laser Switch, Auto Power Off, Low Battery Indication, Backlight Display, DIF Function, AVG Function, Data Storage and High / Low Temp. Alarm Setting Function. ■

Website: www.mecoinst.com

Rittal offers Top Therm chillers

TopTherm chillers in a TS enclosure can be integrated perfectly into an enclosure suite. With their small footprint, modular design and dual-frequency compatibility, they are extremely flexible. In addition, they promise convenient servicing and high reliability thanks to protection against icing.

This configurator is a cost-effective way of designing your required machine and process cooling. Cooling output, volumetric flow and coolant temperatures are precisely tailored to the required level of your application. ■

Website: www.rittal.com

Dometic Australia releases mobile absorption refrigerators

Dometic Australia has released the newest in their range of mobile absorption refrigeration with the 95 litre RM 2356 three-way upright refrigerators using the latest in Dometic technology. The RM 2356 is ideal for caravans, motorhomes and campers that require a compact upright absorption fridge with a large internal capacity of 95 litres with a three cubic foot cut out.

On top of the compact design, the RM 2356 is super convenient with the ability to run off three power supplies by using the new Universal Energy Selection (UES) control system. Dometic's superior absorption technology is completely silent allowing the traveller to sleep in peace when taking their RM 2356 on the road. ■

Website: www.dometic.com.au

Gandhi Automations Offer Industrial Entrance Solutions

India's No.1 Entrance Automation & Loading Bay Equipment Company, Gandhi Automations Pvt. Ltd. offers Porto and Max Vista - Automatic Sectional Overhead Doors – the ideal solutions for all industrial and commercial needs.

Porto: Porto Sectional Overhead Doors are ideal for all industrial and logistics needs. The design and different solutions offered ensure the door to be aesthetically pleasing and perfectly suited to any architectural environment - from modern and traditional industrial buildings to fine commercial buildings. As these doors slide vertically, stopping in the proximity of the ceiling, they blend in with the architectural features of the building. Porto doors are built to ensure the highest ease and flexibility of use, which in turn ensures a quick, hassle free and accurate replacement of old doors. Their compact size ensures more available space both inside and outside the premises. Depending on the structure of the building and the requirement a choice can be made from a standard lift, vertical lift, horizontal lift, low headroom or inclined lift. Porto range consists of a wide series of track systems, panel options and safety features. Special glazed doors provide excellent lighting and vision into the building where required.

Max Vista: Max Vista Sectional Overhead Doors are ideal for industrial and commercial buildings. The doors are made with a combination of aluminium panels and transparent acrylic, grilled or meshed windows giving it a distinctive look and enhancing the look of a building. Max Vista Doors make the environment bright and pleasant to work in as it allows natural light to pass through the large clear areas.

Gandhi Sectional Overhead Doors provide heat insulation and sound proofing thus improving the working conditions on the premises and saving energy. The products are affixed with a CE mark making them reliable and safe.

Key Features:

- Reliable and low- noise operation
- Extreme robustness
- Safe operation in compliance with safety requirements
- Design-oriented surfaces and optimum light solutions
- Minimal bulk for more space indoors and outdoors
- Easy and practical to open and operate
- Energy savings and more comfort
- Bright indoor environment and attractive design
- Pre-painted, galvanised steel, sandwich panel, thickness 40 mm, 80 mm and 100 mm
- The gaskets, made of a special non ageing rubber, seal the perimeter of the door opening
- They produce a perfect seal, preventing water, air and dust infiltration
- Minimal bulk for more space indoors and outdoors
- Easy and practical to open and operate
- Energy savings and more comfort
- Bright indoor environment and attractive design
- Sectional Overhead Doors can be customised as Gas Tight Ripening Room Doors
- Opening – Closing speed = 0.2 - 0.4 m/s.
- Sizes available : Width (max) = 15000 mm
- Height (max) =10000 mm.

For further details, contact: sales@geapl.co.in ■

Hospital building hosts several sustainable features

Image Courtesy: www.multicare.org

The award was given considering the building's water and energy saving features and environment-friendly construction methods...

Puyallup's Multi Care Good Samaritan Hospital, the nine-story, $300-million Dally Tower, received the Green Building Institute's LEED Gold award in 2012. The hospital tower was Washington's first hospital structure to win the Gold award for energy and resources conservation.

The award was given considering the building's water and energy saving features and environment-friendly construction methods. The building and parking structure replaced surface parking lots and a public street, and also replaced impervious surfaces with permeable green space. The structure added no new impacts to the storm water system.

The architect for the project was the Good Sam Design Collaborative, and the members involved from them were Clark/Kjos Architects and GBJ Architecture. The general contractor was Skanska USA. Some other sustainable features of the hospital building are: ecoroofs, bioswales, rain gardens, minimum east-west exposure, sun shades on the windows, renewable-recycled-and-regionally sourced materials, certified wood, low-VOC interior finishes and linoleum-rubber flooring. ■

Standard Chartered's office building saves energy cost

To help fulfill its social brand promise of sustainability and efficiency, Standard Chartered chose CommScope's Redwood building intelligence platform to achieve significant energy savings, improve workplace experience and capture advanced occupancy data within two new office buildings in Asia.

After an exhaustive vendor search, project teams at Standard Chartered locations at Changi Business Park II in Singapore and The Forum in Hong Kong found the Redwood building intelligence platform to be the best option to provide energy savings through efficient LED lighting. Redwood provides sensory network data that enables the bank to better understand both its office space occupancy and energy usage.

"Part of our brand promise focuses on the legacy we leave behind for future generations – and that is more than just wealth. Since the Redwood solution has been operational, we know The Forum now uses approximately 60% less energy with 6% fewer lighting fixtures," said Denis McGowan, Global Head, Workplace, CRES, Standard Chartered. ■

Image Courtesy: www.asiagreenbuildings.com

Since the Redwood solution has been operational, The Forum now uses approximately 60% less energy...

Certification of world's first Passive House Premium is done

Image Courtesy: www.flickr.com

The project was developed by the building services company Airoptima, which now has its headquarters in the world's first Passive House Premium...

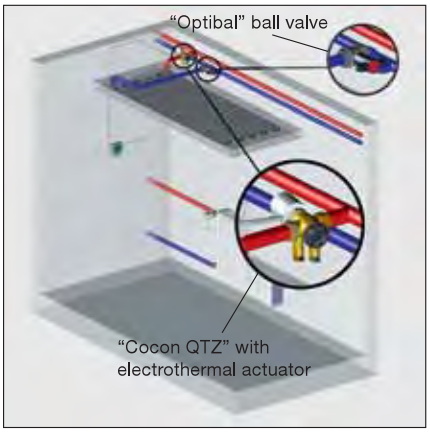
One of the world's most sustainable buildings stands in Bavaria: as the first of its kind, a mixed residential and commercial project in the town of Kaufbeuren has met the criteria for a Passive House Premium certification. With a heating demand of only 8 kWh/m^2, it is uniquely energy efficient. At the same time, a 250 m^2 photovoltaic system on the roof produces renewable energy. The project was developed by the building services company Airoptima, which now has its headquarters in the world's first Passive House Premium. With a total area of about 900 square metres, the building, officially known as the 'House of Energy,' also has space for the operations manager's flat, a training centre, and a permanent exhibition on the topic of 'Construction and Refurbishment.' The three-storey solid construction was certified by the company Herz & Lang. As in every Passive House building in Central Europe, maximum energy efficiency is ensured through triple-glazed windows, an excellent level of thermal protection, an airtight building envelope, largely thermal bridge-free construction and a ventilation system with heat recovery – as for the ventilation, devices from different manufacturers were installed for comparative measurements. ■

MADE IN GERMANY

Pressure independent dynamic balancing valve (PID) “Cocon Q” with automatic flow control: multifunctional and economical

“Cocon QTZ” with electromotive actuator/with pressure test points

“Cocon QFC” with electromotive actuator/with pressure test points



Chilled ceiling system

The Oventrop pressure independent dynamic balancing valve “Cocon Q” combines two hydronic functions in one valve.

Firstly, in connection with standard actuators or thermostats (M 30 x 1,5), the valve controls the flow rate depending upon the room temperature requirements.

Secondly, the maximum flow rate, when the valve is fully open, is automatically controlled, ensuring that the maximum required flow rate in all supply risers is not exceeded.

Your advantage:
- multifunctional applications (e.g. chilled ceilings, fan coil units, air handling units, convector and central heating systems)
- presetting and optical display of the nominal values even with mounted actuator

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