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Publisher's Letter

Energy efficiency emerges as the decisive factor

India's air-conditioning market has already emerged as one of the largest in the world after China, regardless of various figures being quoted by industry bodies as well as research reports.

It is also a well known fact that the biggest hurdle in the way of popularising the air-conditioner market in India is electricity consumption.

Both domestic and industrial air users experience that their electricity bills due to air conditioning tend to increase, especially during summer – a time when air conditioners become almost an unavoidable necessity in India.

To add to their predicament, reliable and stable electricity supply is yet to be achieved even in most of India's urban areas.

The air conditioning industry has made use of this opportunity to innovate as well as design products which take typical Indian conditions into consideration. Air conditioners with inverters are a good example of such innovation.

However, if the air conditioning market has to be expanded further, energy efficiency would be the obvious area of opportunity to innovate further.

Since air conditioning devices tend to be one of the largest guzzlers of electricity, energy efficiency has emerged as the decisive factor in India's air conditioner market.

India's Bureau of Energy Efficiency has already recognised this reality and introduced a smart phone application available at Google Playstore, which would enable customers to purchase 'BEE Star Labelled' devices which are energy efficient.

Due to reduction of customers' electricity bills, BEE initiatives like the one mentioned above, are bound to increase customer awareness in the days to come.

This issue of Cooling India features two pieces on energy efficiency which readers may find relevant.

Please send your comments at pravita@charypublications.in

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Managing Director
Testo India Pvt. Ltd.

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FROM THE EDITOR

3D Printing In The HVAC Industry

Although not yet so popular, application of additive manufacturing technology has already been tried in the HVAC industry. And in some cases the results are quite excellent. It has saved both time and money. Let me put an example here. RedDOT is a company that designs and builds mobile Heating, Ventilation And Air Conditioning (HVAC) systems and components for demanding applications.

RedDOT typically creates a custom design for each vehicle in which its HVAC systems are used. These systems often include injection mouldings, which are expensive to produce in low volumes, often running into the hundreds of thousands of dollars per project. This makes it critical to get the design perfect before committing to tooling.

In the past, the company ordered Stereolithography Apparatus (SLA) and Selective Laser Sintering (SLS) parts from an out-of-state service. The long leadtimes slowed the product-development process. And these prototypes were not rugged enough to use for physical testing. A Stratasys reseller suggested that a Fortus FDM machine could solve both of these problems by providing the internal capability to build rapid prototypes with nearly the same properties as production parts.

According to the Stratasys reseller, Steve Kidd, President of CIMtech Inc., "We offered to build a prototype at no cost so (that) they could easily see the value." Kidd explained. "They were amazed that the part was robust enough for physical testing. RedDOT purchased a Fortus 400mc 3D Production System – because its 14 inch by 16 inch envelope enables the company to make their largest parts in two pieces."

Thus, additive manufacturing or 3D Printing technology has a high potential in HVAC spare parts industry. However, the technology should be introduced exhaustively in the HVAC industry, and also utilised properly with thorough knowledge. Use of HVAC systems is spreading very fast globally, and the old generation machines are being refurbished too. Thus, the time is almost ripe for its spare parts market, wherein adoption of additive manufacturing technology will soon be very essential to beat the competition.

"Technology should be introduced exhaustively in the HVAC industry, and also utilised properly with thorough knowledge..."

Pl. send your views at pkchatterjee@charypublications.in

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Editor: P K Chatterjee

Australian politician to air-condition schools using solar energy

Australian politician Danny Donohue and Ipswich city council's Division 3 candidate, has announced plans to use solar power to implement one of his key election commitments, which is to air-condition all classrooms in Ipswich.

"There are solar powered air-conditioning systems that solve a lot of the problems that have been raised since I announced my policy. We would likely use 48V off-grid inverter air-conditioners, sized to fit any room. Some schools have the problem of ongoing electricity costs. My solution solves that. Naturally solar air-conditioning has no ongoing electricity costs and no burden on the school budget. Some schools have to pay for an expensive upgrade of existing wiring before traditional air-conditioners can be installed. These systems don't require any existing wiring. Again problem solved," he said.

Donohue, who has an Environmental Management degree, said that solar powered air-conditioning is perfect for schools.

"Schools mainly operate during the day. There would be no need for mains power backup. These systems are cost-effective and have quality Toshiba and Mitsubishi components," he said, adding that his policy would mean that Ipswich could lead the way in improving school education.

"It would be something to really be proud of. An education revolution and the return on our investment would be intelligent, well-educated adults. There are companies ready to go with this technology. But it gets even better. The beauty of these systems is they can come with educational programmes and software. Students can monitor solar generation and carbon emission offsetting live on a daily basis," he said.

"High School economics students can participate in carbon trading schemes, all the time encouraging students to be socially and environmentally responsible," he said. ■

Top 5 vendors in refrigerated sea transportation market announced

Technavio has announced the top five leading vendors in their recent global refrigerated sea transportation market report. This research report also lists 18 other prominent vendors that are expected to impact the market during the forecast period.

According to the report the global refrigerated sea transportation market is highly consolidated, and is dominated by a few global vendors. CMA CGM, Maersk Line, MSC, NYK Line, and Seatrade Reefer Chartering are the leading vendors in the market. The market requires vessels to adopt hi-tech technologies and is characterized by its capital-intensive nature.

"The key differentiating element in the global refrigerated sea transportation market is the quality of the services provided by these companies. The major challenges for vendors in this market are the expenses incurred for maintenance of vessels, and the depreciation in the value of reefer vessels," says Sharan Raj, a lead analyst from Technavio, specializing in research on the food industry.

One of the fast-trending factor captivating the refrigerated sea transportation vendors is the shift toward container leasing. ■

Dulas launches battery-free solar fridges for vaccine storage

Renewable energy systems manufacturer Dulas has officially launched its battery free solar vaccine refrigerators.

The firm was awarded more than £57,000 by the Welsh government to support development of battery-free solar power refrigerators that can help bring vaccines to remote parts of the developing world.

Dulas pioneered the use of solar powered refrigerators in the 1980s, for use in off-grid areas to keep vaccines at the necessary low temperatures. However, solar refrigeration systems typically rely on large, heavy batteries to store energy when the sun is down.

Instead, newly developed Solar Direct Drive Refrigerators instead use an advanced phase change material (PCM) which freezes and thaws at 5C, avoiding the need to batteries. Solar energy is used during the day to freeze the PCM, which then slowly melts to maintain a stable 5C temperature inside the refrigerator, which is ideal to store vaccines. ■

Chillventa Award 2016 to be awarded in four categories

Chillventa has announced plans to present awards in four categories, namely commercial refrigeration, large-scale refrigeration, air-conditioning and heat pumps to recognise special and exemplary expert team projects by European manufacturers.

"We are very pleased that we will be awarding the Chillventa Award this year for the first time. There are not many sectors of industry that are as innovative and inventive as the refrigeration, air-conditioning, ventilation and heat pump community, and it is only right to highlight and pay tribute to this. At Chillventa, experts from around the world meet, develop projects together and set them on track. It was therefore an obvious opportunity to invite entries for a high-quality competition to evaluate the best, most exciting and most innovative projects in four categories and to present them with the Chillventa AWARD. Chillventa is an ideal platform for a prize of this quality", stated Chillventa Award initiators, Christoph Brauneis, Senior Editor KKA, tab and jury member, and Daniela Heinkel, Director Exhibition Chillventa, NürnbergMesse.

The Chillventa Award honours teams of experts (planners, system builders, principals/operators) who, in an exemplary collaboration going beyond normal technical standards, have realised a project that excels in terms of functionality, energy consumption and technical innovations. In evaluating the projects, the jury – in line with the Chillventa motto of "Connecting Experts" – will focus in particular on the interplay between the people involved in the project, from conceptual formulation, through planning and system construction to the operation of the system.

Projects submitted for the award must clear demonstrate and map the level of quality reached through cooperative planning.

Alongside these points, the Chillventa Award will also consider the above-mentioned aspects of the system's functionality, energy consumption and technical innovation. Other aspects, such as compliance with the planned budget and timetable, environmental safety requirements, certifications, etc. will be integrated into the jury's assessment. ■

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Split air conditioning market to exceed 104 billion tonnes by 2020

The global split air conditioning market is expected to exceed 104 billion tonnes by 2020, increasing at a compound annual growth rate (CAGR) of over 6 percent during the forecast period, according to the latest market research study released by Technavio in London recently.

This research report, "Global Split Air Conditioning Market 2016-2020," provides an in-depth analysis of the market in terms of revenue and emerging market trends. It also includes an analysis and forecast for various market segments and geographical regions.

The report segments the market into four broad categories, namely, global ductless standard split a/c market, global VRF a/c market, global US ducted split a/c market and the global ducted standard split a/c market.

The global ductless standard split air conditioner market is projected to grow from $58 billion in 2015 to over $73 billion in 2020.

According to Anju Ajaykumar, lead research analyst at Technavio, "Energy efficiency and ease of installation are the main reasons for the growth of this segment".

This type of a/c unit has an established market in the US, Europe and Japan, but is also becoming increasingly popular in other parts of the world such as India, Indonesia, and China. In India, rising disposable income and the growing middle class are responsible for the surge in demand for ductless standard split air conditioners.

According to the US Energy Star programme, an Energy Star ductless a/c unit is capable of saving up to 30 percent in heating and cooling costs, the report said.

The revenue of the global variable refrigerant flow (VRF) air conditioner market is expected to exceed $20 billion by 2020, growing at a CAGR of almost 12 percent, the Technavio report said. ■

Refrigeration Equipment Market in Europe set to grow

The global industrial refrigeration market is expected to grow from $22,571 million in 2014, and reach $33,904 million in 2020, with a CAGR of 7.1%, according to a market research report by P S Market Research.

Evaporator unit, industrial racks, and compressor together accounted about 64% share of the global industrial refrigeration market in 2014.

The growth of food processing industries, in addition to the expansion of refrigerated warehouses in developing countries, such as India, China, and Brazil, is expected to boost the demand of industrial refrigeration during the forecast period. The growth in outsourcing of pharmaceutical manufacturing facility by developed countries has lifted up the demand of pharmaceuticals cold chain supply and logistic in recent years.

Industrial refrigeration plays an important role in chemical manufacturing as well as oil & gas industry. ■

UBA says CO2 car proves efficiency

A car operating with a CO2-based air conditioning system is claimed to be operating more efficiently than current models running with R134a.

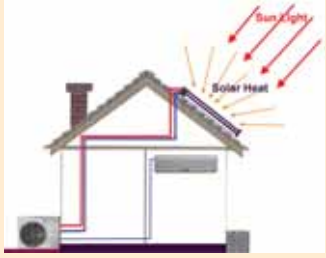
Trials conducted by the German environmental agency Umweltbundesamt (UBA) are said to have shown shown that the energy consumption of a CO2 system during a normal European summer is lower than that of a similar car with an R134a system.

Until 2009 and the rise of R1234yf, CO2 had been the refrigerant of choice of the German car industry as Europe sought a replacement for R134a, a refrigerant under the European MAC directive.

The subsequent global acceptance of R1234yf forced the German car makers to conform, some reluctantly. Since 2009, the UBA has been continuing to trial CO2 in a vehicle, as part of a research project. ■

Canadian Hospital turns to solar power for air conditioning

A combined project utilising renewable energy is underway at West Coast General Hospital in Canada.



A roof-top makeover is in progress at the hospital where photovoltaic solar panels are being installed.

Victor Noll, facilities, maintenance and operations manager at WCGH, said the solar panels are expected to be installed and ready.

There are 404 solar panels being installed, said Scott Fleenor, principal at Terratek Energy Solutions, the company tendered for the instal. Fleenor thinks this is the largest photovoltaic installation on the Island.

The solar panels will help reduce operating costs, energy consumption and waste for the hospital while producing energy locally.

In addition to the solar panels, a new chiller, which is a system that provides cooling to the building, is also being installed at WCGH.

Deanna Fourt, Island Health's director of energy efficiency and conservation, said energy studies done in the past determined that by installing a heat-recovery chiller at WCGH they could use waste heat for the hospital's domestic hot water.

Fourt said the heat-recovery chiller will lower greenhouse gas emissions and the use of fossil fuels, but will increase the hospital's electrical consumption.

To mitigate the increase in power usage from the new chiller, Fourt said photovoltaic solar panels were decided for the hospital's roof. This is the first photovoltaic solar panels that generate electricity for a healthcare facility on the Island.

"The thought was, well, when we're in the chilling, cooling modes, or high chilling cooling modes, we will probably have some sunshine around so maybe we could generate our own power." Fourt said.

"Hot sunny days is when our electricity rates are the highest, because we have high demand, so (the solar panels) will help offset that." ■

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US begins R134a anti-dumping probe

The US Department of Commerce has initiated the anti-dumping duty investigation of R134a refrigerant imports from China.

The investigation began on March 23 following petitioning at the beginning of this month by a US industry coalition which claimed that large and increasing volumes of low-priced imports from China were causing material injury to the US fluorochemicals industry.

Chinese R134a imports are said to have increased by more than 35% from 2013 to 2015, and continue to steadily increase.

Under US law, the Department of Commerce determines whether the dumping or subsidising exists and, if so, the margin of dumping or amount of the subsidy. The United International Trade Commission (USITC) determines whether the dumped or subsidised imports actual cause material injury or threat of material injury to the domestic industry.

The USITC is expected to make its preliminary injury determination by April 18. If it determines that there is a reasonable indication that imports of R134a from China are injuring the home market, the investigation will continue and Commerce will be scheduled to make its preliminary AD determination in August.

According to US Census Bureau statistics, Chinese imports of R134a increased from 10,400 tonnes in 2013 to 14,000 tonnes in 2015. The value of those imports increased by 26% over the same period.

The petitioners for this investigation are the American HFC Coalition and its individual members, as well as District Lodge 154 of the International Association of Machinists and Aerospace Workers.

The HFC Coalition is made up of a number of companies involved in the refrigerants business, including Honeywell, Chemours, Mexichem and Arkema, along with US refrigerant repacker Hudson Technologies and cylinder manufacturers Amtrol and Worthington Cylinders.

Opposing the imposition of duties are three Chinese companies: Zhejiang Quhua Fluor-Chemistry Co, Sinochem Environmental Protection Chemicals and Zhejiang Sanmei Chemical Industry Co. ■

Domestic refrigeration to have the highest growth

The demand for refrigerants in domestic refrigeration application is expected to witness the highest CAGR of 7.1% from 2015 to 2020, in terms of volume. Increasing annual income and rising standard of living are the major factors contributing towards the growth of refrigerants in domestic refrigeration.

"Fluorocarbon captures the largest share of refrigerants, but inorganics are expected to witness a huge growth"

Fluorocarbons are the major type of refrigerants. They capture a major market share of the total refrigerants market in 2014. But due to various regulations related to F-gas such as Montreal protocol, Kyoto protocol, countries have started to phase out HCFCs, and HFCs. The major manufacturers have now started the production of low GWP and ODP refrigerants such as inorganic and hydrocarbons. Inorganic refrigerants are expected to witness a significant growth, by growing with a CAGR of 10.0% from 2015 to 2020.

Manufacturers are focusing on the development of natural refrigerants which are based on hydrocarbons (propane, isobutane), CO2, ammonia, water, and air. Natural refrigerants such as ammonia, CO2, hydrocarbons, water and air have very low GWP and zero ODP. ■

Qatar to ban inefficient air conditioners

The import, storage, display and sale of inefficient air conditioners will be banned in Qatar from July 1.

The Qatari government will ban window and split air conditioners that fail to reach an EER of 8.5 under new standards and technical regulations. The aim of the rationalisation programme on all electrical appliances is to reduce average energy consumption by 20%.

In a country where air conditioners are estimated to account for about 70% of the total electrical consumption in the buildings sector, the Qatar General Organisation for Standardisation (QS), Ministry of the Municipality and Environment, has published explanatory announcements on regulating the import and circulation of air conditioners.

QS says it will carry out intensive inspection campaigns to verify the conformity of these products with approved standards in coordination with the concerned authorities. ■

German Left fails in bid to ban R1234yf

Die Linke, the German Left Group, has failed in a bid to ban the low GWP car air conditioning refrigerant R1234yf.

The vote in the German Bundestag last Thursday called for a German ban on the refrigerant which is being introduced under the European MAC directive to replace R134a in car air conditioning systems. Ralph Lenkert, environmental spokesman for the Left Group, argued that the refrigerant is highly flammable and in the event of a fire formed toxic carbonyl difluoride and hydrofluoric acid.

He called on the federal government to agree on a transitional period with the EU to give car manufacturers time for the introduction of CO2-based air conditioning.

Despite supporting the basic intention of the proposal, the Green coalition party abstained and the vote was defeated.

The parliamentary vote is the latest in a saga of German opposition to the new refrigerant following tests by Daimler in 2012 first raised safety concerns. While subsequent tests by vehicle authorities, including Germany's own Federal Motor Transport Authority, have all declared the refrigerant safe, German opposition has persisted.

In December, the European Commission referred Germany to the EU Court of Justice for its failure to apply the MAC Directive.

Officially known as Directive 2006/40/EC, the MAC Directive stipulates that air conditioning systems in motor vehicles type-approved after 1 January 2011 may not be filled with fluorinated greenhouse gases with a GWP higher than 150. This effectively bans the use of R134a, leaving the "mildly flammable" HFO R1234yf as the only production-ready refrigerant. ■

Honeywell licences R1234yf production in India

Honeywell has entered into a supply and technology license agreement with Navin Fluorine International (NFIL) to produce the refrigerant R1234yf in India.

Small-scale production is expected to begin by the end of this year at Navin Fluorine's manufacturing plant at Surat, Gujarat, Western India.

Worldwide demand is growing for the refrigerant which is set to replace R134a in vehicle air conditioning systems. Honeywell and its key suppliers are investing approximately $300m to increase global production capacity for R1234yf, including the construction of a new, world-scale manufacturing plant at the company's existing Geismar, Louisiana, refrigerants manufacturing site.

Honeywell's refrigerant is marketed as Solstice yf.

There are reportedly already more than 8 million cars currently on the road using R1234yf and that number is predicted to grow to more than 18 million cars by the end of 2016.

"This agreement reflects our commitment to delivering the supply chain reliability and security that customers can rely upon as they transition to next-generation products that are safe to use, available today and capable of making a significant positive environmental impact," said Ken Gayer, vice president and general manager of Honeywell Fluorine Products.

"Honeywell's supply agreement with NFIL, one of India's largest manufacturers of specialty fluorochemicals, represents a first step in our commercial relationship that will help us to meet growing global demand for Solstice yf," he added.

With its GWP of 1300, R134a has been banned in new cars under the European MAC directive which requires the use of a refrigerant with a GWP below 150. R1234f is currently the only viable option.

The US Environmental Protection Agency has also approved R1234yf to replace R134a which is banned in mobile air conditioning systems in new passenger cars and light-duty trucks starting in model year 2021. ■

Ames Laboratory creating new generation of refrigerators

The USA-based Ames Laboratory is currently working on a way to remedy the efficiency problem plaguing refrigerators by finding a better way to cool them.

The team currently working on this project is looking to find a material that, when acted upon by magnetic forces, can generate cooling.

This is an effect called the "caloric effect," which is where the team got the name of its project: CaloriCool.

The team proposed the plan to the Department of Energy and was approved to start developing the material and system to create a refrigerator that is efficient and will not break the bank. Work will begin on July 1.

"After we developed the initial material, it turned out to be a lot harder (than we originally thought). Over 20 years, they've gotten closer and better and more efficient, but it's not quite efficient or cheap enough to be able to sell it to you," said Ames Laboratory Chief Research Officer Duane Johnson. ■

Mitsubishi to supply railcar air-conditioning systems for Siemens Desiro trains in Germany

Honeywell has entered into a supply and technology license agreement with Navin Fluorine International (NFIL) to produce the refrigerant R1234yf in India.

Small-scale production is expected to begin by the end of this year at Navin Fluorine's manufacturing plant at Surat, Gujarat, in Western India.

Incidentally, worldwide demand is growing for the refrigerant, which is set to replace R134a in vehicle air conditioning systems. Honeywell and its key suppliers are investing approximately $300m to increase global production capacity for R1234yf, including the construction of a new, world-scale manufacturing plant at the company's existing Geismar, Louisiana, refrigerants manufacturing site.

Honeywell's refrigerant is marketed as Solstice yf. ■

US companies to pay $495,000 for violating R22 related laws

Two seafood processing and cold storage companies are to pay $495,000 in penalties for violations of laws relating to the management of ozone-depleting refrigerant R22.

In a settlement announced yesterday by the Environmental Protection Agency and Department of Justice, Ocean Gold Seafoods Inc and Ocean Cold LLC will pay $495,000 in penalties for violations of the federal Clean Air Act and Emergency Planning and Community Right-to-Know Act.

According to the US Environmental Protection Agency, the two companies failed to promptly repair R22 refrigerant leaks and failed to keep adequate records of equipment servicing at their facilities in Westport, Washington.

"Because of this settlement, the Ocean Companies are expected to cut their future ozone-depleting releases and reduce their future refrigerant emissions in an amount equivalent to approximately 47 million pounds [approximately 21,320 tonnes] of carbon dioxide each year, another step in our efforts to combat climate change," said director Ed Kowalski of EPA's Pacific Northwest Office of Compliance and Enforcement.

"Investing in better equipment and maintenance to stop wasteful refrigerant leaks is good for our environment and good for business," he added.

Since at least 2007, the companies are said to have failed to promptly repair refrigerant leaks and failed to keep adequate records of the servicing of their refrigeration equipment necessary to prevent leaks, in violation of the Clean Air Act. The companies also failed to provide timely release reports to EPA and emergency planners, in violation of the Emergency Planning and Community Right-to-Know Act.

In addition to the penalties, as part of the settlement, the companies have agreed to fix all refrigerant leaks and implement facility-wide improvements expected to cost about $260,000. ■

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His new position reflects both the critical role he plays at LG and the contributions he makes to the industry as a whole

LG Electronics USA Names Kevin McNamara Senior Vice President, Air Conditioning Systems

LG Electronics USA has named industry veteran Kevin McNamara senior vice president, sales and operations, for LG's US Air Conditioning Systems business. McNamara, who leads all aspects of the global giant's commercial, residential and applied air conditioning business in the United States, joined LG Electronics USA in 2011 as vice president of commercial air conditioning. He brings more than three decades of industry experience to the company. He previously held key management, sales and service roles for Carrier Corporation, York, Trane, Honeywell and McQuay.

"Kevin's leadership has been instrumental in the growth of LG's award-winning residential and commercial air conditioning systems in the U.S. over the past four years," said William Cho, president and CEO, LG Electronics USA. "His new position reflects both the critical role he plays at LG and the contributions he makes to the industry as a whole."

Under McNamara's leadership, LG has delivered significant benefits to US commercial office buildings, schools, hotels and residential spaces nationwide, Cho said. ■

Caleb Nelson

Nelson has his finger on the pulse of all the latest advancements

Ammonia Chiller and Freezer Manufacturer Azane Welcomes Caleb Nelson as New VP-Business Development

As the face of California-based Azane, Nelson will represent the company as it pioneers the USA's nationwide switch to low charge NH3 ammonia systems, which are expected to replace R22 and other refrigerants with high ozone depleting and global warming potential.

"I'm honoured to step up as Azane's new VP-Business Development, and am looking forward to fronting the company as it transforms the face of America's industrial refrigeration chiller and freezer market", said Nelson.

Nelson has been working in the arena since 2005, with roles as a Refrigeration Application Engineer, Project Manager and Director of Refrigeration. He's also fronted a myriad of notable projects, including the USA's first grocery store ammonia application, which went on to receive EPA Greenchill platinum status and the association's "Best of the Best" award.

With over 10 years of experience in the refrigeration industry, Nelson brings a wealth of expertise to the table. Caleb Nelson succeeds former executive level employee, Derek Hamilton. ■

Robert T Sharp

Sharp also had leadership roles within Emerson Process Management, serving in Minnesota and abroad across Europe

Emerson Announces Leadership Appointment for Newly-Formed Combined Business Segment

Emerson has announced the appointment of Robert T (Bob) Sharp as executive vice president for its newly-formed, combined Commercial and Residential Solutions business segment announced last year as part of Emerson's strategic portfolio repositioning of its core businesses.

Sharp currently leads Emerson's Climate Technologies business, which will become a part of the new Commercial and Residential Solutions business segment.

"I have every confidence that Bob will drive innovation and growth for our newly-combined Commercial and Residential Solutions business segment as we transform Emerson to a more highly-focused portfolio," said David N. Farr, Emerson chairman and CEO. "Bob's strong leadership skills and experience will provide the capabilities we need to expand our market opportunities and bring continuous value to our customers."

In his new role, Sharp will lead five business groupings within the Commercial and Residential Solutions segment, including Air Conditioning, Refrigeration, Electronics and Solutions, Sensors and Controls, besides Tools and Home Products. The new Commercial and Residential Solutions segment will include existing businesses. ■

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REAL TIME DISPLAY

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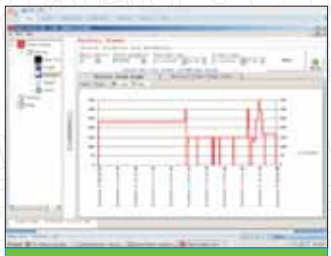
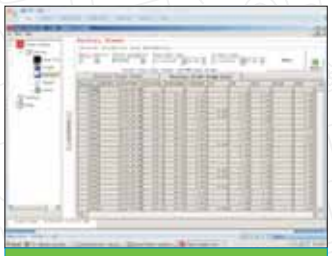


HISTORY TREND DISPLAY



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VER:042016

Achieving Excellence


Image credit: Heatcraft Worldwide Refrigeration

The Mohave Remote Refrigeration Control system enables enhancement of the space in large cold storages...

Many innovative modification works are simultaneously being done at different parts of the world. This article attempts to highlight some of the recent efforts and achievements in the HVAC&R industry...

In the 'Heating, Ventilation, Air Conditioning & Refrigeration (HVAC&R) industry, innovation is a continuous process since very beginning. However, in due course with passage of time, the process of innovation has been more individualistic but its focus has been more versatile. The concept of compartmentalization of the overall machine design has further added to the enrichment of the technologies being used in the industry. Although some industry experts arguably split the HVAC and the R section, there are several common threads that amass the logic behind stitching them together.

Many innovative modification works are simultaneously being done at different parts of the world. Considering today's competitive business arena, most of the companies are now spending hefty amounts to strengthen their respective R&D wings targeting cost reduction, energy saving, better compliance with the environment and safety of the people around. Several governments are also taking up initiatives to uphold the process. As including every such instance is not possible in a small article, let us see some of the recent positive developments in this direction in the United States.

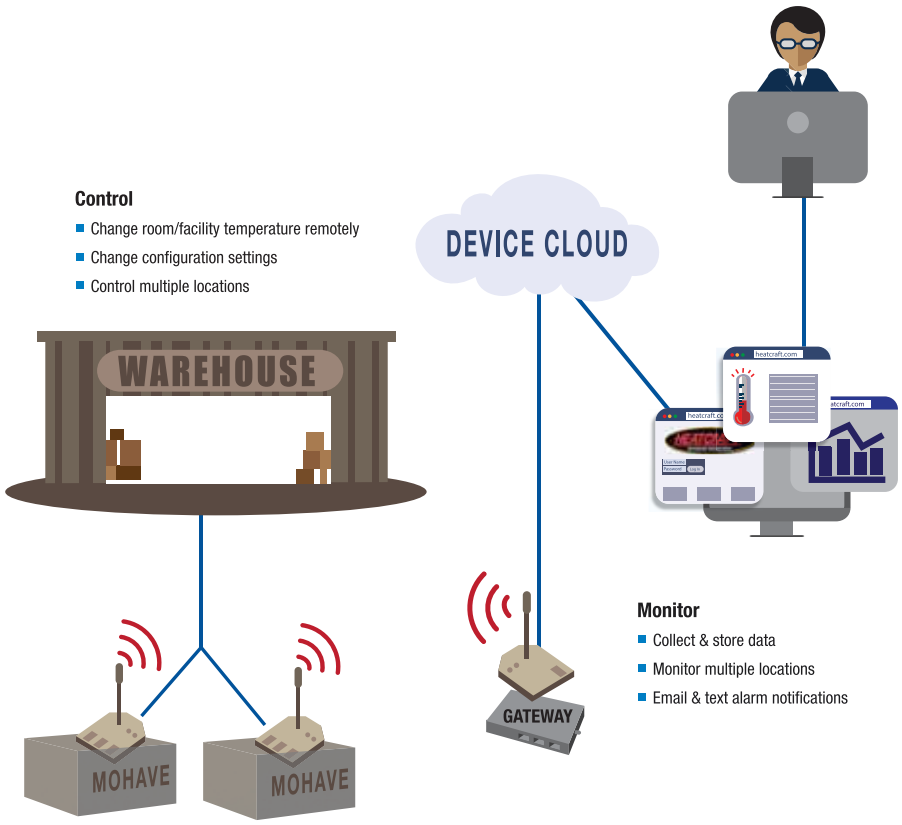


Image Courtesy: Heatcraft Worldwide Refrigeration

An innovative internet-based control system that allows end-users to manage their refrigeration systems using any web browser, from anywhere…

Approach of the most technologically advanced country

Last year (2015), the US Department of Energy (DoE) invested nearly $8 million to develop next-generation HVAC systems for buildings to advance research and development of next-generation heating, ventilating, and air conditioning technologies, supporting the administration's goal of saving money by saving energy, and phasing down the use of chemicals that have a devastating effect on the global climate.

It was estimated that: HVAC systems are the largest energy end-use in buildings, using almost 14 quadrillion British Thermal Units (quads) of primary energy annually, or nearly 30% of all energy used in the U.S. commercial and residential buildings. Non-vapour-compression HVAC systems have the potential to use as much as 40% less energy than current systems.

DoE decided to support advanced vapour compression technology and non-vapour compression technology. Advanced vapour compression systems will use highly efficient versions of the technologies that currently drive HVAC systems, but uses refrigerants that will have a minimal effect on the environment. Non-vapour compression systems will employ new technologies that use refrigerants that don't affect the environment.

DoE's goal is to develop next-generation heating and cooling technologies that leapfrog the existing vapour compression solutions and result in dramatically improved efficiency while utilising near-zero Global Warming Potential (GWP) refrigerants or non-vapour compression approaches.

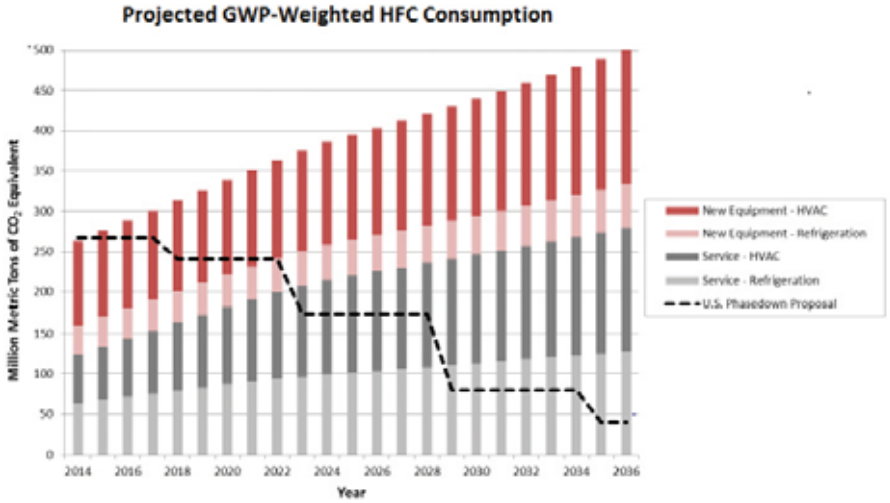


Image credit: Navigant Consulting

The planned research effort would support the U.S. hydrofluorocarbon (HFC) phasedown proposal, which targets an 85% reduction by 2035 compared to a 2014-2016 average baseline...

Application of internet in remote control

Recently, Heatcraft Worldwide Refrigeration, a well known provider of commercial and industrial refrigeration components, systems and service solutions, has released the Mohave Remote Refrigeration Control (RRC), an innovative internet-based

control system that allows end-users to manage their refrigeration systems using any web browser, from anywhere in the world. Round the clock remote monitoring capabilities allow end-users to control box temperatures, change configuration parameters and receive alarm notifications – if any system issues occur, all from the convenience of an internet connection. A wireless mesh network provides increased reliability and significantly reduces installation time.

"The Mohave Remote Refrigeration Control system enables owners/operators and maintenance engineers in large cold storage and processing facilities to improve refrigeration space efficiency by remotely addressing issues that may have traditionally required a service call. End-users will quickly benefit from the convenience of logging in from anywhere and, with immediate system access, they will be able to detect issues before they become a problem," says Russ Jones, Product Manager, for Heatcraft.

The Mohave RRC can process input parameters and monitor output activities for multiple Mohave Hot Gas systems. This web-based system allows for continuous monitoring and is also capable of sending commands directly to multiple Mohave Hot Gas units. The remote troubleshooting functionality allows for quick and accurate system diagnoses and corrective action planning, which could result in more efficient resource allocation – and decreased administrative costs. By eliminating the need for wiring between electronic devices, Heatcraft has reduced installation time, resulting in lower start-up costs.

"We are on the leading edge of controls innovation. The Mohave RRC is just one of the many control solutions offered by Heatcraft and is a part of our strategy to continue to deliver value-added products and services to our end-users. We have utilised the newest technologies to innovate a complete portfolio of refrigeration controls that enhance commercial refrigeration performance for a wide range of applications, from cold storage to foodservice", says Sophia Bellos, Director of Marketing for Heatcraft.

Multiple benefits from innovation

Right now in Milan, at the Mostra Convegno 2016 trade fair, ebm-papst is introducing innovations for refrigeration, air conditioning, and ventilation technology at two stands. In the refrigeration sector, the company is presenting the expansion of the successful 'AxiCool' axial series for evaporators and air coolers. The new 500, 630 and 800 mm sizes are designed for high-performance evaporators and air coolers for commercial and industrial refrigeration. This clever plug & play system solution offers many advantages. The integrated combination of diffuser and discharge vanes increases the efficiency by 30% – and allows an increase in air performance by up to 12% and a reduction of the noise by up to 3 dB(A).

As per ebm-papst, with the NiQ, it is introducing the next generation of energy-saving drive motors – for use in refrigerated display cases and bottle coolers, among other applications. The compact motor combines the well-known properties of the iQ motor series with a new design – inside and out. The developers have been able to make the next iQ generation even more efficient and especially more economical. Based on the typical low speeds for the applications, the motor has been optimised to 800 to 2,000 1/min and the corresponding torque. The aluminium housing has been replaced with plastic, which makes approval possible for areas with indirect contact with foodstuffs, such as in open vegetable display cases.

ebm-papst is also showing new solutions for heat pump applications. With continued optimisation of the peripheral parts in combination with the integrated diffuser, their reliable HyBlade axial fan offers enormous advantages in terms of efficiency and acoustics. On the one hand, it allows the air performance to increase by up to 10%, and on the other hand, a reduction of the noise by up to 3 dB (A). Thus, this new plug & play system solution offers the best conditions for an even more efficient and quieter heat pump.

Yet another innovation from them is the G3G 315 gas blower. For the first time, heating outputs of up to 2 MW are possible with a single compact blower – enough to heat high-rise buildings or entire housing developments, for example. Now planners have completely new options, such as decentralised heating solutions that minimise construction expenses and heating losses from long pipes. In combination with their GreenTech EC technology, enormous savings are possible.

Solid-state cooling and heating technology

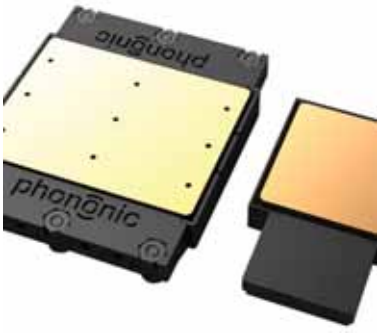
"Finding sustainable and energy-efficient cooling and heating solutions is critical. Americans consume an astounding 189 billion kWhr/year to cool our homes, primarily using compressor-based appliances requiring global warming refrigerants that can leak into the atmosphere," says Tony Atti, Chief Executive Officer and Founder, Phononic.

Phononic, the semiconductor company, which is revolutionising cooling and heating, has been named in the prestigious 2015 Global Cleantech 100, produced by Cleantech Group, whose mission is to connect corporates to

The efficiency of the new NiQ motor has been optimised beyond the level of its predecessors...

The G3G 315 gas blower provides heating outputs of up to 2 MW with a single compact blower...

3) ebm-papst Heating Systems presents the 900 TS with touch screen display for monitoring the boiler status and operating state and for simple configuration…

Solid state cooling and heating components from Phononic…

sustainable innovation through its i3 Connect platform and global events.

The company's solid-state innovation has led to launch their SilverCore technology that offers an efficient and convenient way to cool and heat. SilverCore actively moves particles of heat, known as phonons, to create products that cool faster and quieter compared with compressors, fans and water-based systems. The potential benefits of such applications are seemingly endless.

Final Remark

Innovation has been an integral part of the Heating, Ventilation, Air Conditioning and Refrigeration (HVAC&R) industry. Whether it is a component-wise approach or an overall attempt, or phasing-out of the GWP-increasing refrigerants, the interlying spirit of innovation is ever-growing. Sooner or later solid-state refrigeration will see tremendous growth and drastically reduce energy consumption and offer quite environment-friendly cooling. Internet will be an effective tool to control the temperature anywhere and everywhere from anywhere and everywhere. ■

P K Chatterjee
Editor
Cooling India

Six Tips To Optimise Industrial Refrigeration Efficiency And Lower Energy Costs

With industrial refrigeration accounting for up to 60 percent of a manufacturing facility's total operating expenses, it's no surprise that increasing refrigeration efficiency is a priority. However, too often engineers look to optimise individual components rather than take a holistic approach, leading to wasted energy and operational inefficiencies. To avoid this fragmented approach, here are six steps engineers can take to optimise the entire system and achieve the greatest energy efficiency:

1. Optimise set points, as condensing pressure should typically be run as low as possible. Suction pressure should be run as low as possible while still maintaining the desired room/product temperatures. Even adjusting the suction pressure up a degree could mean a 1.5 percent savings for those compressors.
2. Size compressors to match loads as closely as possible. Two equally sized compressors, each running at 50 percent capacity, can require 30 percent more horsepower than one compressor running at 100 percent, so proper selection up front and sequencing are important. It's also good practice to include different-sized compressors and sequence them properly to keep the machines as fully loaded as possible. For large systems, large compressors handle the majority of the load, while a smaller unit is included as a trim compressor to handle the swings. This will keep the larger compressor fully loaded at all time.
3. Install VFDs on screw compressors to optimize mechanical efficiencies of the machines. The best approach is to set the slide valve position at 100 percent and vary the RPM of the motor according to the refrigeration needs of the machine, which allows it to run more efficiently.
4. Install VFDs on condenser motors to stabilise head pressure and prevent the motors from heavy repeats and intense start/stop cycles. This will allow the fans to change speeds so they don't continually stop and start, which requires additional energy and results in mechanical wear. The biggest payback from a VFD will be on systems with variable load.

5. Use floating head pressure to maintain the ideal temperature for compressor and condenser operations. Higher condensing temperatures require compressors to work harder. Find the optimal break-even point where the condensers and compressors are cumulatively using the lowest overall horsepower requirements.
6. Use a completely integrated automation system to run your machine room, ensure efficiency and automate temperature controls within zones. Automating defrost cycles to sequence at different times can result in significant energy savings. An automated system can make calculations and adjustments automatically, whereas a manual system requires constant operator attention, is susceptible to human error and will react much slower. ■

International Trade Fair For Sanitary And Heating, Ventilation And Air Conditioning

ISK Sodex Istanbul, Turkey | 4 May - 7 May 2016

The ISK Sodex will take place on 4 days from Wednesday, 4 May to Saturday, 7 May 2016 in Istanbul, Turkey.

The ISK Sodex in Istanbul, Turkey, is an international trade fair for sanitation, plumbing, heating, refrigeration and air conditioning technology, which takes place every two years in Istanbul. It is the third largest fair of its kind in the world and the largest in the Eurasian region for ventilation, refrigeration and air conditioning technology.

The aim of this exhibition is to show the scientific and technological progress in the industry, both in theory and in application. Also questions in the context of systems engineering, such as education, research, management, professional development and the legal framework in detail are discussed.

Visitors can comprehensively inform on the latest developments, trends, services and products in the areas of heating, plumbing, air conditioning, cooling, burning, ventilation, installation and measurement technology. The ISK-Sodex offers international companies an ideal opportunity to enter the Turkish market and to expand in the Eurasian space.

On the whole, organisers had welcomed 881 exhibitors and 85,000 visitors from 83 countries at ISK Sodex in Istanbul, Turkey, over four days of the fair, from 7 May to 10 May 2014. ■

Fair organiser: Hannover-Messe International Istanbul Ltd.

Trade Fair for Industrial Heat and Cooling Technology

WTT-Expo Karlsruhe Rheinstetten, Germany | 1 June - 2 June 2016

The WTT-Expo in Karlsruhe, Germany, is a trade fair for industrial heating and cooling technology and has established itself with great success at the exhibition site in Karlsruhe.

This year the WTT-Expo Karlsruhe takes place on 2 days from Wednesday, 1.6.2016 to Thursday, 2.6.2016 in Rheinstetten already for the sixth time.

It is an important platform for the relevant apparatus, component suppliers and service providers in the field of consulting, cleaning / maintenance and research and has significantly expanded its portfolio. The focus of the WTT-Expo is on the theme of industrial heat exchangers and heat transfer technology, and presented in addition to the purely process-oriented application of these devices are now also other areas. As the only trade fair of its kind in Europe, it is ideally suited for high-level contacts and initiating and generating revenue for your business.

On the whole, organisers had welcomed about 135 exhibitors from 11 countries and 2,100 visitors at WTT-Expo Karlsruhe in Rheinstetten, Germany, over three days of the fair, from 8 April to 10 April 2014. ■

Fair organiser: KMK - Karlsruher Messe- und Kongress GmbH

International Heating, Air Conditioning, Installation Systems, Water Treatment And Insulation Exhibition

HVAC Expo Erbil, Iraq | 1 June - 4 June 2016

The Iraq HVAC Expo in Erbil is the first sectoral expo in Iraq, which includes the areas of heating, refrigeration, air conditioning, installation systems, water purification and isolation. The exhibition is the ideal meeting place for experts from Iraq, the Middle East, Asia, Europe and America to build networks and get detailed and comprehensive information about the latest trends and products in the industry.

The HVAC Expo will take place on four days from Wednesday, 1 June to Saturday, 4 June 2016 in Erbil, Iraq.

The Iraq HVAC Expo is communication and information platform in the industry and brings together the main players of the new Iraq under one roof.

On the whole, organisers had welcomed 17,500 visitors at the HVAC Expo in Erbil, Iraq, over four days of the fair, from 30 May to 2 June 2013, besides about 97 exhibitors from 12 countries. ■

Fair organiser: Elan Expo

Duct System Maintenance

Important but Often Forgotten

Duct maintenance is usually the last priority on building managers' minds. Poor duct maintenance impacts not only system efficiency, but also health occupants and hence a high level of duct maintenance is essential...

Just as passages in the human respiratory system transfer air from the environment into the lungs, ducting systems help circulate the air within workspaces to and from the Air Handling Unit. While the technology that drives chiller plants and associated systems has advanced considerably over the last few decades, ducting systems have unfortunately not changed much in this time period. The improvements in duct design have been incremental, with minor design and structural changes that have generally not kept pace with the tremendousdevelopments in the main HVAC systems.

Duct systems, unlike the chiller and auxiliary system components cannot be easily changed and once the ducting has been installed, especially where false ceilings are used, there is not much change that can be done to the ducting layout. On the other hand, chiller pumps, chilled water pipes, values etc. can easily be changed for newer components or in case of breakdown. There is thus an enhanced need to design, install and then maintain the duct system to very high standards so that the air conditioning system functions as per the design.

This is however not the situation on the ground – duct maintenance is usually the last priority on the building managers mind. Poor maintenance of duct has impacts on not only the efficiency of the system, but also the health of the occupants and hence a high level of duct maintenance is essential.

OVERVIEW OF DUCTING SYSTEMS

Duct Types: Ducting can come in many forms – the basic galvanized steel sheet ducting which is the most common method used due to lower cost, the prefabricated and insulated ducts made from Aluminum or Fiberglass as well as flexible tubing ducting systems

Ducting System Components: Figure 1 shows the main components of a typical ducting system. Each ducting system design will vary based on the requirements of the design, layout of the workspace, cost considerations etc.

Vibration Isolators: The AHU fan generates vibrations due to imbalance, misalignment or other mechanical faults which can get transferred to the ducting system and cause ducting system joint failures. The vibration isolators are flexible sections just after the AHU in the supply line and just before the AHU in the return line.

Dampers: To allow the operator to vary flow for modifying temperature or for air balancing purposes, dampers are installed at selected locations. The Dampers control the volume of air that flows to a work space. Modern dampers are electrically controlled using system input parameters in the Variable Air Volume (VAV) type of systems

Diffusers: The conditioned air exits the duct work through diffusers. The diffusers help is distributing the air and giving it maximum travel and also minimize the noise as air passes across a varying diameter orifice.

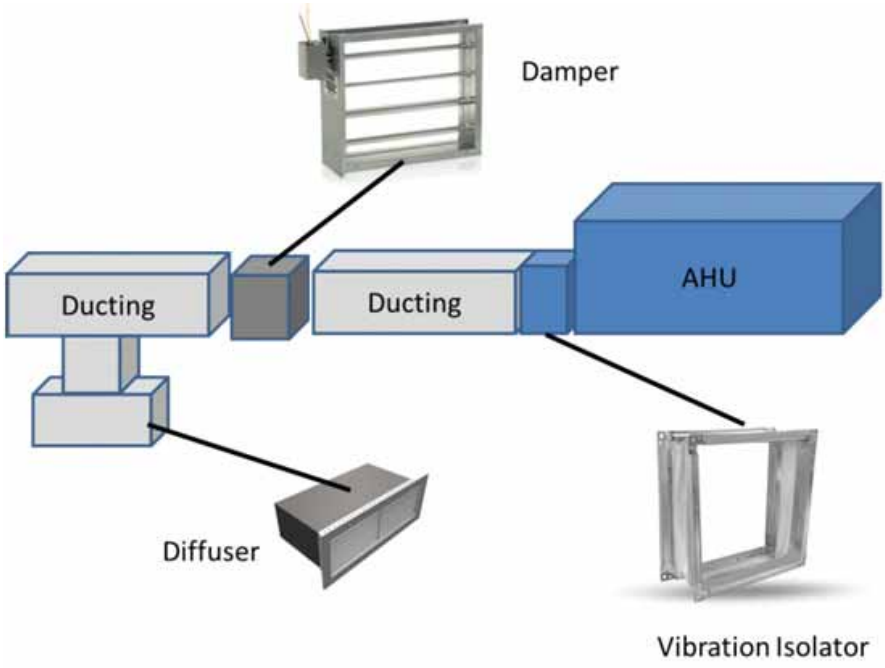


Figure 1: Main Components of Ducting Systems

Duct Installation Standards

The most common standard used for duct design is the Sheet Metal and Air Conditioning Contractor'sNational Association (SMACNA) which lists various guidelines and standards covering aspects such as duct thickness for pressure classes, reinforcement spacing values etc.

A key parameter that impacts the Operations and maintenance team is the integrity of the system – the amount of leakages that are there in the system. The SMACNA standards allow a 5% air volume leakage. The Energy Conservation Building Code (ECBC) also lays down guidelines[1] (Figure 2) for ductwork sealing.

Duct Testing: The most common standard used for testing the ducting system is the SMACNA performance Duct performance test standards. It has four main criteria - Burst Pressure capacity, Collapse Pressure capacity, Wall deflection measurement and Leakage testing. Another standard used for leakage testing is the DW 144 standard (Adopted by Building Engineering Services Association-BESA) which classifies the leakage percentages based on the class of ducts. Duct classification is a function of the operating pressure in the system. Class A systems do not require testing and 6% leakage is permitted, while Class B system need to have 10% of duct work tested and 3% leakage is permitted and so on. The Indian standard for Ducting IS 655 does not specify any testing and works on the principle that is the ducting is designed as per the standards, then the system will function as per design.

WHY DUCT MAINTENANCE IS IMPORTANT AND NECESSARY

Ducting systems are in operation continuously, and there is no "back up" of the duct as other equipment and systems have. The duct systems transport air to the occupants of the building and hence impact the wellbeing of all the users of the work space. Ducting system is thus critical for business operation in any office or workplace and the following are the key reason for the building maintenance team to keep duct maintenance a top priority

Contamination of Air: The key types of contamination that can occur in the ducting system are:

Dust contamination: The most common

Reference: [1] Energy Conservation Building Code (ECBC) - Bureau Of Energy Efficiency

Figure 2: Ductwork Sealing Standards - ECBC

Duct Location	Supply Ducts			
	<500 Pa (2 inch w.g.)	>500 Pa (2 inch w.g.)	Exhaust Ducts	Return Ducts
Outside Conditioned Space	←	←	None	←
Unconditioned Spaces	↑	←	None	→
Indirectly Conditioned Spaces	→	↑	→	None
Return Air Plenums	→	↑	→	None
Cooled Spaces	None	→1	→	None

duct systems are the Galvanized ducts which are fabricated onsite. The construction site is full of dust and construction debris in the environment. All this dust settles in the ducts during the fabrication. While basic duct cleaning is undertaken in many duct installation works, the dust is difficult to fully take out and there is re accumulation of dust on the duct walls from the workspace dust, AHU dust etc. This dust eventually travels into the work space and impacts the air quality of the work space.

Microbiological Contamination: Poorly maintained ducts will have growth of mound on the inside surfaces of the ducting. There would be telltale signs of mold formation at the diffusers where black streaks will be visible. The moldhas harmful bacteria that pass onto the work spaces and clause allergies and health related issues to the occupants.

Leakage of air: Dust systems are designed for a small amount of system volume leakage as the joints of the ducts are not air tight. Higher levels of leakage will result in higher energy usage by way of the AHU fan running longer and faster to maintain the static pressure in the ducting. Leakages can also impact the air balancing of the system which in turn will lead to hot and cold spots, further impacting the overall system efficiency.

Lowering of System Efficiency: Accumulation of dust and mold on the inner walls of the ducting causes the amount of friction that the air experiences to increase. This causes a drop in static pressure, resulting in the Fan running at higher speed and consequently higher energy usage.

MAINTENANCE BEST PRACTICES FOR DUCTING SYSTEMS

The dusting system is typically a reliable, low maintenancesystem in the overall building systems environment. Since there are no moving parts except the dampers, the maintained is relatively easy and not expensive. This is one of the reasons that the basic maintained of the ducting systems is often neglected by the building maintenance teams. A few good maintenancepractices for ducting systems are as follows:

Check for Leakages: Leakages can reduce air flow and increase cost of operation, so the site should be checked for leakages once in six months. This can be easily done by visual inspection method

Air flow testing: The ducting system is usually installed with tap off points that can be used for air flow measurements. A good practice is the measure the air flow at least once a year and compares the data with the design values. Lower flow rates are indicative of higher friction or blocked dampers or air flow passages.

Duct cleaning: It is not easy to estimate the dust and microbiological levels in ducts as most of the ducting is concealed. A good practice is to have the ducts inspected at least once in 2 years by an external agency and then assess requirement of cleaning. Advanced duct cleaning systems allow for quick and reliable duct cleaning are an expense well spent.

Vibration testing: Higher levels of vibrations in the AHU as well as the system can lead to higher noise levels and also possibility of fatigue failure of ducting supports and joints. An annual vibration analysis of the key joints and fasteners will help reduce such damage.

Indoor Air Quality Tests: The best way to assess the quality of the ducting system is to carry out IAQ tests that will bring out the values of various indicators such as particulate matter, microbiological content etc. in the air. IAQ test should be undertaken at least once I six months and especially when there is a major change in internal design of additional head count uses the work space.

CONCLUSION

Ducting systems play an important role in providing conferrable air to the building occupants. Since all the occupants breathe the air from the ducting systems, any deterioration of the air quality will have a negative impact on a large part of the workforce. The sick building syndrome is a classic example of what poor duct system can lead to. Since ducts are always hidden from the user's eyes, there is often a tendency to postpone or altogether eliminate duct maintenance schedules. This can be damaging to the air quality and also have an impact on the operating costs of the HVAC systems as the system will be operating at a higher design point and lower efficacy due to friction losses in the duct work. Thus, the building's HVAC teams should have a well-developed maintenance plan for the ducting system and ensure that it is executed as per manufactures guidelines to have a healthy and efficient ducting system. ■

Aneesh Kadyan
Director - Operations
CBRE South Asia Pvt Ltd.,
Asset Services - India

'Testo to increase its presence in Nepal, Bangladesh as well as Sri Lanka'

Testo India has become a name to reckon with in providing state-of-the-art measurement tools for the HVAC&R industry in India. As traditional solutions get increasingly replaced by smart solutions, Testo India has been providing such digital solutions in keeping with the lastest technological trends. In an e-interview with P K Chatterjee of Cooling India, Testo India Pvt Ltd's Managing Director Kalidas Bhangare elaborates on the company's latest plans. Excerpts...

How is the Indian refrigeration / HVAC market shaping up?

As the number of buildings, green buildings, greenhouses, commercial complexes, malls, hospitals, high rise buildings and offices are on the increase, the requirement of HVAC & R is also growing at the same pace, defining it as a synonym for the national building industry. Today, it is next to impossible to witness any application without HVAC & R, which is why it is one of the fastest growing industries. HVAC & R is no longer a luxury. Rather, it is a part and parcel of everybody's life. Stakes are very high in HVAC & R, since these systems consume close to half the connected electrical power. As a result of expanding markets for refrigeration and air conditioning and changing technology, a dramatic need exists for technologically advanced HVAC & R solutions.

Worldwide, the refrigeration industry is growing in a very big way due to warehousing, large buildings, malls, residential cooling and many more trends. This also consumes a lot of energy and the entire efficiency of the system is dependent on the refrigeration cycle.

The latest trends and advancements which are being witnessed comes from digitisation of working systems. Traditional methods and processes are now getting replaced with smart solutions. The emergence of smartphones has simplified the functioning of every industry. All the time consuming, manually driven operations can now be governed with just one click of the smartphone, making the process more easy, accurate, fast and reliable.

To match the pace with this phenomenally expanding industry, Testo provides complete solutions for measurement of temperature, humidity, air velocity, differential pressure as well as refrigeration analysers / electronic manifolds for HVAC & R industry.

What solutions does Testo provide to its refrigeration related clients?

Testo has a range of electronic refrigeration manifolds / analysers whihc not only helps measure pressure but also calculates accurately the sub-cooling and superheating temperatures, based on the refrigerants selected. At the same time, our clients can also measure and display the actual temperatures by using special surface probes / pipe probes. Using this data, the instrument gives our customers the differential temperature between the calculated and measured temperatures, thus helping them to calculate the efficiency of the system.

In addition to electronic refrigeration manifolds, Testo also has digital vacuum measuring instrument like Testo 552, for the evacuation of refrigeration / air conditioning systems and heat pumps. It measures even the smallest absolute pressures and provides highly precise information on the status of the dehumidification of a system (removal of foreign substances, including oils or foreign gases).

Another tool that Testo provides and which should be a part of every professional's refrigeration technology equipment is Testo 316-3, which is an electronic leakage detector for refrigerants. It detects even the smallest leaks, thanks to its high level of sensitivity. It helps engineers trace leaking spots and thus saves the expensive gas from leaking which also is a reason for an inefficient system.

How do you plan to support the HVAC industry in India with your testing and measuring solutions?

With smart solutions coming up and increased focus on advanced technology, the HVAC industry is showing great potential and growth opportunities. Testo India also enjoys its share in this success story and strives to cater to the segment with its latest technology. Testo India is now even more focussed towards the growth of this industry, with its dedicated and smarter measurement solutions.

The application for the new manifolds Testo 550 and Testo 557 is one of many new developments with which Testo is once again meeting the requirements of the market, and underlining our expertise in refrigeration. A further highlight is the Pirani probe developed by Testo for the new Testo 557, which allows highly precise vacuum measurements.

Does Testo India service refrigeration-related foreign markets from India? What are your immediate plans in this direction?

India is termed as an emerging market and the numbers are only growing. In a very short span of time from its inception, Testo India grew from a small-sized subsidiary to a mid-sized one and is on its way ahead to further increase its sales turnover exponentially. So, we hope to offer many technologically advanced products in the near future which will help Testo touch a new zenith of technology not only in India but also in the surrounding markets of Nepal, Bangladesh and Sri Lanka, through its channel partner network.

Does Testo India plan to introduce new refrigeration based products soon? Please elaborate if any.

Testo India is known for constantly keeping pace with the latest trends and market demands. Providing better performance, precision and convenience, Testo has fulfilled increased market demands and raised the efficiency bar yet again with its new generation of digital manifolds launched recently.

The highlight is the application for wireless integration of mobile devices into the new manifolds, Testo 550 and Testo 557. The new entry-level model Testo 549, with its attractive price-performance ratio, is intended to convince analog users of the advantages of digital manifolds.

The new generation is more robust than ever, for example thanks to

an additional metal frame for the display. Apart from this, all digital manifolds are now water-and-dirt-resistant, according to protection class IP42. Among other steps for more secure operation is a menu structure which has been further simplified and extended by automatic functions. For instance, Testo 557 automatically selects the evacuation mode as soon as the user connects the new Pirani probe. The external probe is an example of the increased performance of the new manifolds: the measuring range has been extended to 60 bar, and the battery life increased to 250 hours. With the new generation, 60 common refrigerants are now stored in the manifold.

With its newest generation tools, Testo has further optimised the price-performance ratio of digital manifolds. With Testo 549 in particular, the company is addressing users who are still operating analog instruments. However, more than the attractive entry-level price, it is the product advantages which are in the foreground of communication. Testo 549 fulfils all daily requirements in refrigeration contracting. Our clients can measure different operating parameters with only one instrument, and obtain a comprehensive real-time overview of the status of a refrigeration system or heat pump. This fast and reliable test not only saves costs – it also makes your work considerably more efficient.

Does Testo India manufacture most refrigeration-related products in India? What are your plans to manufacture such products in India? Could you also elaborate about Testo's R&D infrastructure in India?

Testo's state-of-the-art manufacturing facility and an extensive R&D unit is located in Germany in Black Forest. Most of the products are manufactured in Germany under high quality standards. German engineering allows no leeway to quality assurance. They are manufactured in compliance with different industry standards. Some of our products are TUV approved while we also comply with different EN standards in addition to others.

We also do offer certified calibration according to all valid guidelines. The calibrations take place at Testo's own accredited high-tech laboratory at our facility in Pune.

Testo India, which has its head office in Pune is a sales and marketing subsidiary. Presently our focus is penetrating all the potential markets in India which are untapped or are penetrated at a very shallow level.

We plan to extend our arms to all possible regions, industries and applications in the forthcoming years. New products which Testo plans to launch in the next few years surely give us the confidence to work towards achieving our goals.

Having said that, as I already stated before, we have Testo's own accredited high-tech laboratory at our facility in Pune so that our instruments can be calibrated as well as serviced locally, maintaining international standards.

Could you please elaborate about how Testo India customers benefitted after using your refrigeration measurement-related products?

Testo India has entered into almost every HVAC & R application with its refrigeration products which are meant for measuring various parameters like, temperature, humidity, pressure, velocity, to name a few. Today, we are proud to be associated with some of the biggest companies in India providing solutions for their different applications.

Other than the HVAC & R industry, almost every other industry has also been reached by Testo India with some or the other product, from our extensive range of tools.

What are the main challenges your company faces in the Indian refrigeration measurement market?

With more and more multinational companies coming to India, the expectations are high with cutting edge technology equipments, state of the art execution followed by a great piece of commissioning, operation and maintenance of the refrigeration.

What would you like to communicate to your potential customers and clients?

Today, Testo India has established its identity in the Indian markets not only as one of the leaders in testing and measuring instruments but also as a preferred brand for reliable and high quality assuring measurement technology. We are always committed to provide best services to our customers, not only in India, but also in Bangladesh and Sri Lanka.

Testo India offers an extensive product range which includes:

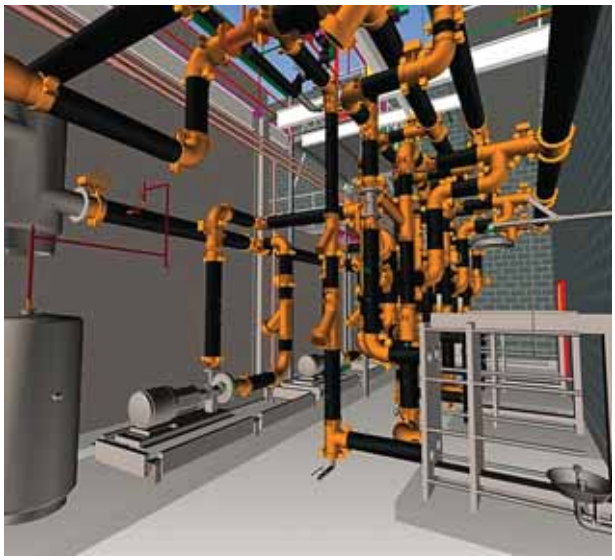
- Portable measuring instruments and systems for temperature, humidity, dew point, pressure, air velocity, RPM, sound and light.
- Compressed Air Solutions like Compressed Air Flow Meters for checking compressed air consumption and Dew Point Transmitters for ensuring dry air.
- Data Loggers and Wireless Data Monitoring Systems.
- Portable Flue Gas Analysers for Combustion and Emission Analysis.
- Thermal Imagers for Predictive and Preventive Maintenance.

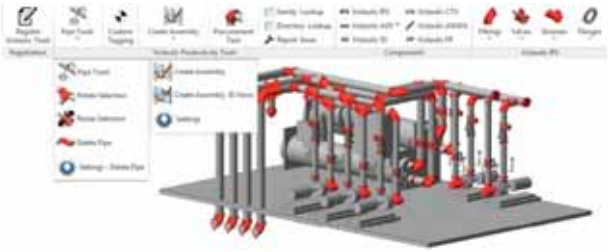
What is your mantra of success in the refrigeration measurement market?

Testo's top preference is to understand our customers' requirements and thus, Testo's pivotal task is to pay constant attention to new technologies which makes innovation our highest priority, and thus helps us to serve our clients in the Indian refrigeration measurement industry better than all the others. ■

Victaulic Launches Add-in for Autodesk® Revit® MEP

Victaulic Tools for Revit enables faster pipe routing and fabrication within Revit





Since 1919, Victaulic has been the world's leading producer of grooved mechanical couplings and pipe-joining systems. Used in the most demanding markets, Victaulic innovative piping technologies and services put people to work faster while increasing safety, ensuring reliability and maximizing efficiency.

With more than 900 active global patents, Victaulic solutions are at work in 115 countries across diverse business lines including oil and gas, chemical, mining, power generation, water and wastewater treatment, military and marine, as well as commercial building and fire protection.

Victaulic, the world's leading manufacturer of mechanical pipe-joining systems, introduces Victaulic Tools for Revit, an innovative Autodesk® Revit® MEP add-in that increases drawing productivity, solves troublesome pipe routing problems and enables the creation of construction and fabrication documentation within Revit. Victaulic Tools for Revit allows users to route pipe twice as fast and increase efficiency and productivity.

The productivity tools within Victaulic Tools for Revit allow users to design virtual, intelligent models with all mechanical or pump room details in half the time compared to current routing techniques within Revit. The enhanced routing and editing tools enable the creation of complex piping systems with fewer clicks. Features that increase routing efficiency include:

- Pipe Splitting: Automatically splits pipe into predetermined minimum and maximum lengths and joins the pipe sections with the specified coupling as the user routes.
- Rotate Selection: Rotates selected portions of the model at a specified angle within the 3D view.
- Resize Selection: Changes the size of all components in a selected area with a single click.
- Delete Pipe: Deletes a selected pipe and connects the system fitting to fitting, while ensuring proper connection points.
- Pipe/Custom Tagging: Automates tagging, placing custom tags on pipe and components within the model.
- Family Lookup: Exports and imports lookup tables being used by the currently open family.
- Directory Lookup: Scans family directories and imports and exports all lookup tables within all families.

Victaulic Tools for Revit makes fabrication possible within Revit, while increasing productivity. Users can create construction details and fabrication drawings, including labour estimates and manufacturer information, without the need to switch software. Features that improve efficiency in the fabrication process include:

- Create Assembly: Creates seamless fabrication assembly documents of the piping system, ensuring all nested families are correctly brought into the assembly and eliminating the omission of loose parts. Ortho and plan views for spool drawings are available.
- Procurement Tool: Automates the bill of material creation for a selected pipe spool.
- Fabrication spool sheet creation from 3D view.

"Victaulic Tools for Revit features an intuitive, user-friendly interface that simplifies training and usage for both new and experienced Revit users," says Ashvin Bhagat, Victaulic Global Design Centre Manager, Construction Piping Services. "The add-in works in all views, comes preloaded with more than 100 Victaulic product families and template designs, and allows users to route with Victaulic as well as other manufacturers and joining technologies."■

For more information visit: www.victaulicsoftware.com.

Importance of Defrosting

Ice gets accumulated in freezers which have not been defrosted. Ice not only takes up valuable freezer space but also makes it difficult for the freezer to work efficiently. Defrosting freezers at regular intervals is a great way to keep them running well...

The worst thing that can happen to a freezing system is frost, which is a thick, cold dusting of fine ice that covers everything inside the freezer turning it all into one big solid icy mess. Frosting is generally caused by opening the freezer too often and allowing too much warm room temperature air in, which can shut down the freezer elements that are built to process only cold air. Blocking air flow by pushing the freezer too close to a wall, which makes the condenser coils act less efficiently. Having a loose rubber seal around the door allows that pesky room temperature air in. Basically, in each of these situations, warm air mixes with sub-freezing air and the result is frost. Solid Ice is found more in the base of chest freezers or anywhere that water can leak and become frozen. It's common to have a small amount of ice form at the back of the fridge but it's time to take action when we see around ½ inch of ice build-up. This is to ensure that food is preserved at the correct temperature and to minimize energy waste. Warm air has more moisture than cold air. When warm air meets cold air, it condenses or turns to water. Each time you open your freezer, a little bit of warm air seeps in and condenses. That moisture freezes, typically on the sides and shelves of a standard freezer in the form of frost. Over time, as the door is opened and closed, letting in new air, water vapour from the air condenses on the cooling elements within the cabinet. The resulting ice inhibits heat transfer out of the cabinet increasing running costs. Furthermore, as the ice builds up it takes increasing space from within the cabinet - reducing the space available for food storage. If the freezer is not frost-free, we may find that the accumulation grows. The walls of ice not only take up valuable real estate in the freezer but they also make it more difficult for the freezer to work efficiently. Since we stock our freezers full of good stuff to help us save money and time, we want to make sure that these appliances are running well. Defrosting the freezer at regular intervals or when the frost build up covers a large area and exceeds 1/4-inch is a great way to keep the machine running well. Defrosting is a procedure, performed periodically on refrigerators and freezers to maintain their operating efficiency.

Manual defrosting

Manual defrosting of the unit is achieved by:

- Temporarily removing all food from the cabinet
- Turning off power to the unit
- Leaving the doors to the unit open
- Waiting for the ice to melt and draining it appropriately. Using a towel is advisable when completing this step.
- The process may be sped up by mechanical removal of ice, or the introduction of gentle heat into the cabinet. Placing a pan of hot water in the cabinet and closing it is an effective method.
- Using a fan to blow in room temperature air will also greatly speed up the melting process as well as help to evaporate the damp surfaces.
- The fastest manual way is to use a vacuum cleaner. Simply insert the hose into the exhaust port (nearly all are designed for this), and use the wand to blow on the coils; this method is much faster than any other.
- It is generally recommended that defrosting should be done annually.
- Any mechanical removal of ice should be done gently so that the equipment is not damaged.

Automatic defrosting

Many newer units employ automatic defrosting (often called "frost-free" or "no frost") and do not require manual defrosting in normal use. Auto-defrost,automatic defrost or self-defrosting is a technique which regularly defrosts the evaporator in a refrigerator or freezer. Appliances using this technique are often called frost free, frostless or no-frost. Frost free fridge freezers are very popular and auto defrosting fridges are a great convenience. A frost-free freezer is equipped with a heating coil and temperature sensor to prevent the accumulation of frost on the insides of the appliance. Although in some cases, users of Frost Free fridge/freezers have noted ice blocking the vent that allows air into the refrigerator compartment. In a frost free appliance the cold air is blown round the freezer using a fan. On modern refrigeration the evaporator (which is the plate that gets cold) is hidden behind the plastic wall inside at the back of the food shelves. When working correctly we can usually see small beads of ice randomly scattered on the back wall unless it's in a defrost cycle when we may see water. All refrigerators and/or freezers whether or not frost free, should be defrosted at least every 6 months (or more if you live in humid conditions or if the door is opened excessively). Frost Free units should be defrosted every year, as frost can form on the evaporator covers, which can look unsightly and degrades freezing performance, sometimes to the point of the freezer thawing out due to degradation of defrosting. This can happen when the defrost timer is not set up correctly/malfunctioning or if the heater units or temperature sensors are malfunctioning. Believe it or not most modern refrigeration has a heating element inside. This heater is used to defrost the appliance automatically. During the defrosting cycle the ice on the back wall melts and runs down the back wall into a channel. It is then directed through a hole out through to the back and runs into the evaporator tray. The evaporator tray is on top of the compressor which gets pretty hot and evaporates this water into the air. Because the evaporator is behind a back panel the cold air has to be blown around the compartment with a fan motor. The defrost cycle also needs sensors and a timer and combined with several sensors throughout and PCBs to control everything.

Automatic defrosting mechanism

There are many separate components in a refrigerator's defrost system that must work in

concert for a frost free system to work properly. The heart of the defrost system is the defrost control. The most common control is a mechanical defrost timer which is a motorized device that opens and closes several electrical contacts. Each contact can be thought of as a simple light switch but instead of a light, one connects the defrost heater circuit, another connects the cooling system. When one of these is switched on, the other is switched off. A motor on the timer turns a cam that opens and closes these contacts at set intervals. During the cooling mode, the defrost timer closes a contact to the compressor circuit so it will run. The circuit to the defrost heater is open. While in this mode, the thermostat cycles the compressor and fan motors on and off to maintain an appropriate temperature. The defrost timer eventually switches into defrost mode and supplies power to the defrost heater(s) to melt any frost that has accumulated on the evaporator (cooling) coil. The cold control contacts remain closed but since the defrost timer is no longer feeding power to that circuit, the compressor does not run. Once the defrost termination thermostat senses a set temperature, it opens the circuit to the defrost heaters, shutting them off. The timer remains in the defrost cycle until the timer advances back to the cooling mode. Since the limit switch is open, the heaters are no longer on for the rest of the cycle. When the timer again advances back into the cooling mode, the compressor will start to run along with any air circulation fans. The defrost limit switch will remain in the open condition until it is reset by cold temperatures. Once a set colder temperature is reached, the defrost termination thermostat closes again. This is OK since the defrost timer is no longer supplying power to the defrost circuit, the heater does not get energized. When the defrost timer again advances into the defrost mode, the limit thermostat will already be closed and will allow power to be supplied to the defrost heater to melt any frost that has developed on the evaporator coil again. Normally the interior evaporator and exterior (if present) condenser fan motors should run whenever the compressor is running and vise versa. If the timer is stopping operation of the cooling system, neither the fans nor compressor should usually be running at that time.

The defrost mechanism in a refrigerator heats the cooling element (evaporator coil) for a short period of time and melts the frost that has formed on it. The resulting water drains through a duct at the back of the unit. Defrosting is controlled by an electric or electronic timer: For every 6, 8, 10, 12 or 24 hours of compressor operation it turns on a defrost heater for 15 minutes to half an hour. The defrost heater, having a typical power rating of 350 W to 600 W, is mounted just below the evaporator in top- and bottom-freezer models and below and sometimes also in the middle of the evaporator in side-by-side models. It may be protected from short circuits by means of fusible links. In older refrigerators the timer ran continuously. In newer designs the timer only runs while the compressor runs, so the more the refrigerator door is closed, the less the heater will be on and the more energy will be saved. A defrost thermostat opens the heater circuit when the evaporator temperature rises above a preset temperature, 40°F (5°C) or more, thereby preventing excessive heating of the freezer compartment. The defrost timer is such that either the compressor or the defrost heater is on, but not both at the same time. Inside the freezer, air is circulated by means of one or more fans. In a typical design cold air from the freezer compartment is ducted to the fresh food compartment and circulated back into the freezer compartment. Air circulation helps sublimate any ice or frost that may form on frozen items in the freezer compartment. Instead of the traditional cooling elements being embedded in the freezer liner, auto-defrost elements are behind or beneath the liner. This allows them to be heated for short periods of time to dispose of frost without heating the contents of the freezer. Alternatively, some systems use the hot gas in the condenser to defrost the evaporator. This is done by means of a circuit that is cross-linked by a three-way valve. The hot gas quickly heats up the evaporator and defrosts it. This system is primarily used in commercial applications such as ice-cream displays.

Common problems with frost free fridge freezers

Modern frost-free refrigeration units work very differently to a conventional fridge or freezer. If the door is left open for too long (especially in humid conditions) the evaporator freezes over and the unit will not keep the food cold. This problem (unlike the older machines) has a greater impact because we can't see the amount of ice built up around the back of the panel hiding the evaporator. In many frost free fridges the ice can form all the way round the fan and cause it to run slowly or even seize up. Prior to seizing up the fan may catch on the ice and make a high pitched noise. This will of course result in the fridge or freezer not getting cold. If you hear a strange noise from your frost free fridge freezer which sounds like something is catching on a rotating fan it could be due to ice forming around it. If it stops working due to ice forming behind the evaporator and round the fan then defrosting the unit manually can fix it but it involves unplugging the unit for at least take 12 hours or so. You may not see much frost as it would be behind the back wall or behind the fan unit. You can't really use a hair dryer on modern units because they may have a thermal fuse which protects the defrost cycle. Also, even just getting to the evaporator to defrost it can be a

mammoth task especially with some of the new style fridges. If a fault re-occurs later it could be due to faulty sensor but if the fault was only due to the door been left open for a few hours accidentally then a total defrost could work. If your fridge has two sloping channels at the back wall and a hole in the middle this is designed to channel the water created on the defrost cycle through to the back of the unit where it runs onto an evaporator tray. This tray sits on top of the compressor and gets quite hot. The water simply evaporates. Sometimes this hole gets clogged up and prevents the water running out to this tray. The result is that water runs into be base of the unit. Very often the appliance will come with small tool for cleaning out this hole, but if not you can improvise. If the water in the base of the unit is frozen solid it could be that the unit has malfunctioned and is over freezing. The blockage preventing the water running through to the evaporator tray could actually be solid ice.

Disadvantages of defrosting

- The system can be more expensive to run when usage is high and if the fan continues or starts to run when the door is opened.
- A safety device is required to be connected with the heating element, due to the high instant-power values that can be reached.
- Increased electrical and mechanical complexity compared to a basic upright freezer or freezer chest, making it more prone to component failure.
- The temperature of the freezer contents rises during the defrosting cycles, especially if there is a light load in the freezer. This can cause "freezer burn" on articles placed in the freezer, from partially defrosting, then re-freezing.
- On hot humid days condensation will sometimes form around the refrigerator doors.
- Defrosting may not be completed by the time the defrost timer cycles back into normal operation leaving ice/frost on the evaporator coils. This condition can lead to "icing up" which will interfere with the operation of the refrigerator.
- In laboratories, self-defrosting freezers must not be used to store certain delicate reagents such as enzymes, because the temperature cycling can degrade them. In addition, water can evaporate out of containers that do not have a very tight seal, altering the concentration of the reagents. Self-defrosting freezers should never be used to store flammable chemicals. ■

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

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S.L.I.E.T.

Good Indoor Air Quality makes Life Better & More Comfortable

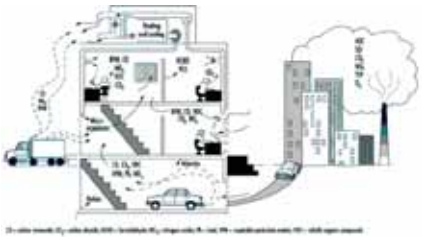
People tend to spend an average of 85 percent to even 90 per cent of their time indoors -- in schools, on the working floor, in offices, but most of all in their own houses or apartments. Therefore, it is of utmost importance to take into account aspects that influence the inner climate, such as fresh air. As the interest in insulation and airtight construction grows, the importance of good ventilation is also increasing. Air circulation, ventilation or replacing polluted indoor air by fresh outdoor air, leads to a healthy and comfortable indoor climate about …

Although we like to be outdoors as much as possible, people still spend an average of 85% to even 90% of their time indoors -- in schools, on the working floor, in offices, but most of all in our own houses or apartments. Therefore, it is of utmost importance to take into account these aspects that influence the inner climate, such as fresh air. As the interest in insulation and airtight construction is growing, the importance of a good ventilation is also increasing. Air circulation, replacing polluted indoor air by fresh outdoor air, leads to a healthy and comfortable indoor climate. A topic to really think about.

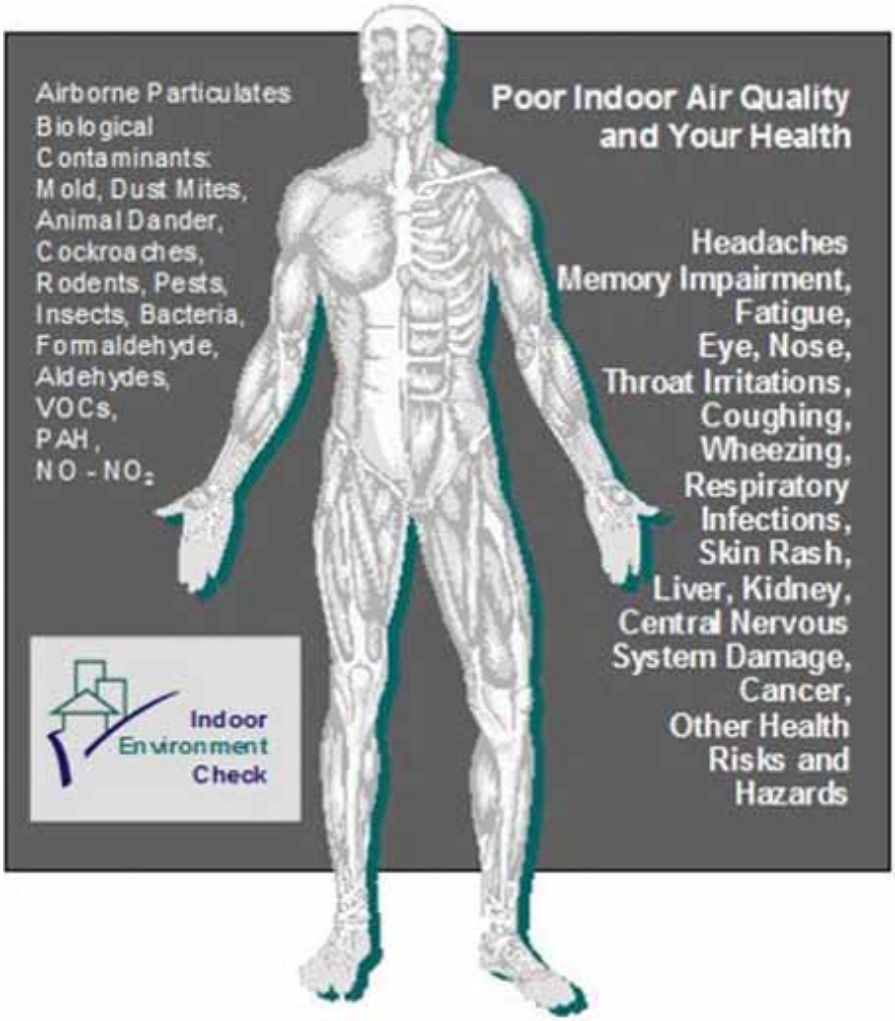
Each day, the indoor air is polluted by a number of sources; occupants (breathing, sweating), their activities (cooking, showering, heating, smoking, …), but also by the building itself and its furnishing (radon, volatile organic compounds, paint, glue, varnish, detergents, …).

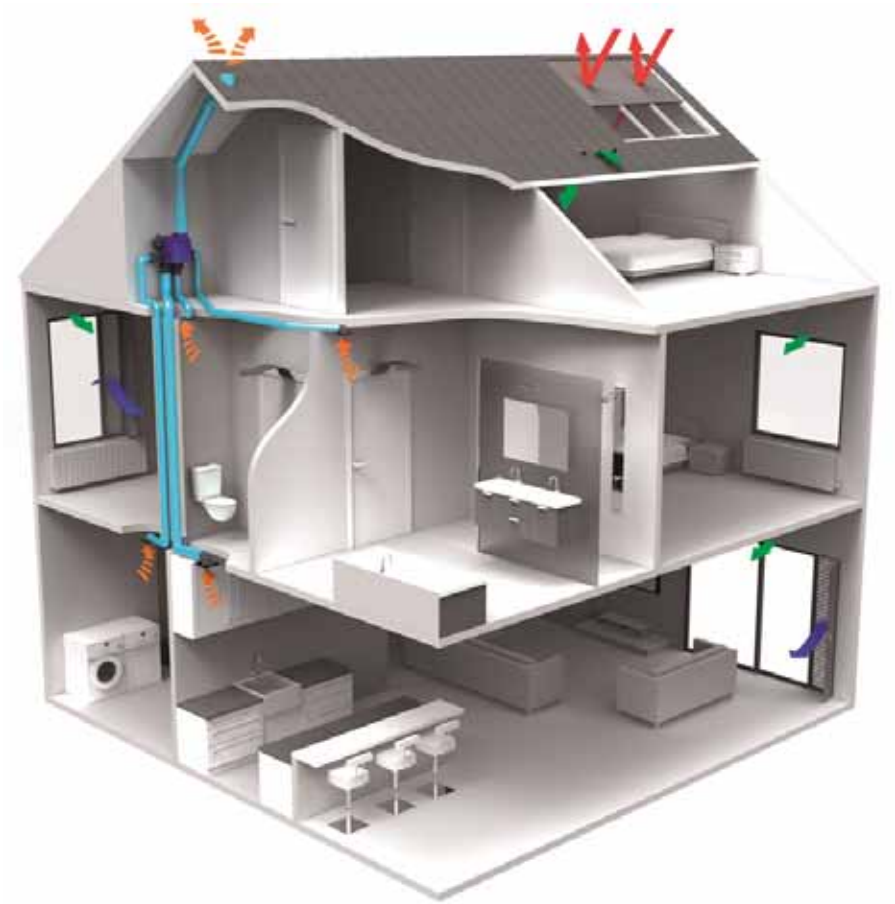
Do you know, that …

- a new building has 3000 to 5000 litres of humidity, which has to disappear and that humans during normal activity produce about 1 litre of sweat every day?
- if the humidity is over 75 % for more than 72 hours you will have mould in your house.
- the number of dust mite increases exponentially with the increase of the humidity and that this is the main reason for allergies.
- the concentration of all these pollutants indoor can be 2 to 5 times worse than outdoor levels, occasionally even much higher.
- the CO2 level in an average room will reach the unhealthy level in 3 hours if the room is not ventilated adequately.
- radon is the most dangerous radioactive gas and it is widely found in houses.
- we do not see these pollutants, but they are there and they have an impact on our health if we do not take the necessary actions to get them out of our buildings.
- 16 % of all heath spending is related to the air quality!



With an increasing trend towards airtight construction, there are problems with humidity, CO2 and various other substances staying inside the home as adequate ventilation is not considered. As a matter of fact, excessive insulation and inadequate ventilation create a dead and stale air which accumulates mites, molds, viruses, bacteria, as well as moisture and harmful chemicals. It has been proven that breathing larger amounts of these pollutants for even the shortest period will affect our health. This may cause health problems (irritation of eyes, nose and throat, headache and sickness, among other issues) as well as comfort problems (smells, condensation, moisture). This is why we must regularly and properly ventilate our buildings, using demand controlled ventilation.





How to ventilate?

Humans do need about 20 m³ of fresh air to feel well. Fresh air, full of oxygen, gives us energy, improves concentration and avoids sleepiness. In the past, ventilation was not an issue, as most of the old buildings had their own 'natural' ventilation through cracks in the construction. Today, our houses and other buildings are constructed as airtight as possible and architects and builders need to include elements, guaranteeing the indoor air quality is not poor.

Many people still believe that opening windows from time to time is sufficient. However the effect of openings windows is only temporary and ventilation through open windows is uncontrollable and, therefore, wasting energy. In addition, they lead to other problems, such as noise, the risk of burglary, the intrusion of insects, …. Many buildings are also equipped with air-conditioning systems. People or building operation and maintenance companies are, however, setting these airconditioners with energy savings, which means they are just recirculating already cooled air, without combining it with fresh outside air. As a consequence, the pollutants concentrate inside the room. A controlled ventilation, 24 hours a day, is the only effective and secure solution to obtain a good indoor air quality and a healthy inner climate.

The A, B, C(+), D of ventilation

In general, there are 4 different ways of ventilating, all of them based on the same three principles:

- The supply of fresh air in the dry rooms, such as living room, sleeping room, ….
- The drive of air through the dwelling via halls by means of louvres in the doors.
- The extraction of filthy air in the wet areas, e.g. toilet, kitchen, bathroom, ….

These ventilation systems are classified by the way the air is supplied and extracted.

A. Natural supply and extraction

The most easy and cheap way of ventilating, which does not always respect the standard. The circulation of air happens in a natural way based on the differences in pressure. The air enters the dwelling through adjustable openings in windows, walls or the roof. These openings are adjustable as they can be opened or closed just a little bit. In this way you can prevent the ventilation to go in overdrive during windy days. Some of these openings are self-regulating, which means they determine the volume of supplied air depending on the weather. Slits under doors allow the air to circulate through the dwelling, ending in the wet rooms, where it is extracted in a natural way by means of adjustable extraction openings.

B. Mechanical supply and natural extraction

Using ventilation system B, the fresh air supply happens mechanically and the air is circulated throughout the dwelling via integrated ventilation channels. The mechanical supply of air results in a so-called chimney effect, resulting in the automatic extraction of air in a natural way. Combining a mechanical supply and a natural extraction, this system can be used to ventilate in a correct way in loud areas or in places where smells can appear. This supplied air can be directed through a filter before entering the dwelling. This kind of ventilation is however barely used in dwellings. Why? The answer is simple: the ventilators of the system are constantly using electricity. The system cannot be stopped and is therefore less interesting than a demand-controlled ventilation system C+ or D.

C. Natural supply and mechanical extraction

This is a system, which can be easily integrated in new builds and renovation. The

installer only has to integrate a minimum of ducts and apart from the regular maintenance of the extraction louvres and the self-regulating window vents no further maintenance is needed.

C+. Natural supply and demand-controlled extraction

The difference between C and C+ is the demand-controlled extraction, using modulating extraction louvres. The ventilation level is adapted based on the way of living. As the ventilation level is never higher than really needed, energy consumption can be minimized. This kind of systems use a central extraction unit, combined with extraction louvres in the various wet rooms.

Ventilation system C+ combines the constant supply of fresh air through self-regulating vents and the transit via door grilles with the extraction on-demand of polluted air in the wet as well as dry rooms thanks to a central extraction unit Healthbox. This unit has a powerful motor with control modules that can ensure proper ventilation of any connected room at all times. Dynamic sensors measure the extraction air in both the wet and the dry rooms 24 hours a day on CO2 or humidity and/or VOCs and adapt the ventilation level to the needs of the residents in an intelligent way. In this way, the Healthbox® makes a healthy indoor environment possible. Thanks to a new integrated technology, the polluted air is not only extracted in the wet rooms, but also in the sleeping rooms, which is very important to have a good air quality during sleep.

This technology ensures that the house is optimally ventilated according to the residents' activities. As a matter of fact, you can have ventilation controlled within the rooms the residents are most present. When they are watching television, the extraction level is raised in the living room. When they go to sleep, the extraction in the living room is decreasing and more polluted air is extracted in the sleeping rooms. Result: RENSON® developed a system that follows the residents and guarantees an optimal air quality in the house.

The supplied air in this setup is not heated. In order to prevent draughts it is better to use self-regulating window vents. The more wind, the more the valve is closing, resulting in the same volume of air supplied at all times. When you are living along a road with a lot of traffic, you can use acoustic window vents. In this way, fresh air is supplied without having problems with disturbing noise.

D. Mechanical supply and mechanical extraction

System D is based on the mechanical supply and extraction of air by means of ventilators. Both the supply and extraction can be controlled, but you need to have a double duct net: one for the supply in the dry rooms and one for the extraction in the wet rooms. In most cases, systems with heat recovery are used. The supplied air is then heated using the warmth of the extracted air. This system has its advantages in some cases, but is also more expensive as you need to have more ducts and you have to take into account the maintenance and change of filers on a regular basis in order to prevent health problems.

Special focus on demand controlled ventilation (DCV)

Demand controlled ventilation (DCV) allows air to be circulated according to a building's use and occupancy. DCV uses sensors to monitor and measure ambient conditions and feed real-time data back to a controller, which adjusts the fan speed modulating the ventilation rate to match the use and occupancy of the building. In this case, ventilation rates are kept to a minimum when nobody is the building or in a specific room. The ventilation is increased when people are entering a specific area of the building. This results in a good air quality in every room of the building and reduces energy in a significant way.

Just an example: if people get up in the morning, they first go to the toilet. The clever sensors of the ventilation system notice someone entering the toilet and immediately increase the ventilation level in the room. When the occupants of the building move from the toilet to the bathroom taking a shower, the ventilation system will detect the increase in humidity and automatically adapt the level of ventilation in both rooms. In the end, when people are going to work, the ventilation will be reduced to a minimum.

Today, demand controlled ventilation can even be extended to the bedroom. As the sleeping rooms are seen as dry rooms, in a normal setup only supply of fresh air is integrated, no extraction. The new technology adds extraction to the bedroom, because during the night people are creating a lot of filthy air, reducing the air quality in the room. By extracting bad smells, humidity and other pollutants out of the bedroom, people are guaranteed a good and healthy rest during the night, increasing activity and improving life quality during the day. ■

Credits

RENSON®

How to impove Energy Efficiency in HVAC Systems

Conditioning fresh air in HVAC systems increases the load on the system. Generally, air is transported through ductwork, while water and refrigerants are distributed through pipework. The entire process is energy intensive since the main users of this energy are the HVAC plant, fans and pumps. System consists of various components and there are some very good opportunities to improve overall energy efficiency of HVAC systems...

A typical Heating, Ventilation and Air Conditioning (HVAC) system consists of plant equipment (chillers, boilers etc.) which transfer energy via air, water or a refrigerant to air distribution systems consisting of a series of fans and coils. These distribution systems are usually called air handling units (AHUs). The AHUs then use this energy to warm or cool the air that is supplied to the office space.

Air is warmed or cooled as it flows over the heating or cooling coils in the air distribution system. Heat rejection is also required at this point, to reject excess heat collected from the space, to the atmosphere. Heat rejection can also occur through plant equipment such as cooling towers or evaporative coolers.

The main thermal loads in a commercial building are a combination of:

i. Heat produced by people
ii. Heat generated by computers and equipment
iii. Solar radiation through windows
iv. Heat conduction through walls, windows and roof
v. Heat generated by lighting.

To provide comfortable indoor conditions, an amount of fresh outdoor air must be supplied to the building. The quantity is proportional to the number of people in the space. Air from outside is usually warmer in summer and cooler in winter than the desired indoor conditions; hence this air must be conditioned.

Conditioning this fresh air increases the load on the system. Generally, air is transported through ductwork while water and refrigerants are distributed through pipework. The entire process is energy intensive - the main users of this energy being the HVAC plant, fans and pumps. Pumps and fans require energy in the form of electricity to distribute water and air through the building. Chillers and boilers can run on either electricity or gas.

Figure 1 shows the schematics of a HVAC system and the interactions between plant, medium, systems and loads. All systems in a building are linked via a Building Management System (BMS), which monitors the systems and provides a point at which issues can be diagnosed, and systems tuned and optimised.

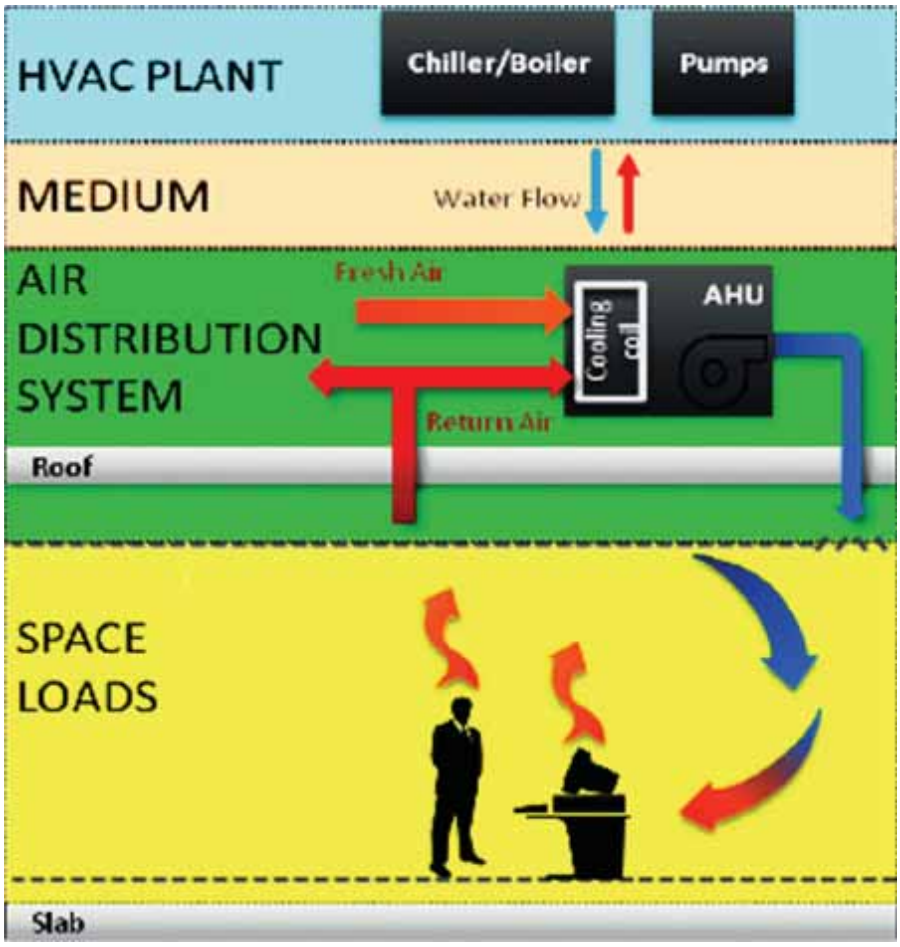


Figure 1

Energy Efficiency Opportunities in HVAC

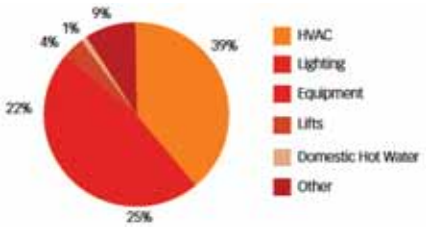


Figure 2 shows the typical energy consumption breakdown in an office building, with HVAC systems consuming the greatest portion (39%)

A further breakdown of the typical energy consumption associated with these HVAC system components is shown in Figure 3.

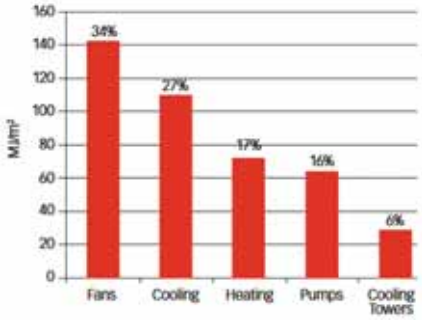


Figure 3: Typical Energy Consumption of HVAC Systems

It is important to reduce overall energy use and increase energy efficiency, while delivering a comfortable environment. Optimum comfort for sedentary work is between 20°C and 26°C, depending on the time of the year and clothing worn

Generally the temperature in office buildings should vary according to the outside temperature and should be changed month to month.

In order to maintain a comfortable temperature and humidity level within a building, the HVAC system must overcome all of the different loads in the building that work against the desired conditions. The methods to improve energy efficiency in a building's HVAC system can be broken down into two categories:

1. Reduction of the loads within a space that the HVAC system has to overcome
2. Improve efficiency of HVAC equipment and systems.

1. Reduce Loads within Space

Reduce Equipment Load – Reducing usage of heat-producing equipment such as computers, printers and lights will reduce the need for HVAC systems to condition a space.

Simple things such as turning off monitors, computers or lights when they are not in use will reduce conditioning loads.

Improvements to Façade (Walls) – Increasing the insulating properties of the building fabric will generally decrease the amount of cooling or heating required, and hence reduce overall energy usage.

Improvements to Façade (Windows) – Window loads occur in the form of solar radiation and conduction. Solar radiation refers to the heat created as direct sunlight comes through a window and hits a solid surface in an internal space absorbing the electromagnetic radiation. Conduction refers to the movement of heat from the hotter side of the window to the cooler side. Shading devices minimise the solar load from the windows and reduce loads in the space. A typical double-glazed window will conduct significantly less heat into a room than a typical single glazed window. Another aspect to be considered is air sealing, a lack of which can lead to increased conditioning requirements.

Demand Based Ventilation – Conditioning fresh air requires considerable energy as it is often at a significantly different temperature to that desired in the space. A minimum quantity of fresh air is required in a space based on occupancy in accordance with Australian Standards. Carbon dioxide (CO_2) sensors can be used to determine the minimum amount of fresh air required and lower the fresh air supplied, saving energy.

2. Improve HVAC System Efficiency

System Selection – Significant energy savings can be realised through optimal system selection. For example, a Variable Air Volume (VAV) AHU regulates the volume of the supply air to the spaces depending on the amount of heating or cooling required. This system allows for greater control and reduces airflow rates, which reduces overall fan energy consumption. This greater control may also reduce energy wastage associated with re-heating, where the heating system counteracts the cooling system.

Plant Selection – Plant selection can greatly affect the overall energy consumption of a building. For example, condensing boilers - used for the provision of heating hot water - can have gross efficiencies over 90%.

Evaporative pads can be used on air cooled chillers to pre-cool air prior to reaching chiller condensers, improving efficiency. Accurate plant sizing also has a large impact on energy efficiency. Chillers generally work most efficiently at a particular load, so they should be sized to operate at or near this load most of the time.

Building Tuning and Commissioning – Energy savings can be achieved through the commissioning and tuning process. After a HVAC system has been installed, commissioning and on-going tuning of the system will allow the system to function as per the original design intent, optimise its operation and obtain maximum energy savings.

Energy Recovery – Energy recovery involves capturing waste energy and recycling it. Exhaust air is generally closer to the desired space temperature than the outside fresh air being introduced into the system. Heat or 'coolth' can be drawn from the exhaust air and used to pre-warm or cool the fresh air entering the system prior to it reaching the AHU. This lowers the energy used by the AHU to condition the fresh air.

Smart Control Strategies – There are many examples of smart control strategies achieved through optimisation of the BMS and building information available to it. One option is to install smart control software that allows the BMS to determine optimum operating conditions for the entire HVAC system to achieve the lowest energy consumption. To achieve this it is important to optimise consumption information for separate parts of the HVAC system. This can be achieved through installation of sub-metering and sensing.

Economy Cycle – Economy cycle involves using 100% outdoor air to supply air to the space. This occurs at times of the year when the outdoor conditions are cooler than the return air temperature in cooling mode. This allows the plant to turn off the cooling coils and reduces chiller energy consumption.

A ten year strategy under the National Strategy on Energy Efficiency should be framed that aims to drive long term improvements in energy efficiency of HVAC systems Nation-wide. Under the Energy Efficiency Working Group, the Buildings Committee manages the implementation of the HVAC Strategy. This committee is comprised of representatives from Govt, State and Local Self Govt. The Strategy takes a whole of life perspective in targeting HVAC efficiency improvement, encompassing the design, manufacture, installation, operation and maintenance stages of the HVAC lifecycle. The Strategy consists of a number of complementary measures that fall under three broad initiatives – People, Practices and Systems. This Basics of HVAC Energy Efficiency factsheet relates to all three categories. It is one of a suite of factsheets developed to provide a quick overview and reference to inform, educate, and encourage energy efficiency in the HVAC industry.

CONCLUSION

7 Easy Tips to Improve Your HVAC Efficiency

Residential and commercial buildings account for 40% of total energy consumption. According to CSE Magazine, HVAC systems use between 40-60% of the total energy consumed in buildings, based on data from the Department of Energy (DOE). Since we normally don't interact directly with our business's heating or cooling systems, we often don't think about the energy consumption and money wasted through inefficient HVAC systems. The following will provide some simple tips to keep your building's HVAC more efficient.

Schedule a professional energy audit

First things first, have a professional conduct an energy audit on your HVAC system. Most utilities in New England offer complimentary energy audits, so there's no reason not to have your systems evaluated for potential energy efficiency upgrades. Depending on the age of the unit and the parts, and the condition the unit is in, there may be some simple fixes you can make without

fronting the cash to purchase a new system. Let's discuss some of the upgrades you can make.

Install an economizer

One of the simplest and lowest-cost solutions, economizers take advantage of cooler temperatures outside your building by bringing in that air, instead of mechanically cooling warmer air by powering the compressor, to cool your building. Thus, the only energy needed is to move the air throughout the building. Buildings often produce a high amount of energy and heat during normal business hours, making the air outside cooler than the air inside the building. This is why we sometimes need to use the AC on cool days. Utilizing this simple solution, on average, can save businesses up to 30% in energy costs.

Implement controls

Controls allow the user to set preferences to how the heating and cooling systems operate and make them run more efficiently behind the scenes. Controls include devices such as programmable thermostats, timing automation systems, demand and occupancy sensors, and more. Simply put, these optimize the heating and cooling functions during peak hours, and for when the building is unoccupied—which is especially important. Why heat or cool your building more than necessary?

Reduce load capacity

Load capacity refers to the total amount of heating and cooling your building uses. Reducing load capacity helps your existing systems run less frequently. There are several important steps you can take to reduce your building's load capacity, including:

Installing insulation

Insulation and air sealing are commonly overlooked components of building energy management. There are many ways to seal and insulate your building, including roofs, walls, pipes, and ducts. Over time, these components wear down, allowing heat to escape through cracks or holes. You want to heat your building, windows, and doors, not "the whole outdoors," as the expression goes. Proper insulation, building envelope sealing, and maintenance can increase the efficiency of your building dramatically.

Installing energy-efficient windows

For small businesses, installing storm windows can help your business save up to 15% of your annual building costs. For larger, multi-story businesses with many windows, the project is a lot more complex, but the concept and savings are similar. In some cases, larger businesses can reduce overall energy consumption by up to 50%.

Business owners should notice an immediate difference on their next energy bill, but those savings will decline without proper maintenance. Installing window film (discussed in the next paragraph), cleaning, caulking, and replacing components all ensure the windows stay at peak performance during their lifetime. For instance, cleaning ensures buildings take advantage of solar heat, while caulking helps stop air leakage.

Installing window film

Another overlooked component of energy management is solar heat—sunlight coming in through the windows. According to FacilitiesNet, "roughly one third of an average building's cooling load is due to solar heat gain through windows" (Zimmermann, 2006). Window film can block up to 80% of solar heat by absorbing and reflecting the heat back outdoors. According to Jim Mannix, business development manager at 3M, "From a building management perspective, you can reduce kwh, make tenants more comfortable and reduce demand charge" (Zimmermann, 2006). In winter, the sun can be used to offset heating costs, as well, provided your windows are properly sealed.

Installing energy-efficient lighting

As a core component to your entire building's energy management, lighting, especially older, less efficient models, generates a lot of heat. Upgrading to more efficient fluorescents or LEDs gives off less heat and reduces the strain on your HVAC system. This is one of the easiest and most cost effective measures for energy savings and maintenance.

Upgrading to Energy Star certified office equipment

Similar to lighting, old office equipment generates a lot of heat. Upgrading to more energy-efficient equipment, especially those that are ENERGY STAR certified, are easy ways to reduce your building's load capacity. Better yet, you can receive rebates on many ENERGY STAR appliances.

HVAC Maintenance

Like all equipment, proper maintenance is essential to ensure your HVAC system is running as efficiently as possible. We recommend checking and tuning up your HVAC before the start of every winter season. Check for leaks and defective equipment in your pipes, ducts, coils, and unit fittings to make necessary repairs. Chillers, boilers, and other heating and cooling equipment all wear down or break over time. Cleaning debris and dust that accumulates in the coils and ducts in the system can prevent your heat transfer from being compromised and your system requiring emergency repair.

It is also critical to change your HVAC filters regularly. You wouldn't run your dryer without changing the lint trap often, right? We recommend changing your filters at least once a month. Filters are cheap, ranging from only a few dollars, and can improve system performance and air quality. Plus, this is important to keep people working in the space healthy.

Educate your workforce

As a business owner or facilities manager, you know the importance of energy savings and how they affect your bottom line. Your company's other employees, however, may not share the same knowledge. It is important to train your employees on the best ways to increase your building's efficiency. Little things such as turning off computers after hours and making sure to turn off lights, even with a motion sensor, affect your building's energy efficiency. We recommend a brief training session to educate your workforce on energy efficiency best practices to reduce load capacity.

Purchasing a new HVAC system

After you've had your HVAC inspected and you've determined it makes more sense to upgrade, we recommend you check the system's Seasonal Energy Efficiency Ratio (SEER) rating. The SEER rating, developed by the Department of Energy, evaluates the efficiency of an HVAC system. Older models generally have SEER ratings of 6 or less. Today, the minimum required SEER rating for all commercially sold units is 13. According to Energy.gov, "SEER 13 is 30% more efficient than the previous minimum SEER of 10." Upgrading models with SEER ratings of 6 or less will see even higher energy savings. ■

The Author wishes to thank to Norman Disney & Young for their valued contributions as well as various sources from the Internet.

Dr. Omprakash G. Kulkarni
Scientist, Mentor, Adviser,
Technology Provider and
Consulting Engineer
Renewable Energy and Others...

Electrolux unveils blast chiller for households & other innovations in taste

A compact blast chiller for domestic use is one of several cooking innovations presented by Electrolux at the Eurocucina 2016 in Italy. As the chosen supplier to half of Europe's Michelin-star restaurants, Electrolux is uniquely positioned to translate expertise from professional chefs into products that help consumers achieve great-tasting meals at home.

Electrolux products at Eurocucina 2016 range from the entry level PlusSteam combination oven for home baking enthusiasts, to the connected CombiSteam Pro Smart oven, and the blast chiller that brings the cook-and-chill technique of professional chefs to life.

Professional solution adapted for home use

The Electrolux Blast Chiller quickly chills or freezes fresh or partly cooked food much faster than an ordinary home freezer, preserving the key qualities of the food. So that after defrosting, the food looks like it was never frozen, and the taste, texture and look are uncompromised.

An added advantage is that a blast chiller can be used to instantly stop the cooking process at any time, so one can quickly finish and serve it later when needed. This has made blast chillers a crucial component in professional kitchens, providing chefs with freedom and creative flexibility in meal creation.

As an example of the performance, when baking cupcakes one needs to allow cooling before icing. However, when removing from the oven, baking still continues from within the crust. A blast chiller stops this, reducing the temperature from 175°c to 25°c within 10 minutes – saving at least an hour in comparison to a regular 'standing' process.

"At Eurocucina 2016, Electrolux will show how expertise gained from working with some of the world's top chefs can help domestic kitchen users get their best ever culinary experience," said Dan Arler, Head of Electrolux Major Appliances Europe, Middle East and Africa. "We will continue to develop our leading position in taste through innovations based on consumer insight and our professional expertise. This has been an important success factor in the past year and remains a key part of our strategy to drive Electrolux profitable growth."

A connected oven for convenience, inspiration and taste

The new CombiSteam Pro Smart Oven is equipped with a CookView® camera; a camera with a live feed direct from the oven to a mobile device, providing users the freedom to pursue other tasks whether in the kitchen or not.

The 'My Electrolux' app (available for iOS or Android this spring) means one can start cooking through a mobile device and also respond instantly, changing temperature and humidity level or switching function with a simple touch or swipe on a smart device.

The app provides intuitive support based on user defined parameters. For instance, by choosing a specific dish, professional recipes will be served from the app database. Notifications will then be sent to the smart device to indicate when to actively become involved in the cooking. The large database of recipes can be filtered by diet, cost, occasion, ingredients or cooking preference.

Innovations to make life – and washing dishes – easier

Electrolux will also profile the ComfortLift dishwasher – a first within the dish category with a mechanism that means users no longer need to bend for loading or unloading.

Another innovation, highlighting Electrolux increased focus on consumables and accessories, is the iF Design award-winning glass basket. This product provides a great cleaning solution for even the most delicate of glassware, responding to insight from Electrolux consumer research that shows nearly half of owners hand-wash wine glasses for fear of damage. ■

Take measurements with Testo smartphone Apps!

Testo Smart Probes are eight intelligent, wireless probes which equip customers to smartly measure in real time using smart phones. These pocket friendly smart probes can travel with users. Their low-budget price makes it easy for first time users to make a spur-of-the-moment purchase of an additional measuring instrument.

They are wirelessly controlled through the free App for iOS and Android installed on smartphones or devices which also serve as displays for measuring instruments.

One App – Eight measuring devices – a lot of advantages

- Monitor measured data wirelessly, e.g. during system adjustments.
- Show measured values of upto six smart probes at the same time.
- Monitor changes using trending as graph or table
- Save and send measured values as .pdf or excel files on Android smartphones.
- Simple user interface, as capabilities of smart device are used (e.g. touch screen)
- All needed measuring parameters in one handy case
- Price-attractive sets available

Here is the range of Testo Smart probes at a glance:

- **Smart Clamp thermometer Testo 115i** to measure flow and return temperatures
- **Smart Thermal Anemometer Testo 405i** measures airflow velocities, temperatures and volume flows
- **Smart Vane Anemometer Testo 410i** measures airflow velocity, volume flow and temperature
- **Smart Differential Pressure Gauge Testo 510i** measures gas flow and static pressure. It also determines air flow velocity and volume flow
- **Smart High-Pressure Gauge Testo 549i** measures high and low pressure
- **Smart Thermal Hygrometer Testo 605i** measures air temperature and relative humidity
- **Smart Infrared Thermometer Testo 805i** for non-contact IR measurement of surface temperature with 8-point laser circle spot marking
- **Smart Thermometer Testo 905i** measures ambient temperature as well as the temperature in ducts and air outlets ■

About Testo India

Testo India Pvt. Ltd., a 100% subsidiary of Testo AG, Germany was founded in 2006 in Pune. The company has established thirteen home offices in major metros and a channel partners' network covering this enormous country.

Testo has become a major supplier for HVAC industries, refrigeration, airflow and environmental monitoring instruments for markets as diverse as chemical, steel, power, cement, food and beverages, pharmaceuticals, biotech etc.

For more information visit: www.testo.in/smart-probes

Different Type Of Chillers & Their Application

There are basically two types of chillers which may be classified according on their refrigerent cycles and applications. Examined here are different types of chillers and their various applications...

A chiller is a heat transfer device that uses refrigeration system to remove heat from a process load and transfers the heat to the environment. Chillers may also be seen as cooling machines of choice to condition industrial, commercial, and institutional facilities.

They are used to lower the temperatures of all kinds of equipment and processes such as: robotic machinery; semiconductors; injection and blow molding machines; welding equipment; die-casting and machine tooling; paper and cement processing; power supplies; power generation stations; compressed air and gas cooling systems; medical imaging machines; chemical, drug, food and beverage production; even simply to cool potable water to desirable levels. Whether for office comfort, keeping data server centres from overheating, or specialized industrial processes, water temperature control plays a vital role in many of the behind-the-scenes activities that affect our everyday lives.

A chiller consists of a reservoir that is filled with a fluid such as water or ethylene glycol/ water mixture which is continually circulated. In a typical building application, chilled water is circulated to air-handlers or now the increasingly used chilled beams in order to transfer heat from air to water, or stated the other way, transfer cooling from the water to the building air. The schematic diagram of a chiller plant is shown in figure 1.

Types Of Chillers

Chillers can primarily be classified as absorption chillers and refrigerant compression chillers, based on the refrigerant cycle on which they work.

Cooling processes are significantly different in the two types of chillers. Absorption chillers use a heat source such as natural gas or steam to create refrigeration or cooling effect. Refrigerant chillers use mechanical compression and are the most common. Refrigerant compression chillers consist of four main components - a compressor, an evaporator, a condenser and a valve metering system. Basically, a refrigerant gathers heat, and then uses an evaporator heat exchanger to remove that heat.

There are two main types of refrigerant compression chillers, air and water. Air condensers are cooled by utilizing the air, whereas water condensers are cooled by using water sources. Water cooled chillers are generally located within the building and use cooling towers, a pond, or river located near the building to reject water's heat from the condenser.

Chillers with condensers cooled by air operate essentially the same as those cooled by water regarding the refrigerant cycle and the steps along the way. The cooling medium on the condenser is of course air instead of water. Air cooled chillers are intended for outdoor installation and operation.

These reject heat to the atmosphere by mechanical means such as circulation of outdoor air by a fan directly through the machine's condenser. These types of condenser cooled units do not require a cooling tower as is common with water cooled chillers since the air rejects heat to the atmosphere. Based on compression method of the refrigerant in its vapour phase, chillers can also be classified into four categories. The compressors may be reciprocating, centrifugal, rotary screw and rotary scroll type.

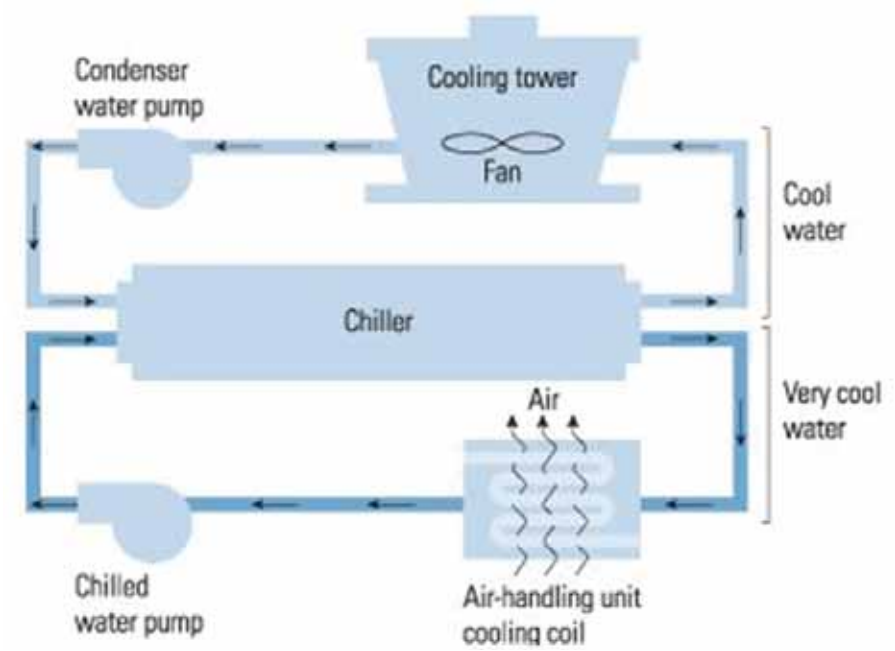


Figure 1: Schematic diagram of a chiller Plant

Reciprocating compressors possess a crankshaft and pistons. The pistons compress the gas and the gas is heated. The hot gas is discharged to the condenser. The pistons have intake and exhaust valves that can be opened on demand to allow the pistons to idle. A few examples of this would be in an office or school, but not necessarily in a hotel or an apartment building.

Common capacities range from 20 to 125 tons but can even get up to 450 tons. Centrifugal compressors operate much like a centrifugal water pump. They contain an impeller that compresses the refrigerant. Centrifugal chillers can provide a very high cooling capacity in a compact design. They have the ability to vary capacity continuously to match a wide range of load fluctuations with near proportional changes in power consumption. This provides tight temperature control and energy conservation.

The capacity can range from 150 tons up to 2400 tons. Rotary screw or helical DNA type compressors have two mating helically grooved rotors. As the rotors rotate, the gas is compressed by volume reduction between the two rotors. These helixes require high tolerances to fit perfectly, thus driving up the initial cost.

Capacity is controlled by a sliding inlet valve or variable-speed drive (VSD) on the motor. Capacities range from 25 to 450 tons with the largest capable of 800 tons. Rotary scroll compressors use two spirals to pump and compress the refrigerant. Commonly, one of the scrolls is fixed while the other orbits eccentrically without rotating within the other fixed scroll.

This motion traps and compresses pockets of fluid between the scrolls. This design and operation makes them the most efficient of the four compressor types. The capacity of single refrigerant loop scroll compressor ranges from 2 to 25 tons. Typical chilled water cooling temperature ranges between 39-45 °F. The classification of chillers from various aspects has been shown in Fig.2.

For proper heat transfer between the circulated water to be cooled and the refrigerant, it is important to maintain sufficient chiller water flow. The commonly recommended

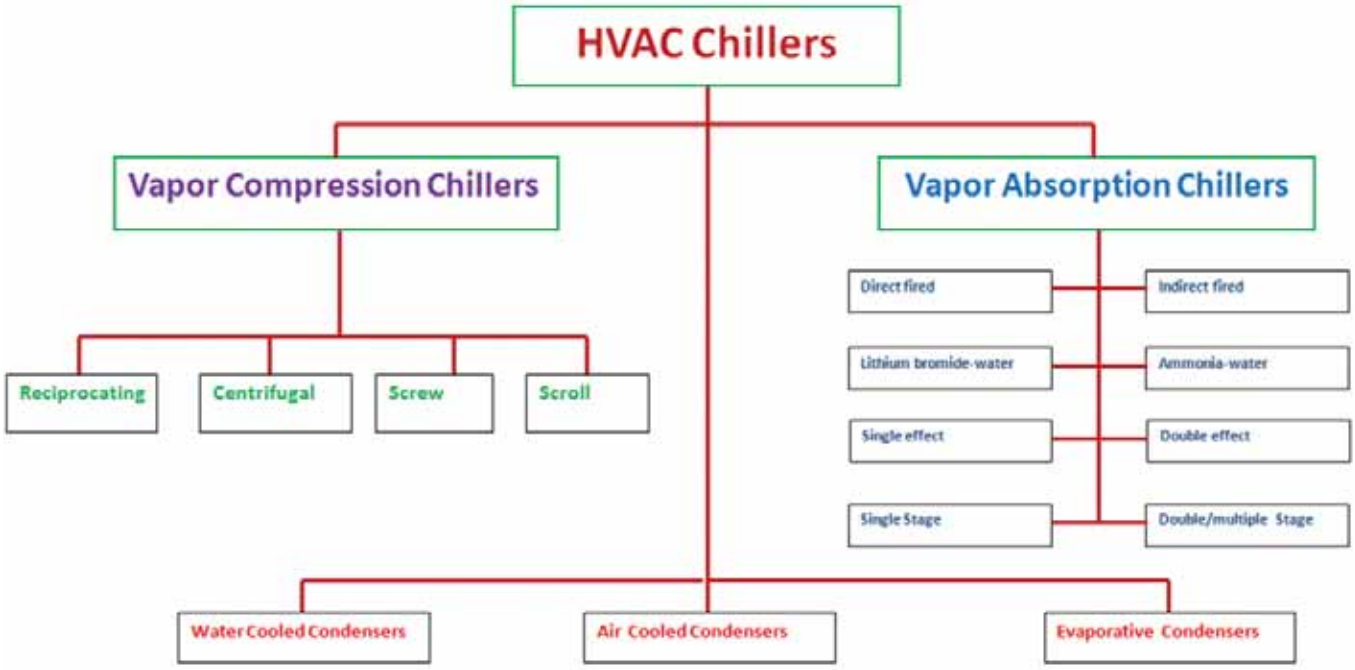


Figure 2: Detailed classification of Chillers

range of chilled water flow velocity is between 3 and 12 feet per second. Therefore, it is very important for a chiller to maintain this flow for proper efficiency and corresponding energy usage as well as maintaining long-term performance.

Absorption Chillers

Absorption chiller is a machine which operates based on vapour absorption refrigeration cycle. This cycle consists of four major heat exchangers, (generator, condenser, evaporator and absorber) with two kinds of solution, (refrigerant and absorbent). During this cycle high pressure will prevail inside generator and condenser, while inside evaporator and absorber there will be low pressure. The cycle starts with input waste heat in the generator. As a result of this heat input, the solution in the generator will be separated into refrigerant and weak solution. The refrigerant in the vapour form will enter into condenser and will change into liquid. The solution part will enter absorber, since there is a pressure difference between condenser and evaporator, the refrigerant will flow inside evaporator and will absorb heat from cooled water that is in circulation inside evaporator. Consequently, the temperature of circulated water decreases and then it is used for air-conditioning purpose. The evaporated refrigerant will then enter absorber where it will be mixed with weak solution, the mixture will then get the liquid state and finally it will enter generator and the cycle is repeated. The schematic diagram of the vapour absorption refrigeration cycle has been shown in Fig. 3.

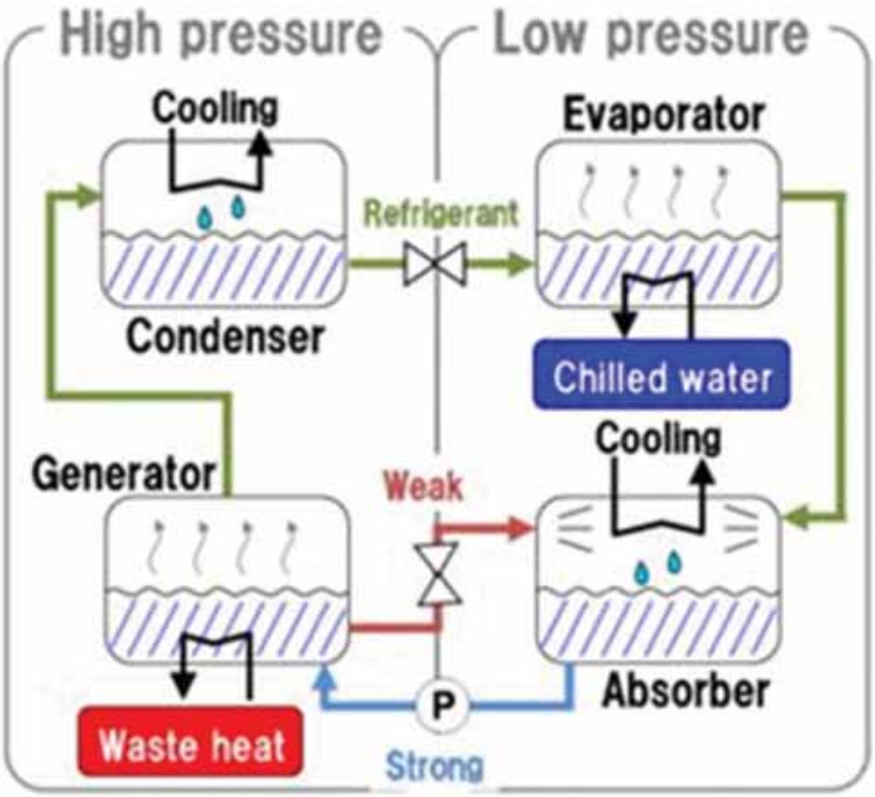


Figure 3: Schematic diagram of vapour absorption refrigeration cycle

Vapour Compression Chillers

The schematic diagram of chiller based on vapour compression refrigeration cycle has been shown in Fig.4. Refrigerant gets vaporized by taking heat from chilled water in evaporator thus serving its prime purpose. Refrigerant comes out of evaporator as vapour but on other side chilled water is produced. Thus, heat is added to refrigerant at constant pressure but is extracted from chilled water. Both refrigerant

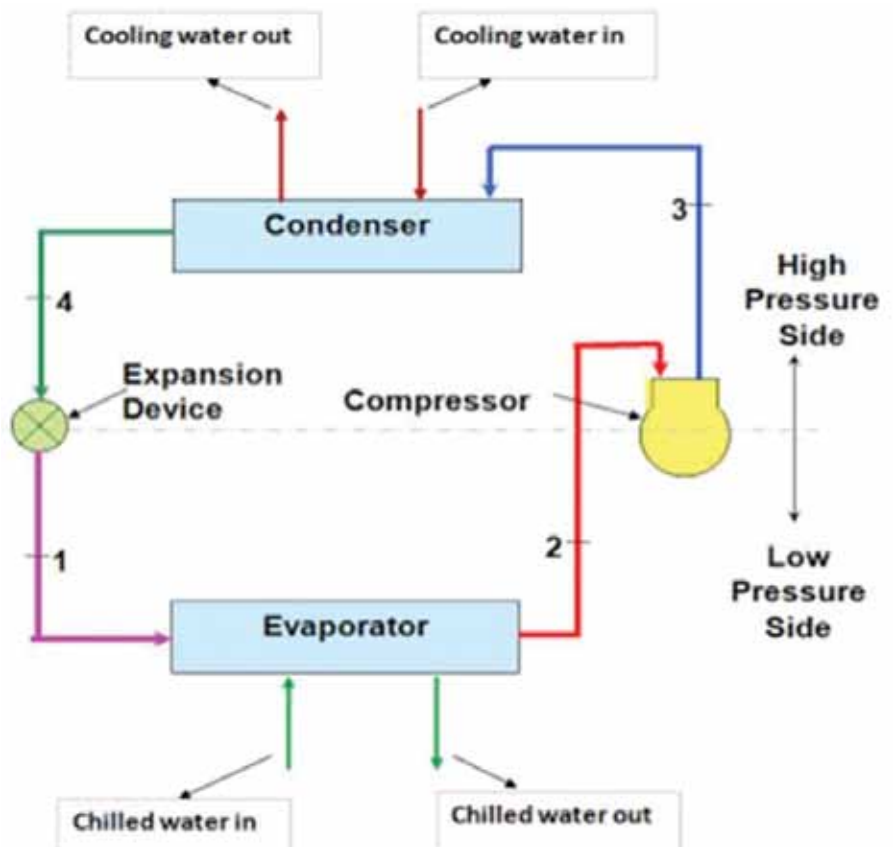


Figure 4: Schematic representation of vapour compression refrigeration cycle

and chilled water don't get mixed and are separated by some solid wall in between them in evaporator like shell and tube design. Refrigerant vapours come out of evaporator and then compressed by chiller compressor to high pressure and temperature. Compressor requires energy input for its working and hence electric energy is supplied to it. Refrigerant vapour rejects heat to outside cooling liquid or air. Refrigerant in condensed or liquid form coming out of condenser is expanded in expansion valve and its pressure and temperature are reduced to level of evaporator so that above cycle is repeated again.

Applications

A chiller can be realized as a refrigeration system that cools water. Air conditioners and dehumidifiers condition the air while a chiller, using the same refrigerating operations, cools water, oil, or some other fluid. This chilled solution can then be used for cooling in a wide range of operations. Some of the most common applications are as follow:

1. Plastics Industry: Cooling the hot plastic that is injected, blown, extruded or stamped.
2. Printing Industry-Cooling warm rollers due to friction and ovens curing the ink, along with ultraviolet lamps also for curing purposes.
3. Medical Industry: MRI Systems-The hospital MRI units need to be cooled to operate properly.
4. HVAC Industry: Large scale air-conditioning systems pump this chilled water to coils in specific areas of high rise buildings. The air handling systems for each area open and close the water flow through specific area keeping the air of the rooms at a desired temperature.
5. Laser Cutting Industry: Technology has created machines that can cut out very specific steel products with the precise use of a laser cutting machine. These lasers run at very high temperatures and must be cooled to run properly.
6. Brewery Industry- The cooling of the kettles in fermentation has become an upcoming industry where chiller have been used to keep the kettles and storage area of beer at cold temperatures.

Future Scope

New formulations of lubricants and refrigerants blended with nano particles could yield increased energy efficiency for chillers.

Carbon dioxide has been used in some supermarket refrigeration equipment. However, the high operating pressures with CO2 are a concern.

Hydrocarbons as refrigerants offer the possibility of good efficiencies. HFOs will become the new mainstream refrigerants of choice for chillers

The development of oil-free centrifugal compressors, where magnetic bearings replace the use of oil for lubrication has seen even greater increases in efficiency and lower operating costs. ■

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Clean Room High Speed Doors designed and manufactured by Gandhi Automations are high in demand in industries such as Pharmaceutical and Chemical, which require quick open and close applications at the entry and exit points as controlled environment needs to be maintained.

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The key features of Clean Room High Speed Doors offered by Gandhi Automations are briefly mentioned below:

- Clean Room High Speed Doors are designed for inside applications and protects your environment against draughts, humidity, dust and dirt
- Operating speed and superior sealing properties improve traffic flows and provide environmental control and savings on energy costs
- Concept of low air permeability in pressurized rooms with positive and negative air pressure
- High door efficiency & low permeability values EN 12426 EN 12427 : < 12m^3/m2h Δ 50 PA
- High leak tightness is due to curtain being tightly integrated in special SS 316 matt finish side guides
- Bottom safety edges and photocells combine to ensure operator safety at all times
- Heavy duty motor: 400V three phase, opening speed upto 1.5 m/s with inverter system
- Size upto:4000 mm (W) X 4000 mm (H) ■

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Energy Efficiency
for Refrigeration & Air Conditioning

Due to development and enlargement of cities in cold regions, conventional heating methods severely pollute the environment. In order to clean up cities, governments have drawn up measures to restrict heating by burning coal and oil and encouraged citizens to use heating fuelled by electricity or gas. New approaches are being studied and solar-assisted reversible absorption heat pump for small power applications using water-ammonia are being developed...

Over the years, al parts of a comnercial refrigerator such as the compressor, heat exchangers, refrigerant and packaging have all improved considerably due to extensive research.

However, improvements in conventional refrigation have been incremental since this technology is already nearing its fundamental limit of energy efficiency.

There are different methods and techniques to provide energy for heating and cooling systems. Also important is the optimisation and improvement of operational conditions of heat cycles and the performance of ground source heat pump systems (GSHPs).

With the improvement of people's living standards and the development of economies, heat pumps have become widely used for air conditioning. The driver to this was that environmental problems associated with the use of refrigeration equipment, the ozone layer depletion and global warming are increasingly becoming the main concerns in developed and developing countries alike.

Due to development and enlargement of cities in cold regions, conventional heating methods can severely pollute the environment. In order to clean up cities, governments drew up many measures to restrict heating by burning coal and oil and encouraged citizens to use heating fuelled by electricity or gas. New approaches are being studied and solar-assisted reversible absorption heat pump for small power applications using water-ammonia are being developed.

An air-source heat pump is convenient to use and so it is a better method for electric heating. The ambient temperature in winter is comparatively high in most regions, so heat pumps with high efficiency can satisfy their heating requirement. On the other hand, a conventional heat pump is unable to meet the heating requirement in severely cold regions anyway, because its heating capacity decreases rapidly when ambient temperature is below -10°C.

According to the weather data in cold regions, the air-source heat pump for heating applications must operate for long times with high efficiency and reliability when ambient temperature is as low as -15°C. Hence, much research and development have been conducted to enable heat pumps to operate steadily with high efficiency and reliability in low temperature environments.

For example, the burner of a room air conditioner, which uses kerosene, was developed to improve the performance in low outside temperature. Similarly, the packaged heat pump with variable frequency scroll compressor was developed to realise high temperature air supply and high capacity even under the low ambient temperature of –10 to –20°C.

Such a heat pump systems can be conveniently used for heating in cold regions. However, the importance of targeting the low capacity range is clear if one has in mind that the air conditioning units below 10 kW cooling account for more than 90% of the total number of units installed in the EU.

Earth-energy Systems (EESs)

The earth-energy systems, EESs, have two parts; a circuit of underground piping outside the house, and a heat pump unit inside the house. And unlike the air-source heat pump, where one heat exchanger (and frequently the compressor) is located outside, the entire GSHP unit for the EES is located inside the house.

The outdoor piping system can be either an open system or closed loop. An open system takes advantage of the heat retained in an underground body of water. The water is drawn up through a well directly to the heat exchanger, where its heat is extracted. The water is discharged either to an aboveground body of water, such as a stream or pond, or back to the underground water body through a separate well.

Closed-loop systems, on the other hand, collect heat from the ground by means of a continuous loop of piping buried underground. An antifreeze solution (or refrigerant in the case of a direct expansion 'DX' earth-energy system), which has been chilled by the heat pump's refrigeration system to several degrees colder than the outside soil, circulates through the piping, absorbing heat from the surrounding soil.

In some EESs, a heat exchanger, sometimes called a "desuperheater", takes heat from the hot refrigerant after it leaves the compressor. Water from the home's water heater is pumped through a coil ahead of the condenser coil, in order that some of the heat that would have been dissipated at the condenser is used to heat water. Excess heat is always available in the cooling mode, and is also available in the heating mode during mild weather when the heat pump is above the balance point and not working to full capacity. Other EESs heat domestic hot water (DHW) on demand: the whole machine switches to heating DHW when it is required.

Hot water heating is easy with EESs because the compressor is located inside. Because EESs have relatively constant heating capacity, they generally have many more hours of surplus heating capacity than required for space heating.

In fact, there are sources of energy all around in the form of stored solar energy, which even if they have a low temperature, can provide the surroundings with enough energy to heat the soil, bedrock and ground water as a heat source for domestic dwellings as shown in Figure 1, for example.

Some emphasis has recently been put on the utilisation of the ambient energy from ground source and other renewable energy sources in order to stimulate alternative energy sources for heating and cooling of buildings. Exploitation of renewable energy sources and particularly ground heat in buildings can significantly contribute towards reducing dependency on fossil fuels.

The Cooling Cycle

The cooling cycle is basically the reverse of the heating cycle. The reversing valve changes the direction of the refrigerant flow. The refrigerant picks up heat from the house air

Figure 1: Using the soil, bedrock or groundwater as the heat source

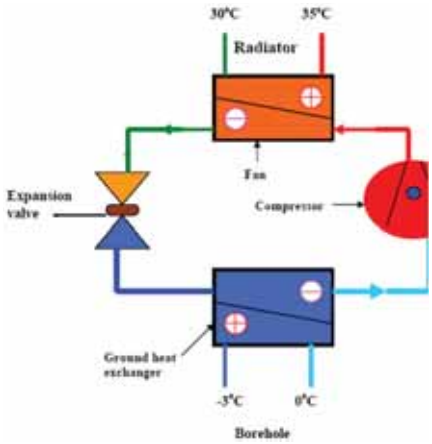


Figure 2: Detail of the GSHP circuit

and transfers it directly in DX systems or to the ground water or antifreeze mixture. The heat is then pumped outside, into a water body or return well (in the case of an open system), or into the underground piping (in the case of a closed-loop system). Once again, some of this excess heat can be used to preheat domestic hot water.

Unlike air-source heat pumps, EESs do not require a defrost cycle. Underground temperatures are much more stable than air temperature, and the heat pump unit itself is located inside; therefore, problems with frost do not arise.

Function of the GSHP Circuit

The collector liquid (cooling medium) is pumped up from the borehole in tubing and passed to the heat pump. Another fluid, a refrigerant, circulates in the heat pump in a closed system with the most important characteristic of having a low boiling point. When the refrigerant reaches the evaporator, which has received energy from the borehole, and the refrigerant evaporates. The vapour is fed to a compressor where it is compressed.

This results in a high increase in temperature. The warm refrigerant is fed to the condenser, which is positioned in the boiler water. Here the refrigerant gives off its energy to the boiler water, so that its temperature drops and the refrigerant changes state from gas to liquid.

The refrigerant then goes via filters to an expansion valve, where the pressure and temperature are further reduced. The refrigerant has now completed its circuit and is once more fed into the evaporator where it is evaporated yet again due to the effect of the energy that the collector has carried from the energy source (Figure 2).

Efficiencies of the GSHP systems are much greater than conventional air-source heat pump systems. A higher COP (coefficient of performance) can be achieved by a GSHP because the source/sink earth temperature is relatively constant compared to air temperatures.

Additionally, heat is absorbed and rejected through water, which is a more desirable heat transfer medium because of its relatively high heat capacity. The GSHP systems rely on the fact that, under normal geothermal gradients of about 0.5°F/100 ft (30°C/km), the earth temperature is roughly constant in a zone extending from about 20 ft (6.1 m) deep to about 150 ft (45.7 m) deep.

This constant temperature interval within the earth is the result of a complex interaction of heat fluxes from above (the sun and the atmosphere) and from below (the earth interior). As a result, the temperature of this interval within the earth is approximately equal to the average annual air temperature. Above this zone (less than about 20 feet (6.1 m) deep), the earth temperature is a damped version of the air temperature at the earth's surface.

Below this zone (greater than about 150 ft (45.7 m) deep), the earth temperature begins to rise according to the natural geothermal gradient. The storage concept is based on a modular design that will facilitate active control and optimisation of thermal input/output, and it can be adapted for simultaneous heating and cooling often needed in large service and institutional buildings. Loading of the core is done by diverting warm and cold air from the heat pump through the core during periods with excess capacity compared to the current need of the building. The cool section of the core can also be loaded directly with air during the night, especially in spring and fall when nights are cold and days may be warm.

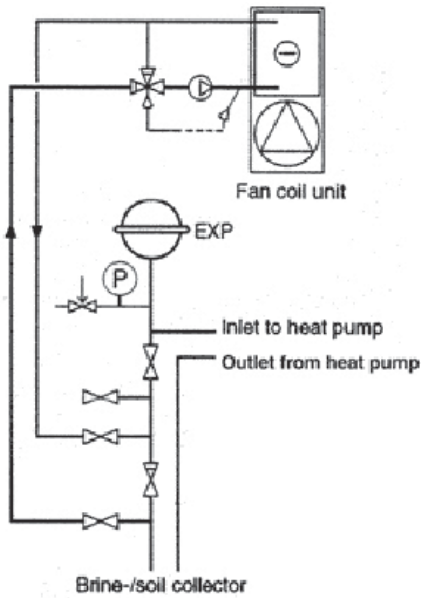


Figure 3: Diagram of cooling system

Free Cooling

The installation can additionally be fitted with fan convectors, for example, in order to allow connections for free cooling (Figure 3). To avoid condensation, pipes and other cold surfaces must be insulated with diffusion proof material. Where the cooling demand is high, fan convectors with drip tray and drain connection are needed.

Refrigeration and Heat Pumps

The pressure (ps) is a function of how rapidly vapour can be removed through suction or formed through pressure. At equilibrium, the rate at which vapour is formed (determined by Q) equals the rate at which it is removed. Therefore, both the heat transfer rate into the liquid (Q) and the vapour removal rate (suction pump capacity) determines the pressure and hence Tsat(s) (Figure 4). This is governed by the following set of equations.

$Q = m\, h_{fg}$ (1)

$m = \rho\, g\, V$ (2)

$Q = \rho\, g\, V\, h_{fg}$ (3)

$Q = V\, h_{fg}/v_g$ (4)

Both h_{fg} and v_g depend on the saturation temperature (or pressure) as assumed in Figure 5, which describes the relationship represented by eqn. 4.

The RHS of the Figure 6 is the 'converse' of the LHS, and constitutes a heat pump. Heat is 'pumped' from the LHS to the RHS. The main difference is that the vapour, after compression, will almost certainly be superheated and must cool to Tsat(c) before condensing will occur. The same reasoning (in converse) applies to the RHS as previously applied to LHS. Obviously, with the above system, the entire refrigerant would eventually end up on the RHS, and the heat pumping (& refrigeration) effect would cease.

Clearly, to ensure that the system can operate continuously liquid refrigerant needs to be fed from the RHS back to the LHS. This can be achieved by simply allowing it to flow back under its natural pressure difference. In this way a continuous closed circuit refrigeration (Or heat pump) system is obtained (Figure 7).

Control of the liquid flow rate is needed to ensure that it equals the vapour formation rate, and an appropriate balance of liquid quantities in the evaporator and condenser is maintained. When the liquid passes through the expansion valve it experiences a sudden drop in pressure,

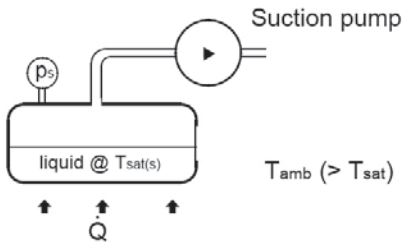


Figure 4: Refrigeration Cycle

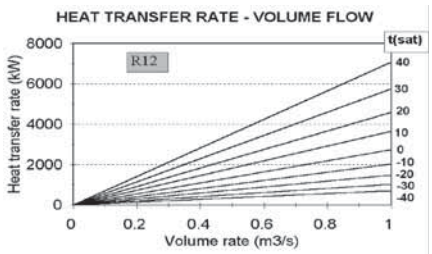
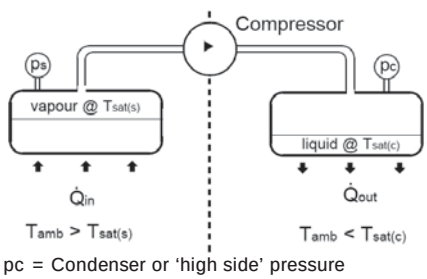


Figure 5: Heat transfer rate versus volume rate



pc = Condenser or 'high side' pressure
ps = Evaporator, 'low side', or suction pressure

Figure 6: Heat pumps

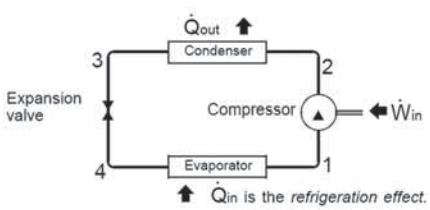


Figure 7: Simplified refrigeration system diagram

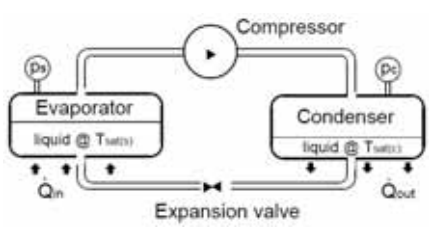


Figure 8: Heat pump refrigeration cycle

which causes instantaneous boiling (known as flashing). Vapour is formed using the liquid's sensible heat, which causes the liquid to drop in temperature to Tsat(s). A saturated liquid/vapour mixture will enter the evaporator. Figure 8 explains this cycle in practice.

System Performance

The system balance requires the overall work done to be equivalent to the net energy used by the system. Hence,

$$Q_{out} - Q_{in} = W_{in} \quad (5)$$

For operation as a refrigerator, a measure of system performance is the amount of heat absorbed per unit work supplied to drive the system. This is known as the Coefficient of Performance.

$$COP_{ref} = Q_{in} / W_{in} \quad (6)$$

For operation as a heat pump, a measure of system performance is the amount of heat delivered per unit work supplied to drive the system. This is known as the Coefficient of Performance.

$$COP_{hp} = Q_{out} / W_{in} \quad (7)$$

It follows that (for the same system):

$$COP_{hp} = COP_{ref} + 1 \quad (8)$$

Vapour Compression Refrigeration

The term "vapour compression refrigeration" is somewhat of a misnomer, it would be more accurately described as 'vapour suction refrigeration'. Vapour compression is used to reclaim the refrigerant and is more aptly applied to heat pumps. Vapour compression refrigeration exploits the fact that the boiling temperature of a liquid is intimately tied to its pressure. Generally, when the pressure on a liquid is raised its boiling (and condensing) temperature rises, and vice-versa. This is known as the saturation pressure-temperature relationship.

Refrigerant Properties

In practice, the choice of a refrigerant is a compromise, e.g., Ammonia is good but toxic and flammable while R12 is very good but detrimental to the Ozone layer. Figure 9 shows some commonly used refrigerants and their typical ranges of usability.

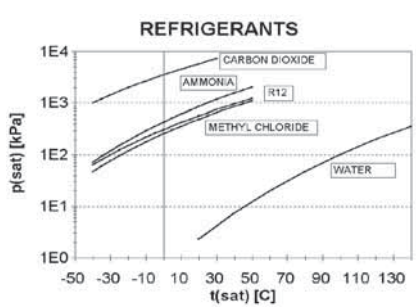


Figure 9: Refrigerant chart

Ideally, a refrigerant will have the following characteristics.

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

Cooling Mode

In the cooling mode, cool vapour arrives at the compressor after absorbing heat from the air in the building. The compressor compresses the cool vapour into a smaller volume, increasing its heat density. The refrigerant exits the compressor as a hot vapour, which then goes into the earth loop field. The loops act as a condenser condensing the vapour until it is virtually all liquid. The refrigerant leaves the earth loops as a warm liquid. The flow control regulates the flow from the condenser such that only liquid refrigerant passes through the control. The refrigerant expands as it exits the flow control unit and becomes a cold liquid.

Heat Pump Antifreeze

A potential negative effect of all geothermal heat pumps is the release of antifreeze solutions to the environment. Antifreeze solutions are required in colder climates to prevent the circulating fluid from freezing. Antifreeze chemicals include methanol, ethanol, potassium acetate, propylene glycol, calcium magnesium acetate (CMA), and urea. These chemicals are generally mixed with water when used as a heat exchange fluid. These chemicals can be released to the environment via spills or corrosion of system components.

Approved antifreezes include methanol, ethanol, propylene glycol, calcium chloride, or ethylene glycol. These antifreezes must be mixed with water, at concentrations of 20% or less. Geothermal heat pumps for a single-family residence and the antifreezes for these units were evaluated by.

These authors evaluated total energy consumption, corrosion due to the antifreeze, and the operational and environmental effects

Table 1: Cost and risk factors for heat pump antifreeze

Factor	Antifreeze					
	Methanol	Ethanol	Propylene glycol	Potassium Acetate	CMA	Urea
Life cycle cost	3	3	2	2	2	3
Corrosion risk	2	2	3[a]	2	2	1
Leakage risk	3	2	2[a]	1[b]	1	1
Health risk	1	2	3	3	3	3
Fire risk	1[a]	1[c]	3	3	3	3
Environmental risk	2	2	3	2	2	3
Risk of future use	1	2	3	2	2	2

Notes: Ratings- 1 means potential problems and caution required, 2 means minor potential for problems, 3 means little or no potential problems.
a) DOWFROST HD; b) GS-4; c) Pure fluid only. Diluted antifreeze (25% solution) is rated 3.

of six antifreeze solutions, namely methanol, ethanol, potassium acetate, propylene glycol, CMA, and urea.

However, the excluded salt solutions, such as sodium and calcium chloride, from their study because they pose serious potential corrosion problems. The differences in total energy consumption for the studied antifreezes were considered minimal.

Nevertheless, recommended that propylene glycol was a good choice based on its low health, fire, and environmental risks (Table 1). Unfortunately, these authors did not assess the leak potential of these antifreezes in the plastic pipe (e.g., HDPE & CPVC SDR-11) commonly used for the ground loop.

However, the bond between the grout and borehole can be compromised by desiccation of the geologic materials near the borehole, as the heat from the borehole lowers the moisture content of the geologic materials and these materials contract. In areas with thick unsaturated zones, the bentonite grout may dry out over time, compromising the seal. To improve heat exchange, some advocate the use of spacers, which moves the heat conductor pipe to the side of the borehole, putting it in contact with the geologic materials. However, the use of spacers appears to increase the environmental risk of antifreeze leaking into groundwater, by reducing or removing the bentonite between the heat conductor pipe and geologic materials.

Air Distribution

The air distribution system can make a big difference in both the cost and the effectiveness of geothermal heating and cooling. It also has an important effect on personal comfort and health. The air-handling component is either a separate cabinet or is part of the cabinet that houses the geothermal heat pump, and includes the blower assembly that forces air through the ductwork. The supply ductwork carries air from the air handles to the rooms.

Typically, each room has at least one supply duct and larger rooms may have several. The return ductwork moves air from the room back to the air handler. Most buildings have one or more main return ducts located in a central area.

The cold liquid refrigerant is circulated through the air handler where it absorbs and removes the unwanted heat from the air and vaporises the refrigerant to a gas.

The gas is compressed to increase its temperature and then the underground/ underwater coils act as a condenser rather than an evaporator (as in the heating cycle) (Figure 10). The heat in the refrigerant is transferred to the ground/water as the refrigerant condenses.

Refrigerants are present in the GSHP systems and so present the threat of the HCFCs and toxicity. However, new types and blends of refrigerant (some using CO2) with minimal negative impacts are approaching the market as shown in Table 2. Because the GSHPs raise the temperature to around 40°C they are most suitable for underfloor heating systems or low-temperature radiators, which require temperatures of between 30° and 35°C. Higher outputs, such as to conventional radiators requiring higher temperatures of around 60° to 80°C can be obtained through use of the GSHP in combination with a conventional boiler or immersion heater.

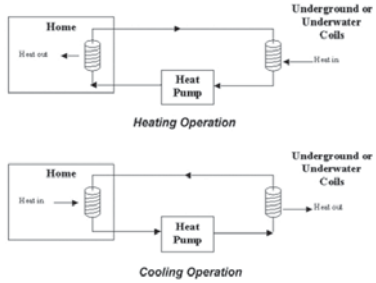


Figure 10: Heating and cooling operations

The GSHPs come in 15 models from 4 kW up to 30 kW (even up to 300 kW when connected in parallel). At least 65% of the heating and hot water energy consumption of a house can be saved (65-75% of heating costs with a heat pump) as a result of using such a system.

However, sizing of the heat pump and the ground loops is essential for the efficient operation of the system. If sized correctly, a GSHP can be designed to meet 100% of space heating requirements.

The sizing of the system is very sensitive to heat loads and should therefore be installed into properties with high-energy efficiency standards, particularly new build.

It is a good and practical idea to explore ways of minimising space heating and hot water demand by incorporating energy efficiency measures (Figure 11).

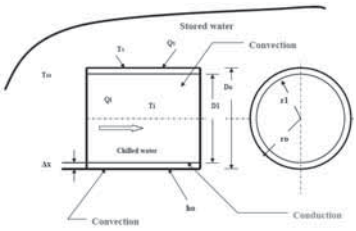


Figure 11: Schematic of heat transfer through a circular tube heat exchanger

This is known as the saturation pressure-temperature relationship (Figure 12). The refrigerant exits the compressor as a hot vapour, which then goes into the earth loop field (Figure 13).

Figure 12: The ideal cycle on Pressure-Enthalpy diagram

Some Definitions

1. The word "Efficiency" is defined as the

Table 2: CO_2 emissions

System	Primary Energy Efficiency (%)	CO_2 emissions (kg CO_2/kWh heat)
Oil fired boiler	60 – 65	0.45 – 0.48
Gas fired boiler	70 – 80	0.26 – 0.31
Condensing gas boiler + low temperature system	100	0.21
Electrical heating	36	0.9
Conventional electricity + GHSP	120-160	0.20-027
Green electricity + GHSP	300-400	0.00

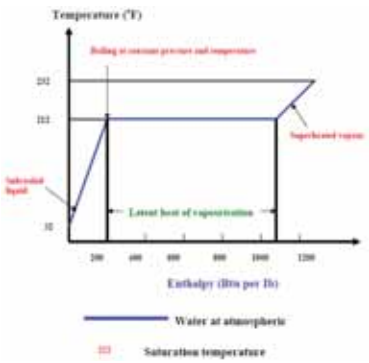


Figure 13: Water undergoing a charge of state

ratio of useful heat output to energy input, e.g., if an open fireplace loses half its energy up the chimney it is said to be 50% efficient.

2. The COP or "Coefficient of performance" is found by dividing the useful heat output by the energy input, e.g., a heat pump that produces 3 kWatts of heat for 1 kWatt of input power has a COP of 3. The open fireplace example with 50% efficiency would have a COP of 0.5 (1/2).
3. The heat "Source" is the outside air, river or ground, wherever the heat is being extracted from. Sometimes is referred to as an ambient source.
4. The "Sink" is the name given to the part where the heat is usefully dissipated, such as radiators in the room, underfloor heating, hot water cylinder, etc.

Horizontal Collector

This can be either coiled 'Slinky' or straight pipes that are buried 1.5 m to 2 m deep in open ground (in gardens). The pipe is usually plastic and contains a Glycol antifreeze solution.

Antifreeze

This is simply an additive to water that makes its freezing point lower. Common salt does the same thing, but Ethylene or Propylene Glycol is more practical for heat pump systems.

Refrigerant

This is the working fluid within the heat pump. It evaporates in one part and condenses in another. By doing so, heat is transferred from cold to hot. This fluid is sealed in and will not degrade within the heat pumps life.

Heat Exchanger

This is a simple component that transfers heat from one fluid to another. It could be liquid-to-liquid, or liquid-to-air, or air-to-air. Two heat exchangers are housed within the heat pump, one for the hot side (the condenser), and one for the cold side (the evaporator).

Slinky

The name is given to the way that ground collector pipes can be coiled before buying in a trench.

Passive Heat Exchange

When waste hot water preheats cold input water, it is said to be 'passive'. This costs nothing to run. A heat pump is said to be 'active' it can extract heat from cold waste water but requires a relatively small power input.

Some Refrigeration Characteristics

The seasonal energy efficiency ratio (SFEE) may be applied to each of the components.

Assuming that KE & PE effects are negligible, i.e., the SSFEE is applicable; Vis

$Q + W = m\,\Delta h$ (9)

Compressor:

Compression assumed adiabatic:

$\Delta Q = 0$ (10)

$W12 = m\,(h2 - h1)$ (11)

Or

$W_{in} = m\,(h2-h1)$ (12)

Condenser:

$W23 = 0$ (13)

$\Delta Qout = m\,(h2-h3)$ (14)

Expansion valve:

$W34 = 0$ & $Q34 = 0$ (15)

$\Delta h3 = h4$ (16)

Evaporator:

$W41 = 0$ (17)

$\Delta Q_{in} = m\,(h1-h4)$ (18)

Refrigeration effect

It follows that:

$COP_{ref} = (h1-h3)/(h2-h1)$ (19)

$COP_{hp} = (h2-h3)/(h2-h1)$ (20)

In order to determine the above equations, the

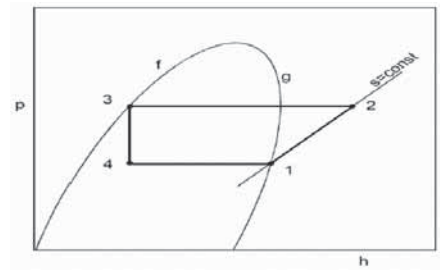


Figure 14: Refrigeration cycle

specific enthalpy values will be needed. Because refrigerants work in the liquid/vapour phases appropriate property charts or tables must be used.

The Ideal Refrigeration Cycle

- Isentropic compression (.1 → 2)
- Constant pressure cooling/condensation (.2 → 3)
- Throttling (3 →.4)
- Constant pressure vaporisation/heating (4 →.1)

The ideal refrigeration cycle plotted on the p-h chart as shown in Figure 14.

Real Refrigeration Systems

Evaporator superheat

g →1 given in K above Tsat(s)

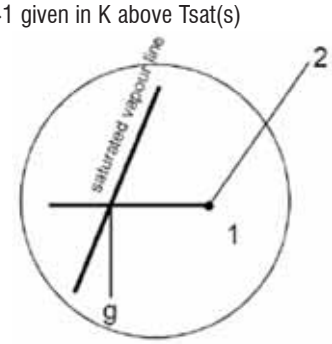


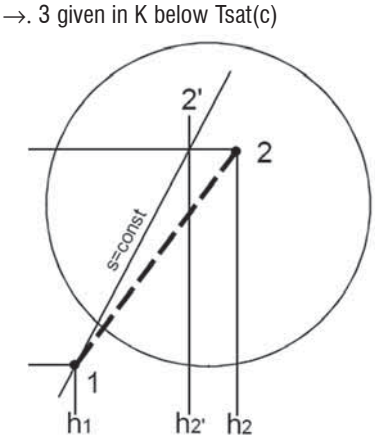
Figure 15: Evaporator superheat

Isentropic Compressor Efficiency

$\eta_{isen} = h2'-h1/h2-h1$ (21)

Condenser Sub-cooling

f →. 3 given in K below Tsat(c)



NB: s1 = s2'

Figure 16: Isentropic compressor

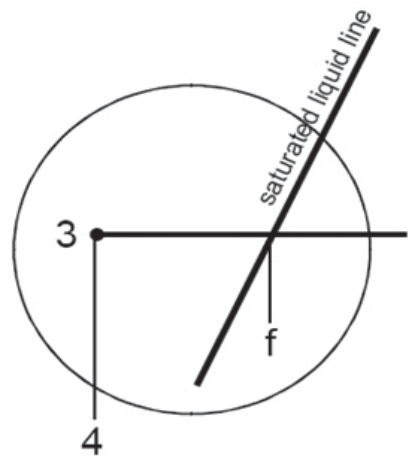


Figure 17: Condenser sub-cooling

Refrigerant Properties (Charts and Tables)

Because refrigeration systems basically work between two pressures, and specific enthalpy is one of the most useful properties we need, refrigerant thermodynamic properties are normally presented in the form of a pressure - specific enthalpy (or p-h) chart.

This is done for convenience, and is simply an alternative way of presenting property data, instead of, e.g., p-V, or T-s, or h-s (Figures 15-17).

Other useful properties are also shown on the chart, Vis: specific entropy, specific volume, temperature and quality. Regard these properties as 'contours'.

The pressure axis (y-axis) is typically logarithmic.

Pressure Drops in Evaporator and Condenser

Clearly, any or all of the above effects can be present, but the pressure drops are often small enough to be neglected (Figure 18).

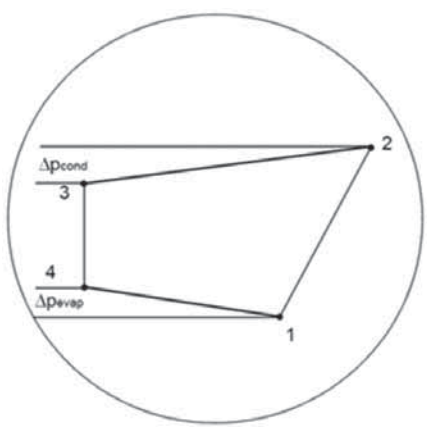


Figure 18: Pressure drops in evaporator and condenser

Refrigeration System Performance Improvement

Liquid-Suction heat exchanger (Figure 19-20)

Assuming no losses:

$$H_{1b}-h_{1a} = h_{3a}-h_{3b} \quad (22)$$

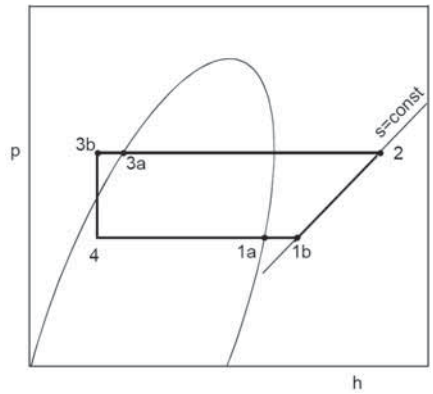


Figure 19: Diagram of liquid-suction heat exchanger

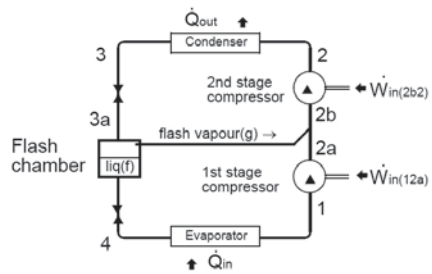


Figure 20: Liquid-suction heat exchanger cycle

Multiple Compression Using Flash Chambers

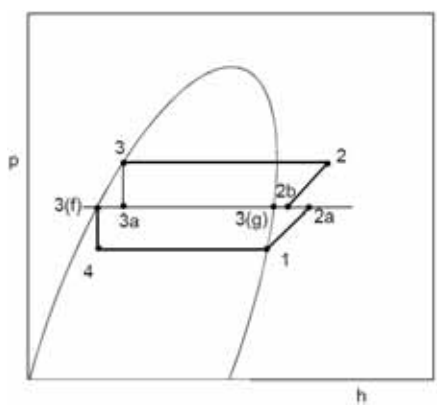


Figure 21: Cycle of multiple compressions using flash chamber

Diagram of Multiple Compressions Using Flash Chamber

At point 3a, have a mixture of vapour and liquid, which is separated, in the flash chamber (Figure 21). The proportion of the total mass flow that is liquid (and proceeds to the evaporator) is given by:

$$x_f = h_{3\,(g)}-h_3/h_{3\,(g)}-h_{3\,(f)} \quad (23)$$

The remaining vapour mixes with the discharge from the first stage compressor to give different inlet conditions to the second stage.

Assuming adiabatic mixing:

$$1^* h_{2b} = x_f h_{2a}+(1-x_f)\, h3_{(g)} \quad (24)$$

A similar equation can be used to find s_{2b}

Finally the COP is given by:

$$COP = (x_f\,(h_1-h_4))/\,(x_f\,(h_{2a}-h_1)+(h_2-h_{2b})) \quad (25)$$

Discussions

Thermal comfort is an important aspect of human life. Buildings where people work require more light than buildings where people live. In buildings where people live the energy is used for maintaining both the temperature and lighting. Hence, natural ventilation is rapidly becoming a significant part in the design strategy for non-domestic buildings because of its potential to reduce the environmental impact of building operation, due to lower energy demand for cooling. A traditional, naturally ventilated building can readily provide a high ventilation rate. On the other hand, the mechanical ventilation systems are very expensive.

However, a comprehensive ecological concept can be developed to achieve a reduction of electrical and heating energy consumption, optimise natural air condition and ventilation, improve the use of daylight and choose environmentally adequate building materials.

Energy efficiency brings health, productivity, safety, comfort and savings to homeowner, as well as local and global environmental benefits. The use of renewable energy resources could play an important role in this context, especially with regard to responsible and sustainable development. It represents an excellent opportunity to offer a higher standard of living to local people and will save local and regional resources. Implementations of GSHPs offer a chance for maintenance and repair services.

It is expected that the pace of implementation will increase and the quality of work to improve in addition to building the capacity of the private and district staff in contracting procedures.

Financial accountability is important and more transparent. Various passive techniques have been put in perspective, and energy saving passive strategies can be seen to reduce interior temperature and increase thermal comfort, and reducing air conditioning loads.

The scheme can also be employed to analyse the marginal contribution of each specific passive measure working under realistic conditions in combination with the other housing elements. In regions where heating is important during winter months, the use of top-light solar passive strategies for spaces without an equator-facing façade can efficiently reduce energy consumption for heating, lighting and ventilation.

The use of renewable energy resources could play an important role in this context, especially with regard to responsible and sustainable development. It represents an excellent opportunity to offer a higher standard of living to local people and will save local and regional resources.

Implementation of greenhouses offers a chance for maintenance and repair services. Various passive techniques have been put in perspective, and energy saving passive strategies can be seen to reduce interior temperature and increase thermal comfort, and reducing air conditioning loads.

Renewable energy is the term to describe a wide range of naturally occurring, and replenishing energy sources. The use of renewable energy sources and the rational use of energy are the fundamental inputs for a responsible energy policy. The energy sector is encountering difficulties because increased production and consumption levels entail higher levels of pollution and eventually climate changes, with possibly disastrous consequences.

Moreover, it is important to secure energy at acceptable cost to avoid negative impacts on economic growth. On the technological side, renewables have an obvious role to play. In general, there is no problem in terms of the technical potential of renewables to deliver energy and there are very good opportunities for renewable energy technologies to play an important role in reducing emissions of greenhouse gases into the atmosphere-certainly far more than have been exploited so far. But there are still technical issues to be addressed to cope with the intermittency of some renewables, particularly wind and solar.

However, the biggest problem with replying on renewables to deliver the necessary cuts in greenhouse gas emissions is more to do with politics and policy issues than with technical ones. The single most important step governments could take to promote and increase the use of renewables would be to improve access for renewables to the energy market. That access to the market would need to be under favourable conditions and possibly under favourable economic rates.

One move that could help-or at least justify-better market access would be to acknowledge that there are environmental costs associated with other energy supply options, and that these costs are not currently internalised within the market price of electricity or fuels.

It could make significant difference, particularly if, appropriate subsidies were applied to renewable energy in recognition of environmental benefits it offers. Cutting energy consumption through end-use efficiency is absolutely essential. And this suggests that issues of end-use consumption of energy will have to come onto the table in the foreseeable future.

The scientific consensus is clear-climate change is occurring. Existing renewable energy technologies could play a significant mitigating role, but the economic and political climate will have to change first. Climate change is real, it is happening now, and greenhouse gases produced by human activities are significantly contributing to it.

The predicted global temperature changes of between 1.5 and 4.5 degrees C could lead to potentially catastrophic environmental impacts-including sea level rise, increased frequency of extreme weather events, floods, droughts, disease migration from various places and possible stalling of the Gulf stream.

This is why scientists argue that climate change issues are not ones that politicians can afford to ignore. And policy makers tend to agree, but reaching international agreements on climate change policies is no trivial task.

The most favourable orientation, which is due north, results in diminished excessive solar gains through the windows.

However, most buildings cannot be oriented at will. If the only possible orientation is due south, and no external shade is used, the index reveals extra heat gains of some 0.26 over the value of totally shaded window. Application of the model results from exploring the relative importance of the thermal inertia of walls, floor and ceiling.

Heat stored in building materials, as proven in old, massive buildings, can be compensated during high insolation hours with thermal losses at night and early morning hours, when ambient temperatures are below 25°C.

Temperature variation will be lower for higher thermal capacities of building materials. However, it is known while thermal capacity increases the relative importance of individual heat flows change. For example, for lower wall temperatures, the contribution of radiative heat transfer will be reduced, and the relative importance of convective processes will increase, and thus the difficulty to calculate accurately the overall heat flows. The relevance of certain passive techniques is variable with prevailing weather.

Finally, the required temperature dependent air transport properties were evaluated by the following expression, which are valid between 2°C and 77°C with temperature expressed in k:

Thermal diffusivity, $\alpha = 1.534 \times 10^{-3}\ T - 0.2386\ (10^{-4}\ m^2s^{-1})$

Kinematics viscosity, $v = 0.1016\ T - 14.8\ (10^{-6}\ m^2s^{-1})$

Thermal conductivity, $k = 7.58 \times 10^{-5}\ T + 3.5 \times 10^{-3}\ (Wm^{-1}K^{-1})$, and

Thermal expansion coefficient, $\beta = T^{-1}\ (K^{-1})$

In order to depict the relative contribution of each of these techniques to inside temperature, a dimensionless index is defined as follows. When interior temperature exceeds 25°C, it will be considered as a temperature discomfort condition. This reference temperature is widely elements. Then the following expression:

$$F(t) = \max(T_t - 25.25) \quad (26)$$

I_s a time function of truncated temperature and it will be able to estimate the overall discomfort by means of the integration along the day for each different scenarios S:

$$A(S) = \int_S F(t)\,dt \quad (27)$$

Then, for each passive technique, let:

$$A_{max} = \max[A(S)\text{: for all scenarios } S] \quad (28)$$

Finally, the normalised temperature index for each scenario S is:

$$I(S) = A(S)/A_{max} \quad (29)$$

Naturally, it would be preferred, for comfort reasons that this index would be small, preferably nil. It may be seen that the variable is directly related to temperature discomfort: the larger the value of the index, the farthest will inside conditions be from expected wellbeing.

Also, the use of electricity operated air conditioning systems will be more expensive the higher this variable is. Hence, energy expenditure to offset discomfort will be higher when comparing two index values; the ratio of them is proportional to the expected energy savings. When the external shade blocks the windowpane completely, the excessive heat gains belong to the lowest values in the set, and the dimensionless index will be constant with orientation.

For the climate conditions of the locality, it can be seen that a naked window can produce undesirable heat gains if the orientation is especially unfavourable, when the index can have an increase of up to 0.3 with respect to the totally shaded window.

Conclusion

With increasing worldwide awareness of the serious environmental problems due to fossil fuel consumption, efforts are being made to develop energy efficient and environmentally friendly systems by utilisation of non-polluting renewable energy sources, such as solar energy, industrial waste heat or geothermal water. The GSHPs are suitable for heating and cooling of buildings and so could play a significant role in reducing CO2 emissions. Ground source or geothermal heat pumps are a highly efficient, renewable energy technology for space heating and cooling. This technology relies on the fact that, at depth, the Earth has a relatively constant temperature, warmer than the air in winter and cooler than the air in summer.

A geothermal heat pump can transfer heat stored in the earth into a building during the winter, and transfer heat out of the building during the summer. Furthermore, special geological conditions, such as hot springs, are not needed for successful application of geothermal heat pumps. The GSHPs are receiving increasing interest because of their potential to reduce primary energy consumption and thus reduce emissions of the GHGs. The GSHP is generally recognised to be one of the most outstanding technologies of heating and cooling in both residential and commercial buildings, because it provides high coefficient of performance (COP), up to 3-4 for an indirect heating system and 3.5-5 for a direct heating system.

The main benefit of using the GSHPs is that the temperature of the subsurface is not subject to large variations experienced by air. It is currently the most common thermal energy source for the heat pumps, and so would allow construction of more efficient systems with superior performance. The GSHPs do not need large cooling towers and their running costs are lower than conventional heating and air conditioning systems. As a result, the GSHPs have increasingly been used for building heating and cooling with annual rate of increase of 10% in recent years. ■

Abdeen Mustafa Omer
Energy Research Institute (ERI), Nottingham, UK

Precautions while storing refrigerants

Refrigerants are hazardous gases and their storage should not be taken lightly. Regardless of whether they are R-134A, R-410A, R-22, or any other kind of refrigerant, proper steps and precautions must always be taken while storing refrigerants. Below are a few key points to remember when storing refrigerants:

- Ensure that all cylinders of refrigerants are stored upright and are without risk of tipping over.
- Refrigerants should be stored in a well ventilated area and temperatures should never exceed over 125 degrees Fahrenheit.
- If the temperate becomes too hot, pressure could build up inside the container, which could cause the container to rupture. This could cause the release valve to fail which could result in an explosion.
- Ensure that all refrigerant containers /cylinders have pressure release devices to avoid combustion and / or explosions.
- Ensure that there are no combustible or flammable materials near the containers.
- Perform regular visual inspections of cylinders with refrigerants to ensure that everything is in good order.
- Limit the number of people who have access to refrigerants, since the more people who have such access, the higher is the chance of an untoward incident. Also, please keep out refrigerants out of the reach of children.

Emerson Climate Technologies Unveils

Integrated Products & Solutions At ACREX 2016

Emerson Climate Technologies, a business segment of Emerson (NYSE: EMR) showcased their theme, 'Transforming Technologies', at ACREX 2016, South Asia's largest exhibition for the HVAC&R (Heating, Ventilation, Air conditioning & Refrigeration) Industry. It gave customers an opportunity to experience firsthand, the innovative, energy efficient & environmentally responsible features of Emerson products& solutions.

Speaking on the occasion Sridar Narayanswami – vice president &managing director, Emerson Climate Technologies, India said "Market needs are changing dramatically, and the requirements for our business to innovate in the 'new' world are much greater and even more challenging than ever. With energy supply constraints, food safety and environmental concerns becoming increasingly important industry issues, we continue to invest in new product development to improve compressor energy efficiency, research in new refrigerants and system solutions to continuously raise benchmarks."

Integrated air conditioning solutions for residential and commercial applications

ACREX 2016 saw Emerson Climate Technologies introducing their new Copeland Scroll™ variable speed compressor, integrated with Emerson control techniques drive. Optimized for commercial chillers and packaged unit applications, this integrated package offers optimal drive selection for the compressor and has built-in compressor safety and control features that ensure system reliability.

Emerson Climate Technologies also acquainted visitors with the 60HP Tandem R410A Copeland Scroll compressor with CoreSense™ Communications. This will soon be introduced in the market. In addition, Emerson also highlighted its portfolio of new products designed for R410A, R32 and R290 refrigerants,offering customers a broader choice as the industry transitions to environmentally responsible refrigerants.

Intelligent cold chain solutions

Demonstrating leadership in the cold chain segment, Emerson showcased products and solutions to meet the 'Farm to Fork' needs of the industry. The booth highlighted its state-of -the-art training, end user project design capabilities along with development of intelligent products to enable the next level of evolution for the segment.

The fair witnessed Emerson launch the full featured semi-hermetic water cooled condensing unit(CDU) designed by making use of the highly efficient shell and tube heat exchangers with Emerson's proven range of high efficiency Copeland semi-hermetic compressors. These water cooled CDUs can be adopted as an option to air-cooled units in applications where space is a constraint.

The Multi Compressor Pack developed for food retail, cold storage applications was showcased at the booth, creating a stir from the cold chain fraternity for its versatile applications. Available in 2, 3 and 4 compressor combinations, these feature best-in-class Copeland Scroll&semi-hermetic compressors.

Copeland R32 is recognized for the 'Green Product' award at ACREX-2016

The ACREX Awards were announced during the expo. There was good reason for Emerson to cheer as the Copeland ScrollR32 Compressor was recognized with The ACREX Award Of Excellence 2016 in the 'Green Product' Category. These compressors areavailable in 3.5 to 10HP range and are compatible with low GWP R32. They come with vapor/liquid injection technology to control high discharge line temperature, gain added capacity &improvement in coefficient of performance, thus reducing its carbon footprint and environmental impact.

The awards were selected by an eminent & experienced jury from the HVAC&R industry and were presented at a grand ceremony in the presence of a large audience of HVAC&R professionals. ■

About Emerson

Emerson (NYSE: EMR), based in St. Louis, Missouri (USA), is a global leader in bringing technology and engineering together to provide innovative solutions for customers in industrial, commercial, and consumer markets around the world. The company is comprised of five business segments: Process Management, Industrial Automation, Network Power, Climate Technologies, and Commercial & Residential Solutions. Sales in fiscal 2015 were $22.3 billion.

For more information visit: www.Emerson.com

Hitachi Air Conditioning Europe releases its lowest noise level mini cassette on the market

Hitachi's new RCIM FSN4 mini-cassette range is the widest on the market, with capacities ranging from 0.6HP to 2.5HP (1.9kW to 8.5kW nominal capacity in VRF system heating mode).

The air panel has a new, simple and stylish design combined with a high specification. Its 620 x 620mm dimension has been reduced by 80mm compared to the previous model so it can be installed into a grid ceiling with a 600 x 600mm opening without needing to cut the grid or interfere with lighting or other ceiling fixtures and fittings.

Thanks to an optional motion sensor, the setting temperature and airflow can be adjusted automatically according to human activity, enabling reductions in power consumption.

The new design also provides better air distribution and higher comfort. Each louver of the RCIM cassette can be controlled individually, while redesigned panel louvers and the shape of air outlets improve the Coanda Effect.

The improved 3D twisted blade of the turbo-fan and the air outlet also achieves a very low noise performance; the 0.6HP to 1HP units noise pressure level is only 24.5 dB(A), the lowest on the market. ■

Website: www.hitachiaircon.com

New Champion LX Series 16 SEER Heat Pump contributes to lower operating costs

Johnson Controls has introduced its new Champion LX Series 16 SEER/9.0 HSPF heat pump which features advanced modulating technology proven in Champion's five-year accelerated test facility and more than 215,000 hours of research.

The unit's ability to adjust its operating capacity provides quiet, efficient operation as it adjusts heating and cooling levels up or down to provide only what is actually needed to condition the space. This provides more even temperatures and lower operating costs.

Reducing compressor speed and decreasing airflow also allows the system to operate longer without drastically over-cooling the space, improving dehumidification.

Its durable powder painted steel coil guards provide protection against corrosion and coil damage. An engineered and balanced, direct-drive fan design minimises vibration and sound. Coils are optimized for efficient airflow and effective refrigerant circulation providing optimal heat transfer.

Contractors will appreciate easy access to commonly serviced items, a sturdy fan guard, smooth edges that allow easier handling and a compact footprint for easy trucking and placement on site. The unit features Champion's fee-free, 1-year labour limited warranty. ■

Website: www.johnsoncontrols.com

Kelvion launches Goedhart coolers for CO_2

Germany based Kelvion has launched CO_2 versions of its Goedhart air-cooler. The LX versions have been optimised for use with CO_2 and designed for a range of cooling and freezing applications at operating pressures up to 60 bar.

Featuring copper/aluminium heat exchangers, the new LX versions are available for the following ranges: VCI (single discharge ceiling-mounted air coolers), VCe (air coolers with large high efficiency fans), DVS (dual discharge), VNS (with extra-low air velocities for sensitive goods such as vegetables and fruit), and BC50/BC50XF (for blast-freezing).

Standard versions of these ranges will continue to be available for use with synthetic refrigerants. Goedhart air coolers can also be specially designed with stainless steel heat exchanger tubes for operational pressures greater than 60 bar. ■

Website: www.kelvion.com

Climaveneta launches R1234yf chiller

Italy-based Climaveneta has introduced a screw-chiller operating on R1234yf to its Integra range of 4-pipe air source products.

Offering cooling capacities from 200 to 1100kW, the new i-FX-Q2 family employs inverter driven screw compressors and EC motor fans.

They are said to be the first multi-purpose units adopting the new generation HFO1234yf low GWP refrigerant, which is now being widely adopted for use car air conditioning systems.

The use of variable speed technology in both compressors and fan is said to provide unbeatable performances, especially at partial loads. ■

Website: www.climaveneta.com/EN

Hillphoenix offers CO2 to small retailers

USA-based refrigeration company Hillphoenix is now offering the AdvansorFlex CO2 system to small and medium-sized retailers.

The AdvansorFlex is said to deliver all the benefits of CO2 refrigeration in a compact and scalable format that could be applied to stores of every size.

AdvansorFlex is said to be ideal for smaller retailers who want the environmental benefits and energy savings of CO2 refrigeration but don't have the square footage for a full-sized system. Multiple AdvansorFlex units can also be grouped together in a distributed system for larger stores.

A single AdvansorFlex unit can serve as a centralised refrigeration system in smaller stores such as convenience stores, pharmacies, and smaller format grocery stores. The unit's weatherproof enclosure allows for both inside and outdoor placement, and its compact footprint is said to take up less floor space in back rooms, equipment rooms, mezzanines, and rooftops. ■

Website: www.hillphoenix.com

Azanechiller 2 sets ammonia benchmark

UK-based Star Refrigeration has re-engineered its low-charge ammonia Azanechiller to produce a machine which is said to exceed the EU's ecodesign directive by 51%.

Through a combination of variable speed reciprocating compressor technology, EC fans, close approach evaporator design and in-house PLC software, Azanechiller 2.0 delivers a SEER of 5.6 for comfort cooling applications and a Seasonal Energy Performance Ratio of 7.59 for process cooling.

"With COPs up to 3.63 at 100% load and 35°C ambient, increasing to 11.9 at 50% load and typical UK ambient temperatures of 10°C, the Azanechiller 2.0 is 15% more efficient than its screw compressor counterparts at design conditions," claims Angus Gillies, design director at Star Refrigeration.

A low charge design uses a combined evaporator / separator to achieve refrigerant volumes as little as 0.18kg/kW.

"Azanechiller 2.0 is brilliantly engineered to deliver consistent efficiency and reliability in highly demanding environments. It offers a 39% reduction in chiller weight compared to the previous model range and a 16 % improvement in seasonal running costs. This is achieved with an ammonia charge as little as 61kg," Walkinshaw claims.

The Azanechiller 2.0 features two separate model ranges for high and medium temperature applications. This makes it suitable for a wide variety of end user markets, including temperature controlled storage, food processing and beverage production. ■

Website: www.star-ref.co.uk

Take Temperature Measurements Safely with FLIR's New TG54 & TG56

FLIR launched the new TG54 and TG56 Spot IR Thermometers, which allow professionals to quickly and easily take measurements in places that are out of reach for most IR thermometers.

These thermometers let users take non-contact temperature measurements with a distance-to-spot ratio of 24:1 (TG54) and 30:1 (TG56).That means that with a TG56, they can measure a one-inch sized target from up to 30 feet away! A built-in laser and powerful LED work light help pinpoint the problem area, even in poor lighting conditions.

Both thermometers have a large, colour display and a graphical menu structure so thhat the high and low alarms are easy to set and can't be missed. Every temperature setting is simple to find as well as select, including emissivity, which has pre-determined levels and can also be custom adjusted.

The TG54 and TG56 allow users to view their current temperature readings along with their last two readings together on one screen. This makes comparing temperature differences convenient without having to memorise or write them down.

The main differentiating feature between the two products is that the TG56 includes a thermocouple Type K input for added flexibility when taking measurements. ■

Website: www.flir.in/TG54-56

MECO introduces digital clampmeters

MECO has introduced its latest Digital Clampmeters Models 27T-Auto and 72T-Auto.

27T-Auto is a 3 ½ Digit 2000 Counts Digital Clampmeter having a Current Range upto 400A AC and Voltage Range 600V AC & 600V DC with the jaw opening size of 25mm. Basic accuracy for AC Current is ± 2% rdg + 3dgt, for AC Voltage ± 1.2% rdg + 3dgt and for DC Voltage ± 0.8%rdg + 3dgt. In addition it has features like NCV, Temperature, Max function, Resistance, Audible Continuity, Diode Test Function etc.

72T-Auto is a 3 ¾ Digit 4000 Counts Digital Clampmeter having Current Range upto 400A AC and Voltage Range 600V AC & 600V DC with Jaw opening size of 25mm. Basic accuracy for AC Current is ± 2.5%rdg + 5dgt, for AC Voltage ± 1.2%rdg + 3dgt and for DC Voltage ± 0.8%rdg + 3dgt. In addition it has features like NCV, Temperature, Capacitance, Frequency, Resistance, Audible Continuity, Diode Test Function etc. ■

Website: www.mecoinst.com

index to **advertisers**

Calmac's power storage tanks enable Alachua County Library HQ to give up high-priced energy

The USA-based Calmac, a leader in energy storage systems, has announced that the Alachua County Library Headquarters in Gainesville, Florida uses Calmac's IceBank energy storage tanks to reduce operating costs and save taxpayer money.

Calmac's technology enables the 80,000 square foot library, which was built in 1992, to shift cooling load so that it uses night time energy which is 68 per cent cheaper than energy used for creating instantaneous cooling during daytime hours.

Additionally, thermal storage allows monthly demand (kW), and the resulting demand charges, to be cut in half. This is significant, since 40 percent of the headquarters' total annual electric costs can be directly attributed to cooling the structure and the facility's power provider implements a demand charge that equates to roughly US $9.25 in extra fees per kW during peak demand hours.

The decision to install Calmac's IceBank technology occurred in conjunction with the decision to replace the library's antiquated chiller. ■

(Source: www.calmac.com)

Pterodactyl building wins the Institute Honour Award for Architecture

Pterodactyl which has been designed by Erwin Moss Architects has won the Institute Honour Awards for Architecture.

Onlookers at Culver City in California, USA, may notice with the shape and structure of the set of blocks and engage with Pterodactyl's eccentric form. A set of blocks exploding out of a four-story parking garage which serves as the Pterodactyl's podium predate it, but was built to withstand the load of an upward expansion.

Completed in February 2015, Pterodactyl stands on top, but cantilevers out front of the parking structure, reducing neighbours' sight of the banal and furthering a sense that something uncommon is at work.

Despite its tumbling-blocks appearance, the building's main level has a simple rectilinear interior. It has an open floor plan suited to contemporary office layouts, and much of its glass front is two stories high, providing an appealingly day-lit setting that a look at the exterior might not suggest.

Setting the 16,000-square-foot building atop a four-story parking garage provided a unique piece of the project's sustainability strategy.

(Source: www.aia.org)

Arcus Center: One of the 60 awarded American projects for 2015

The center's architecture supports the work of social change in several important ways…

With its mission to catalyze positive social change, the Arcus Center works to develop emerging leaders and engage existing leaders in the fields of human rights and social justice. As a study center and meeting space, the building brings together students, faculty, visiting scholars, social justice leaders, and members of the public for conversation and activities aimed at creating a more just world.

The Center's architecture supports this work in several important ways. Inside, the building's visually open and day-lit interior is designed to encourage 'convening' in configurations that begin to break down psychological and cultural barriers between people and help facilitate understanding.

The presence of a living room, hearth, and kitchen for sharing food at the center of the building creates the potential for frequent informal meetings and casual or chance encounters. ■

(Source: www.calmac.com)

LOUVER TYPE MIST COOLING SYSTEM

For

CHILLERS

A Superior Alternative to Cooling Tower

▲ *Louver Type MCS*

Assured Approach of 1°C to WBT.
Guaranteed Power Saving with Small Foot Print...
Not a miracle, a reality!

Other Superior Features of LTMCS

- **NO FILLS / NO FINS, NO FANS**
- Zero Maintenance due to all Non-moving parts, Choke-less Nozzle design and Special non-corrosive MOC
- Exremely easy operation
- Life of more than 15 to 20 years

Over 300 installations

Typical case study data of a 1200 TR Chiller

Sr. No.	Parameter	Cooling Tower (Induced Draft)	**LTMCS**
1	Wet Bulb Temperature	29°C	29°C
2	Chilled Water Temp in °C (Assumed)	5°C	5°C
3	Supply Temp. from CT / LTMCS	33°C	30°C
4	Approach to WBT	4°C	1°C
5	**ΔT for Chiller**	**28°C**	**25°C**
6	Chilled Water Compressor Motor Kw for 1200 TR	720	643
7	Energy Saved in %	-	10.7%
8	**Energy Saved in Kw**	**-**	**77 Kw/Hr**
9	Total Running Hours per Annum	8640	8640
10	**TOTAL POWER SAVED PER ANNUM**	**-**	**6,65,280 Kw**

MIST imitating nature

Mist Ressonance Engineering Pvt. Ltd.

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Big Smart Fan

High Volume Low Speed (HVLS)

An European Product

Benefits

- Low Capital, Installation and Maintenance costs
- Low noise level < 45 dBA with standard gear reducer
- Sizes are available between 2.5m till 7.3m
- IE4 SUPER Premium Efficiency motors are available
- Permanent Magnet motors available
- Low noise levels <35 dBA with permanent magnet motors
- High performance & Energy saving
- Lower power consummations lead to power saving more than 30% compare to a conventional ventilation methods
- Summer Cooling - Winter Destratification
- Pole installation option available for open areas
- Solar powered Outdoors fans available for warm climates

Recommended Applications

- Places with maximum air movement required e.g. Farms, Animal Husbandry Facilities etc.
- Big buildings with high ceilings e.g. warehouses, Hangers, Industrial facilities, Malls, Shopping centres, Sports Halls etc.
- Intensively used areas where people come together e.g. Entertaining centres, Cafeterias, Libraries, Museums, Mosques, Temples, Gurdwaras, Theatres, Opera, Concert halls, Exhibition Centres, showrooms etc.

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