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Cooling India

April 2014

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Publisher's Letter

Refrigerants make up 32% of carbon footprint

By using ammonia, refrigeration can be realized with the least possible energy requirement. Ammonia refrigeration is the most cost effective and energy efficient method of processing and storing frozen and unfrozen foods and is ideal for use in many types of refrigeration systems. The consumption of anhydrous ammonia for refrigeration purposes is only a tiny fraction of the amount of ammonia manufactured each year is deliberated in an article 'Ammonia Refrigeration'.

A refrigerant's function is to transfer heat across the system in a chiller. To effectively manage and use the refrigerant in the chillers, it is essential to have a refrigerant management plan that addresses the points brought out in the article, 'Managing your Refrigerants – Key to Lowering costs and Sustainable Operations'.

In recent years, the advances in manufacturing technology have caused the production of nanoparticles. This new technology created a special class of fluids, called 'nanofluids' which refers to a two-phase mixture, and an overview of its concept is detailed in 'Nanofluids as a Coolant In Radiator' that studies nanofluids behavior for its selection in various applications.

Further, there is an interesting case study that delves upon designing highly efficient air conditioning systems for Kai Fu Jian Guo Hotel at Zhengzhou International Airport, China and thus save CO_2 emissions, to meet load variations of a hotel. Saving CO_2 emissions has become a major issue nowadays, since refrigerants make up 32% of carbon footprint – which needs reduction. And, all the more, we present a new layout in the magazine for you and would appreciate feedback.

Please send your comments at pravita@charypublications.in

Pravita Iyer
Publisher & Director

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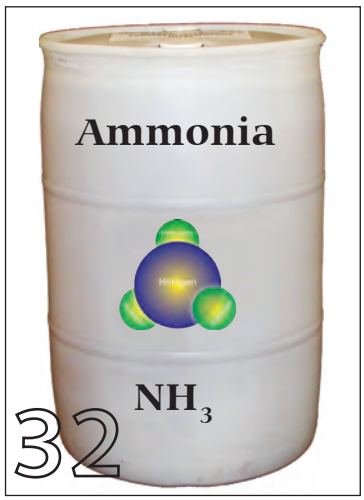

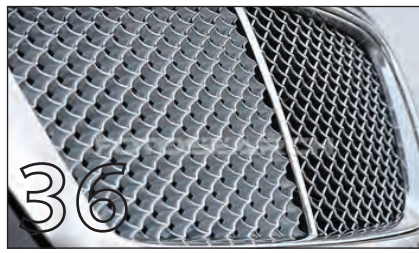

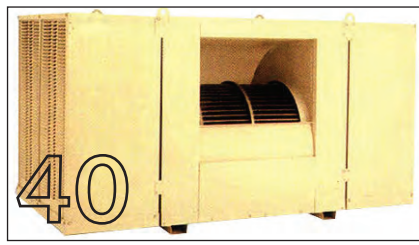

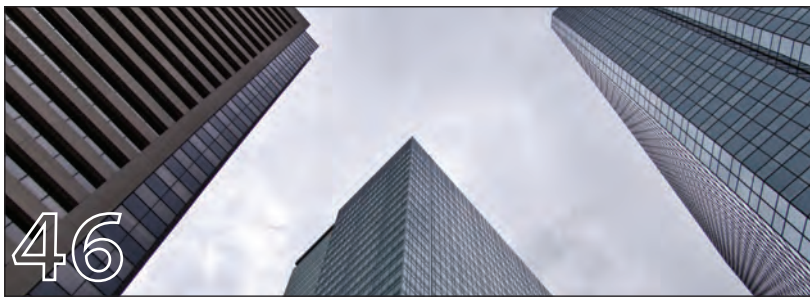

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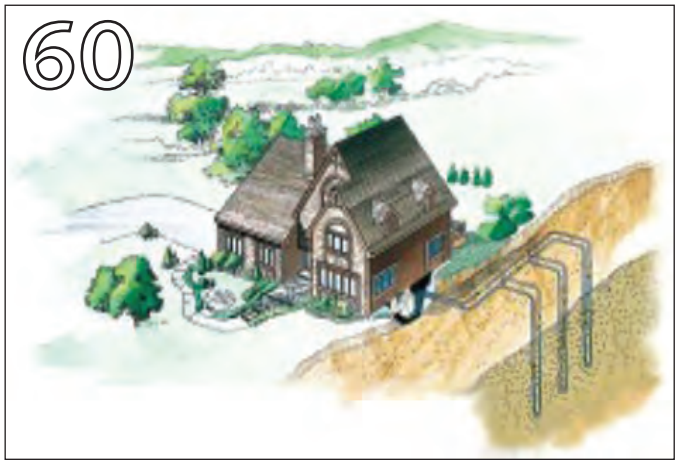

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Editor: Gopal Krishna Anand

Editorial

Global RAC Technology with Perspective upon Refrigerants

Surrounding atmosphere at a place during some specific seasons may not be comfortable for people to work; industrial processes environment may be non-favorable or conducive working atmosphere is not existing. In order to enhance comfort and environmental quality or simply creating ambience involves technology of refrigeration and air conditioning (RAC). To run such applications, the process needs a refrigerant that transfers heat from one place to another.

In concern towards environmental safety, reliable and high-performance refrigerants/ solutions for RAC applications are required; more so, in persective of the protocols, regulations, conferences and interactive sessions being held globally. The sprawling awareness and regulatory control over F-gases, comprising CFCs, HCFCs and HFCs, is split between the Montreal Protocol and Kyoto Protocol. The only safe solution is using natural refrigerant where the side effects are 'minimal'. However, replacing current RAC applications with natural refrigerants, must cognize long-term goal of reducing direct and indirect CO_2 emissions.

Analysis of low GWP refrigerants is necessary with growing population and increasing urbanization. RAC is of prime interest for 'United Nations Framework Convention on Climate Change' Technical Executive Committee - the policy arm of the 'Technology Mechanism'. The goal of this technology mechanism's is to promote technology development and transference to accelerate action on climate change mitigation and adaptation. It is projected, energy demand for cooling of buildings will grow more against estimated 15-20% of global electricity consumption today.

Refrigeration systems negatively impact climate change. Refrigerant manufacturers should prefer search for refrigerants in consideration of the ODP, GWP and TEWI (Total Equivalent Warming Impact) factors. Refrigeration technologies influencing GW emissions into environment is - firstly a chemical effect due to emissions of refrigerant fluid, secondly, due to energy use by the refrigeration technologies of the system. Fluorocarbon refrigerants have extremely high GWPs. R134a has a GWP of 1,300 implying emission of 1kg equivalent to emission of 1.3 tonnes of CO_2; R404a has a GWP of 3922 whereas, CO_2 has a GWP of 1. More refrigeration means more CO_2 into atmosphere. So to do the best for environment we must reduce CO_2 emissions. With low/zero ozone depletion levels, non-halogenated refrigerants or hydrocarbons like R1270, R170 etc, currently offer a long-term alternative to conventional refrigerants influencing seasonal comforts. All the more, innovative technology based on natural refrigerants needs a willing emphasis.

Gopal Krishna Anand

Haier India enters 11th year of operations with a New Office

Haier India, the global leaders in Home Appliances & Consumer Electronics and the Number 1 Global Major Appliances Brand, has relocated its India headquarters to Okhla Industrial Estate. The 42,000 sq ft office, which replaces older facility doubles the office space to accommodate entire sales, marketing, service, product delivery & management teams. This move is yet another important milestone for Haier India which recently commemorated the completion of 10 years in the Indian market and is a reflection of the company's stability, confidence in the market and continuous expansion. To give dealers a first-hand experience of the new products, Haier has created an 'experience zone' at the new office that showcases Haier's new and innovative products. With the newer bigger facility, the company will strive to provide quality products and develop further innovation to its consumers. The company recently introduced their unique 'i-age' line of products, inspired by the Internet age. Commenting on the new office, Mr. Eric Braganza, President, Haier India said, "We are happy to have finally found the ideal location that offers room for showcasing our products as well as accommodate future expansion. This move was essential especially with the rapid growth of our Indian operations." Unmatched Service quality is one of the key components of Haier's strategy and the new office with ample space for the service process systems (SPI) team will only aim to strengthen this wing. Haier is among the first organizations in the Indian consumer durables industry to adopt service process systems (SPI) model. ●

SHARP launches highly Energy Efficient new Inverter ACs

Sharp Business System (India), the leading consumer Japanese brand with over 100 years of lineage in white good industry, introduced the new series of inverter ACs(AH-XP10LV) which takes a step further in Sharp's endeavour to introduce 'one of a kind products'. Making use of its patented plasma cluster technology, sharp's AC conditions room's air with highly concentrated Plasmacluster Ions suppresses bad odour for refreshing cleanliness. Sharp Inverter circuitry modifies and maintains room temperature by switching the compressor between high and low operation modes, instead of switching it on/off completely as non-inverter models do. This gives comfortable, even temperature control with high power savings. Its inverter air conditioners reduce energy consumption through its proprietary energy-saving technologies and increases performance efficiency using high power DC motors Electronic Digital Control for the compressor and outdoor fan and a pulse linear expansion valve. "While pushing the boundaries of technology, Sharp is striving to design a comfortable future as well as a more pleasant environment, Sharp is aiming to increase AC market share in India by manufacturing energy efficient Inverter AC's which can be afforded by any Indian middle class family" says S K Sinha, MD SHARP Business Systems India Limited. It also uses Nature Wing Technology which helps to minimize air resistance and boost air circulation efficiency; this technology has been highly acclaimed by multiple evaluators in Japan. The product is available in the market at the Price of Rs 32,990. Sharp Business Systems (India) Limited (SBSIL) is a hundred per cent subsidiary of Sharp Corporation with its head office in Delhi and branches all across India. ●

Toshiba Introduces Black Pear, industry's most Versatile Air Conditioning Controller

Toshiba Air Conditioning (a division of Toshiba Carrier UK Limited) introduced a new control and monitoring system called Black Pear. It connects directly to the HVAC control bus, providing instant connectivity to Building Management Systems, and overcoming the need for a central controller and separate interface. Its built-in LCD display gives field engineers local control over units, and enables fast and accurate commissioning following installation with USB-based software. Black Pear is compatible with all the major communications systems, enabling virtually universal application for Toshiba air conditioning equipment with all types of Building Management Systems. When the controller is powered up, it scans the network to identify connected units. The local keypad can be used to directly control all indoor units within a building. In the event of a BMS failure, this feature is very valuable as it maintains communication across the network, enabling individual units to be controlled despite the BMS failure. A single Black Pear module can connect up to 64 indoor units, meaning it can cater for large applications without having to be doubled up or multiplexed. The system is the result of a project between Toshiba UK and control specialist Microtrol, whose other clients include British Aerospace, Ford Cosworth, GSK and Star City. David Dunn, general manager of Toshiba Air Conditioning, said, "The aim was to provide a cost-effective and simple-to-use control solution that would overcome the need for a central control system. Black Pear provides just that, saving engineers time, saving space on-site and making commissioning quick, accurate and straightforward." He added, device is easily configured to communicate with connected air conditioning units in the same way that a standard central controller communicates with devices across a building - but with all its inherent advantages. ●

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New Models of Multi-split Inverter System Air Conditioners by MHI

Starting in June, Mitsubishi Heavy Industries, Ltd, will launch the new "KXZ Series," multi-split inverter system ACs for applications in office buildings and other large-scale facilities, targeting overseas markets. The new series achieves higher energy-saving capability through enhanced efficiency and diversified operational controls. The addition will expand the company's product lineup and also improve its basic performance. The power output capacities of KXZ Series will be 10–20 horsepower (HP) with single units and up to 60HP by combining up to three units. The new series will retain basic configuration of current models. They will adopt improved heat exchangers and newly developed compressors to achieve even higher efficiency. Concentrated winding motors-equipped in the new compressors enable a reduction in power loss in the motor coils. The adoption of a multi-discharge port system for the compressor scroll mechanism suppresses power loss caused by excessive compression and thereby achieves energy-saving benefits especially in the seasonal efficiency rating. As a result of these various improvements, KXZ Series achieves near 40% higher cooling efficiency (EER)2 and about 8% greater heating efficiency (COP)3 than the current model (in case of 24HP). The basic performance of the KXZ Series has also been enhanced, offering a broader operation temperature range than current models. Cooling range of operation is now up to 46°C DB (dry bulb temperature) instead of 43°C DB. The new KXZ series also promotes further energy savings by optimizing the supplied capacity based on the actual heat demand from each room. ●

ABB to divest Thomas & Betts HVAC Business for $260 Million to Nortek

ABB, the leading power and automation technology group, signed an agreement to divest the Thomas & Betts' heating, ventilation and air conditioning (HVAC) business for $260 million in an all-cash transaction to Nortek Inc., headquartered in Providence, Rhode Island. The sale is expected to close in the second quarter of 2014, subject to regulatory clearance. ABB is divesting this business because of limited synergies with ABB's core portfolio. ABB will continue to supply its high efficiency electrical motors and industry leading drives as well as its low voltage products range to the HVAC industry. The acquisition of Thomas & Betts in 2012 advanced ABB's strategy of expanding the reach of its Low Voltage Products division into key geographies, sectors and products. By combining ABB's low-voltage protection, control and measurement products with Thomas & Betts' electrical components, ABB has created a broader low-voltage offering with significant market access. "The divestment is in line with our strategy to continuously optimize our portfolio and to focus our efforts on driving profitable growth in our core automation and power businesses," said ABB CEO, Ulrich Spiesshofer. "Overall, Thomas & Betts continues to provide great synergies with significant growth opportunities and our integration process is fully on track." "This sale allows us to focus on our electrical business and on the benefits from the synergies with ABB in North America and the rest of the world," Thomas & Betts CEO Chuck Treadway added. "HVAC has delivered strong performance and its employees and customers will benefit from the focus and investment of Nortek, a specialist in this area. Acquiring this business will enable Nortek to extend its residential heating and cooling business into the adjacent segments of the commercial HVAC market." ●

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OM-5-2012

Erick MELQUIOND
President

Approval date : 2006/06/19
Re-checked on : 2014/02/17
Valid until : 2014/06/30

VTS India has been awarded the prestigious EUROVENT certification. The Company fulfilled strict requirements concerning calculation of device parameters, process of its installation, quality of components and the product itself. Thorough tests conducted simultaneously in the TUV lab showed that the VENTUS units assembled in Poland and in India obtain the same quality results. This is the proof that VTS, irrespective of the location, takes special care that the quality of the services and products it offers, is always on the same, highest level. EUROVENT Certificate in India is a success measured in a long and quality-oriented work that will certainly bring the company closer to the position of market leader. VTS Group is leading supplier of the AHU solutions available in 40 countries on 5 continents. During 25 years of its operations, VTS managed to attain the position, which allows it to compete with the global players priding themselves in 100 year history. VTS sales level has already exceeded 6,300,000 units, which puts VTS in the position of the European leader and a key player in the world's markets. VTS Capital Group comprises nearly twenty regional companies situated in such countries as China, India, the United Arab Emirates, Chile, Russia or the USA, which employ more than 350 technical-sales representatives. ●

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Alfa Laval accelerates 'Two Ways to Market' Distribution Business Strategy

In line with Company's Equipment Division's two ways to market strategy and aim towards Double Distribution growth, the second annual Distributor's Meet was organised at Alfa Laval India during 20-21 February 2014 in Pune. It took punch line "We Drive Impact' and image of South India's' Snake Boat Race' as a theme. Susanne Pahlen Aklundh, Head & Executive VP EQD, Alfa Laval presented Distribution Strategy to distributors while Jan Hedemann, MD Alfa Laval India focused on growth of distribution India will have during 2014. Kumud Jhamb, VP & Head EQD, India presented key growth drivers of distribution business. 45 representatives from all 31 distributors from India and Nepal participated in the event. ●

Ingersoll Rand appoints Madhusudan Rao as Chief Financial Officer

Ingersoll Rand, appointed Madhusudan Rao as CFO & India Controller for company. He has the responsibility of Ingersoll Rand's financial strategy and functions. He has over 30 years of experience in varied industries such as manufacturing, high technology R&D, and financial services. Prior to joining Ingersoll Rand group, he was Finance Director with Northern Trust Bank. He was CFO with Fidelity Business and was CFO of GE India Technology Centre and other companies within GE. He is a qualified Chartered Accountant and Company Secretary and also holds a certified master black belt in six sigma quality. ●

Ecocooling announces 200th Data Centre Cooling Installation using Energy Saving Technology

EcoCooling, the leaders in direct-air evaporative cooling completed their 200th data centre cooling installation using energy saving technology. "Using CRECs (computer room evaporative coolers) instead of the conventional CRAC units (computer room air conditioning units) can save over 90% of the energy needed to cool a data centre," said EcoCooling managing and technical director Alan Beresford, "we are very pleased to announce Serve The World as the 200th data centre to adopt this solution at its 600kW Oslo facility in Norway." It has taken a number of years for the CREC cooling to be accepted as a safe and reliable alternative to expensive refrigeration-based CRAC cooling. The World now joins a list of highly respected data centre operators able to operate with PUEs (power utilisation effectiveness) of 1.2 or less regardless of the level of occupancy in the data centre. Other data centres which have grasped the power and cost saving Eco-Cooling CREC cooling technology include Insurance company Unum, UK telecoms companies BT and TalkTalk, public sector organisations Humberside police and Warwickshire County Council plus colocation specialist Capgemini, as well as Cambridge University and RNLI (the Royal Naval Lifeboat Institute) Within the 200 installations there are data centres with power consumptions from 10kW to 1MW. For a 1MW installation the EcoCooling CREC solution would require only around 40kW of power compared to as much as 1000kW with conventional CRAC cooling. This saves the cost and infrastructure for 960 kW of power. Aberdeen University Data Centre – cooled by EcoCooling CRECs has been awarded Data Centre Project of the Year in the BCS & Computing UK IT Industry Awards – covering the UK's entire IT industry. A number of best practices including the deployment of EcoCooling CRECs has led to a PUE of less than 1.1. ●

MAC Directive: no Evidence to Support the Safety Concerns

A scientific review of the research regarding the safety aspects of the use of refrigerant R1234yf in Mobile Air Conditioning (MAC) systems, published by the European Commission, concludes that, there is no evidence of a serious risk in the use of this refrigerant in MAC systems under normal and foreseeable conditions of use (according to the existing legal framework on the general safety of products). The review reinforces the conclusions by the German market surveillance authorities the KBA (Kraftfahrt Bundesamt), which stated that there is no sufficient supporting evidence of a serious risk that would entail the intervention of the authorities. The review of 2013 KBA testing procedures was conducted as a confidence-building measure that the Commission had proposed to the Member-States. The Joint Research Centre (JRC) reviewed the testing procedures and the review was performed by the JRC in an open and transparent way. In practical terms this assessment reaffirms the position of the Commission that the automotive manufacturers have the means to mitigate the inherent risks of the use of the refrigerant, which are known and have been studied. The refrigerant is not the only fluid used in vehicles that is flammable or that may cause formation of dangerous emissions when burning. Automotive manufacturers, as part of their responsibility to provide for safe products, have found ways to mitigate these risks in a way that is consistent with a high level of protection for the safety and health of persons. Though measures to further improve MAC safety have also been presented. Examples such as release valves in MAC circuits, fire extinguisher, reduction of hot surfaces (thermal insulation) and additional ventilation were discussed on different occasions during the working group meetings. This review was slated for debate with the Member States during April 2014. ●

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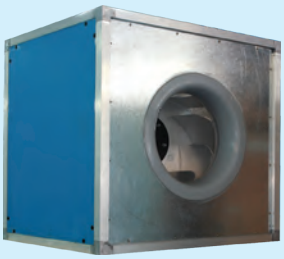

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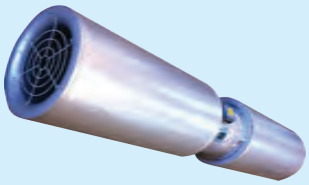

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Data Center Cooling Market worth $8.07 Billion by 2018

MarketsandMarkets broadly segments the Data Center Cooling market by cooling solutions: air conditioning, chillers, economizers, cooling towers, cooling solutions for servers/racks, management systems and other solutions; by services; by type of users: cloud providers, colocation providers and enterprises; and by regions: North America, Europe, Asia Pacific, Middle East and Africa and Latin America. Data center managers have to sustain within strict infrastructure budgets. With increase in demand for data centers, power consumption associated with them is also rising, thus creating a critical demand for low power consuming cooling techniques. Also, with swift advancements in technology, changes in the infrastructure spending are seen. With advanced data center cooling systems, the power consumption can be reduced, which in turn will lower the operational cost of running a data center. MarketsandMarkets expects the Data Cooling market to grow from $4.91 billion in 2013 to $8.07 billion by 2018. This represents CAGR of 10.4% from 2013 to 2018.

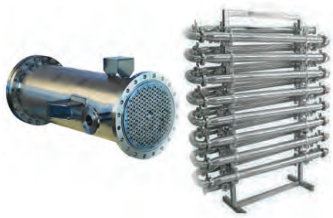
Emerson Climate Technologies (India) appoints Kale as GM

BB Kale appointed as GM Product & Marketing for Emerson Climate Technologies India, effective April 1, 2014, brings ample experience that spans Strategic Product Portfolio Management, Global Product Management, Business Development, Design, Engineering, Operations Management and Marketing Communication. In new role, he will lead the entire Marketing function for Emerson Climate Technologies in India. He is BE in Mechanical Engineering & MBA, S.P. Jain Institute of Management, Mumbai. ●

Green Revolution Cooling demonstrates Flexible Hardware, Effective Output, wins Big in Liquid Submersion in Europe

Green Revolution Cooling announces its win of a recent competition to provide the most effective new cluster by way of maximized computational output per cost to Vienna Scientific Cluster (VSC), a group of progressive Austrian universities. Green Revolution Cooling achieved the highest ranking and was awarded its first major liquid submersion contract of 2014. This comes after another number one in late 2013, when GRC received top accolades for most energy efficient high-performance supercomputer in the world. This distinguishing award came from the Green500 for GRC's role in the engineering of cooling solutions for Tokyo Institute of Technology's TSUBAME-KFC system. GRC is making headlines across the data center cooling industry again as the CarnotJet System builds upon its reputation as the most cost-effective solution on the market as it simultaneously continues to gain popularity as the most energy efficient solution in the world. Christiaan Best, founder and CEO of Green Revolution Cooling, states, "We created the CarnotJet™ to provide the lowest possible in capital expenditure and operational costs both for new build and for retrofit data centers – and through these successful competitions, challenges, and awards, our clients are coming to a few conclusions. That we have achieved this ambition, that it makes sense for them, and that now is the best time to take advantage of the economics GRC's solutions provide." Green Revolution Cooling has made their goal of maximized savings a reality by minimizing the equipment necessary for build-outs and by creating a power infrastructure that reduces energy consumption by half when compared to conventional rates.GRC accomplished this win by placing highest in a scoring criteria including measurements and tests primarily centered around maximizing computational output for a fixed cost - an area in which GRC thrives. ●

Heat Exchanger Market worth $19,505.8 Million By 2018



Europe has always been a strong market for heat exchangers and globally, this market has been a leader for heat exchangers with respect to demand as well as production capacity. The region has the presence of most of the global leaders in heat exchanger manufacturing. Heat exchanger consumption in the region is estimated to grow at a CAGR of around 4.7% from 2013 to 2018. This region has a relatively slow growth rate as a result of its dominant market size and slow economic activity as compared to the other regions. The demand in this region is boosted mainly due to the increased replacement demand for the heat exchangers. "Asia-Pacific – the fastest growing" Heat Exchanger market Asia-Pacific, being the fastest growing heat exchanger market globally, is estimated to grow at a CAGR of 10.6% for the next five years. Asia-Pacific is witnessing high industrial growth, which hints at an ever-increasing demand of heat exchangers for its diverse applications. China dominates the heat exchanger market in Asia-Pacific region, being a major consumer and the fastest growing country in terms of heat exchanger demand. Currently, a high share of heat exchanger is consumed by the chemical industry and the demand of heat exchangers through chemical industry is expected to grow in the next five years at a CAGR of more than 11.5% from 2013 to 2018. After China, countries, including India and other Asian countries, are showing increasing growth in demand for heat exchangers. Moreover, increasing number of heat exchanger manufacturers from Asian countries are putting vigorous efforts for developing a strong base of heat exchanger market, with a target of reducing heat exchanger imports. ●

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Mitsubishi Electric US Cooling & Heating Division celebrates Annual Distributor Conference in Hawaii

More than 300 distributors, manufacturer's representatives, employees and spouses joined Mitsubishi Electric US' Cooling & Heating Division (Mitsubishi Electric), America's No. 1 selling brand of ductless cooling and heating systems, in Kapalua, Hawaii, for its 2014 Distributor Conference. The annual event, held during March at the Ritz-Carlton, Kapalua, gives Mitsubishi Electric the opportunity to honor its distributors and together toast to the success of ductless and Variable Refrigerant Flow (VRF) zoning systems in the U.S. market. "As the first manufacturer to bring ductless and VRF zoning technologies to the U.S., we have spent more than three decades building a network of the best distributors for our product," said Bud Nardello, vice president of sales, Mitsubishi Electric US Cooling & Heating Division. "They are the key players in the market - the movers of our products - and the partnership we have today with our distributors has been critical to our ongoing success in building this market." The theme for this year's conference was "E nana I kekuma a me kalaikou'ike", which in Hawaiian translates to "look to the source and carve your vision." According to Nardello, it reflects the key to success for Mitsubishi Electric and its distributors. "We got to this point by working cohesively with our distributors," he continued. "We wanted this year's theme to reflect how we've gotten here and that our future success as industry leaders rests on continuing to have a common goal." Included in the three-day conference were presentations from the division's executives, who brought distributors up to speed on everything from current state of residential and commercial sales to product branding and advertising initiatives. ●

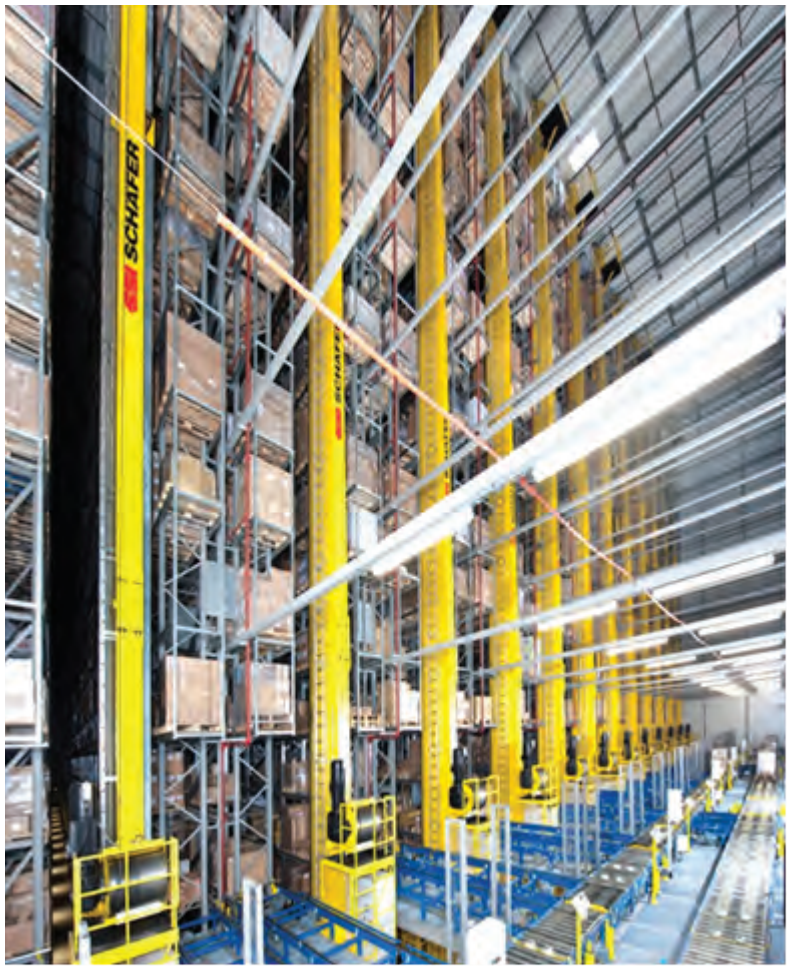
ASHRAE joins NAHB and ICC to develop new National Green Building Standard

National Association of Home Builders (NAHB), building science society ASHRAE and the International Code Council (ICC), for the built environment, agreed to jointly develop the 2015 edition of the ICC/ASHRAE 700 National Green Building Standard. This is the third edition of the standard and the first time that ASHRAE has partnered on its development. "ASHRAE's participation is welcome news for the home building industry," said NAHB Chairman Kevin Kelly, a home builder & developer in Wilmington, Delaware. "This cements the position of the National Green Building Standard as the preeminent green standard for residential construction." In 2007, NAHB and ICC convened a consensus committee of home builders, code officials, product manufacturers, building science and energy-efficiency specialists and governmental representatives to develop the standard. It was approved in 2009 by the American National Standards Institute (ANSI) as the first green standard for residential construction, development and remodeling. Since then, the National Green Building Standard has helped define and advance sustainable home building, remodeling and development – a sector expected to represent as much as a third of the market by 2016. Now known as the ICC 700 National Green Building Standard, it was updated in 2012 by a subsequent consensus committee and again approved by ANSI. NGBS has been used to certify more than 32,000 single- and multifamily homes and residential developments for reaching its established benchmarks for energy, water and resource efficiency, indoor environmental quality, home owner education and site development. According to ICC Board President Stephen Jones, CBO, and CEO Dominic Sims, in a joint statement, "ASHRAE's welcome involvement will help position the ICC/ASHRAE 700 National Green Building Standard even further ahead as the leading consensus standard in the industry." ●

New Energy Efficiency Solution for Refrigerated Transportation Market: Smartcool announces 18% savings

Smartcool Systems Inc, announces initial results of 18% energy savings from an evaluation of Smartcool's energy efficiency technology on two sea-going refrigerated containers. "This is an exciting new market that we are entering," says George Burnes, President and CEO of Smartcool. "Not only does it offer a huge amount of potential on its own, but it is also highly complementary to our established customer base of food retailers. Our major supermarket customers depend on refrigerated transportation as an integral part of their business. Offering a new solution to address the costly energy consumption in this sector will open the doors to new cus-tomers and provide a lucrative value-added offering to our existing customers." Smartcool has established a well-respected energy efficiency solutions business for refrigeration and air conditioning using its own software products. Initial testing of Smartcool's software on this new application has been very successful, demonstrating 18% energy savings on the compressor in a Carrier refrigeration unit. This will translate to a return on investment well under 12 months for customers, leading to rapid sales penetration for Smartcool. The refrigerated transportation market includes over-the-road trailers, box trucks, sea-going containers and rail containers. Globally, there are over 5.5 million refrigerated trucks and trailers, and an additional 2 million refrigerated sea-going containers. Diesel-fueled generators are the primary source of electricity for transportation refrigeration systems. These generate electricity at a cost of up to $0.80/kwh depending on the prevailing cost of diesel. In the case of refrigerated trucks and trailers, the refrigeration unit consumes approximately 1 gallon of diesel fuel per running hour. ●

Automatic Storage and Retrieval Machines by SSI SCHAEFER



Automatic storage and Retrieval machines by SSI SCHAEFER are an important component of its Intra-logistics solution. They handle storage and retrieval operations in high-bay warehouses and move products to transfer stations. In a warehouse where optimized storage with quick transport of material and short access time is required, SSI Schaefer offers innovative storage and retrieval machines that generate electrical energy and stores, which is again used to accelerate the cranes during horizontal movement, thus representing the economic and environment friendly side of warehouse automation. Through minimal energy consumption the environment is protected and the cost of maintenance is reduced. Since we manufacture our own products, we continuously deliver quality, reliable products to our customers.

With the use of building blocks, the pallet SRM Exyz can be tailored exactly to the individual needs of users and provides more storage capacity as well as higher flexibility and efficiency. The highest energy-saving categories and efficient energy recovery systems are already standard with Exyz.

The **Schaefer Lift & Run** system represents an economic solution for the highly dynamic handling of pallets in a channel storage warehouse. The storage device SLR consists of a transfer car with lifting device for the load handling unit Schaefer Orbiter System (SOS) and operates in connection with vertical lifts. High dynamics, low space demand, and efficient energy use make this system an alternative to the classic pallet SRM for various applications. SSI SCHAEFER offers a wide spectrum of standard devices that can be adapted as single or double mast units based on capacities, travel and lifting speeds, installation height and load based on requirement and application to meet the exact needs of the customer. Compact assembly groups and pre-tested storage and retrieval machines guarantee short assembly times. Proven, high-quality machine parts result in comfortable maintenance schedules. Intelligent control routines furthermore provide low-wear and energy-efficient warehouse operation. Further, models with dedicated load handling devices, multiple load pick-up, equipment for utilisation in a deep-freeze environment, turning devices with aisle-change-bridges, flexible drive concepts as well as redundant configuration with several storage and retrieval machines per aisle are available. ●

Suunil Dabral,
Country Manager- Schaefer Systems International Pvt Ltd

Managing your Refrigerants

Key to Lowering costs and Sustainable Operations

The function of the refrigerant in a chiller is to transfer heat across the system. Early air conditioning systems used natural refrigerants such as carbon dioxide and ammonia. While these refrigerants are easily available and provided good system efficiencies, they were also very dangerous and toxic.

Fig. 3: Fluorescent Leak Detection

Aneesh Kadyan, Director - Operations, for a leading real estate services firm heads the operations of a large team of professionals in the building and facility management arena. He is a post graduate in Mechanical Engineering and has about two decades experience in management of services in technology intensive environments. His areas of interest include Maintenance management, corporate governance, Strategic planning and technology interventions in Industry. Aneesh is a Professional Engineer, a certified Energy Auditor and an IGBC Accredited Professional (AP).

Organic refrigerants were developed in the late 1920's, the first one being the CFC (Chloro Flouro Carbon) based refrigerants such as CFC 11. These refrigerants were used extensively till the late 70's as they met the requirements of ideal refrigerants till then – low toxicity, chemical stability and low flammability, coupled with high thermal performance (Normal boiling point, critical point and heat capacity). HCFC were also introduced in the mid 1950's but were used for specialized installations as their CoP (Coefficient of Performance) was lower than that of CFC refrigerants.

The linking of depletion of Ozone layer to CFC's in the early 1970's led to a shift to use of HCFCs. The growing awareness of the negative impact of refrigerants on the environment led to two new requirements of refrigerants – Low ODP (Ozone Depletion Potential) set by the Montreal treaty and Low GWP (Global Warming Potential) defined by the Kyoto protocol. CFC 11 has an ODP of 1 which is the highest whereas HCFC- 22 has an ODP which is 95% less than CFC 11. Refrigerants such as HCFC, 134a have zero ODP and low GWP. Modern refrigerants have eliminated the chlorine completely and are classified as HFC (Hydro Flouro Carbon) refrigerants,

which have zero ODP and almost negligible GWP. HFC 401A is a blend of HFC 32 and HFC 125 and is a replacement for small air conditioning units using HCFC 22. Figure 1 shows the ODP and GWP of commonly used refrigerants.

While the ODP of modern refrigerants is a fraction of the early refrigerants, they still have potential to harm the ozone layer as well as contribute to the greenhouse effect that leads to global warming. The cost of refrigerants has also considerably increased due to the requirement to meet low ODP and GWP levels, and hence, are a major cost for the operator of air conditioning systems. There is thus a business case as well as an environmental case to effectively manage the refrigerant in the chiller plants that exist in building in the booming commercial and retail sector.

Managing your Refrigerants

The refrigerant charge in a chiller installation depends on a number of factors such as operating conditions, type of compressor, length of piping in the case of split units etc. USGBC guidelines require the refrigerant charge to be between 0.2 Kg to 2.2 Kg per Ton of cooling capacity. Thus, a 150 TR chiller commonly found in the building sector would use anywhere between 150 – 300 Kg of refrigerant charge. In case of a partial recharge of approximate 50% due to a system breakdown, and an average cost of Rs 500 per Kg, chillers owners can expect to pay upwards of Rs 100,000 towards refrigerant top up. Limiting the refrigerant leakage from chillers is also a requirement of the USGBC LEED guidelines which mandate a leakage rate (Lr) of 0.2 – 2 % and an end of life refrigerant loss of below 10%. Refrigerant re charges end up increasing the operating costs as well as have a negative impact on the environment and hence, operators and maintainers need to ensure that leakages are minimized and prevented.

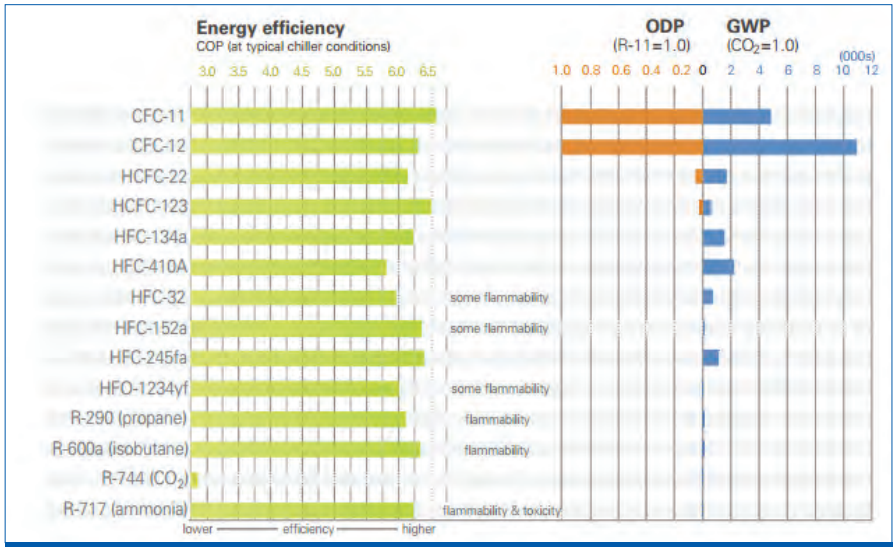


Fig. 1: ODP and GWP of Refrigerants

Refrigerant Management Plan

To effectively manage and use the refrigerant in the chillers, it is essential to have a refrigerant management plan that addresses various aspects such as charge monitoring, storage, leak identification and disposal among others. While there are no regulations as yet in India to monitor and track refrigerant use in building chiller installations, it is only a matter of time that control mechanism will be introduced due to the potential environmental impact that leaked refrigerants have. Developed countries have robust, legislated refrigerant management plans that include annual reporting of refrigerant leakages and technician certifications. The LEED Existing Buildings certification also mandates a refrigeration management plan as a pre-requisite.

A good chiller maintenance program should have procedures and processes developed to cater for refrigerant management. Figure 2 shows the key components of a refrigerant management plan.

- **Monitoring**
  Effective tracking of the use of refrigerants is the starting point for an effective refrigerant management plan. Monthly and annual top ups due to repairs or leakages need to be captured and recorded to calculate cumulative consumption. This data is useful in meeting regulatory guidelines as well as Green Building requirements.
- **Enhanced Maintenance**
  Successful refrigerant loss prevention starts form effective maintenance of refrigerant system pipelines and fittings. While most refrigerant system components are fastener free and do not need physical maintenance, regular visual inspection will help identify potential problematic areas which can lead to refrigerant leaks. Maintaining the correct refrigerant levels is essential for the system to run efficiently and as per design recommendations. A trend analysis of the compressor suction and discharge pressures is a good way to see any dip in refrigerant levels as well as identifying excess charge conditions. Regular checking of piping condition is essential in predicting possible leaks due to pin holes in pipes. Use of anti-corrosive coating over exposed copper pipes will reduce the chances of pipe pitting. Similarly, positioning guards around piping that can potentially be dislodged will also help arrest leaks form those areas.

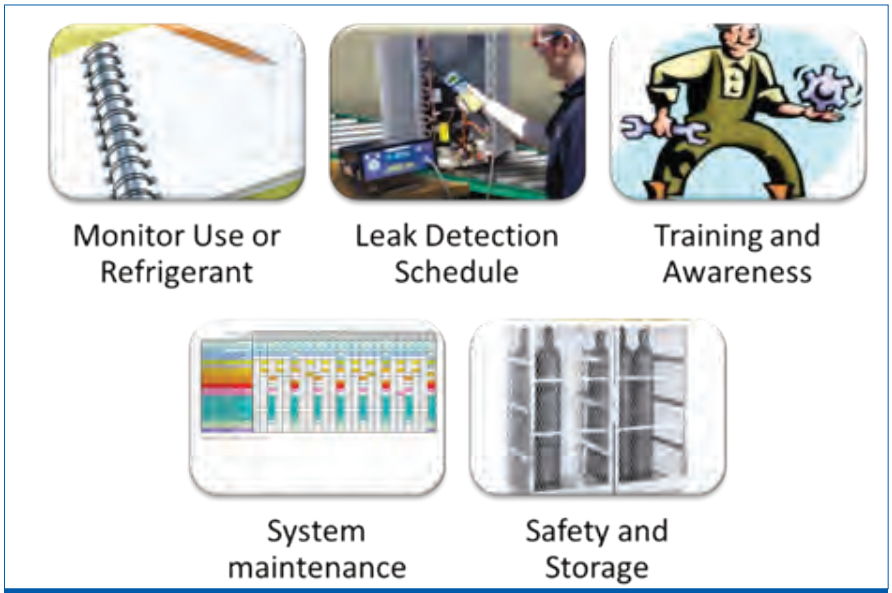


Fig. 2: Components of a Refrigerant Management Plan

- **Leak Detection**
  Modern Chiller systems are less susceptible to leaks due to the robust design. Leaks are more frequently found in systems which have large piping requirements such as split units. Gas leaks typically occur around valves and fittings around the flare joints. Another common place for leaks to spring up is the evaporator coils. Capillary tubes used for sensing temperature are also prone to damage and resultant leakage of gas. The most common reason for leakage to occur from these locations is corrosion or material failure due to stress. Corrosion can occur internally due to use of poor quality oil or can be due to external environmental conditions. Pitting of evaporator coils exposed to the environment in the vicinity of landfills, sewerage drains or reclaimed lands are a major cause of refrigerant leak. Leak detection is usually of two types:
  - **Reactive leak detection**
    This method is used when deterioration is system performance is observed and fault analysis reveals lowering of gas charge. A the chiller is designed to run on varying load, minor leakages in gas are not readily evident and a significant amount of gas can leak off before the performance degrades drastically. Leaks are usually detected by either a halide touch or by the traditional soap solution method. Leaks can also be identified by looking for oil traces as the gas is mixed with Oil.
  - **Predictive leak detection**
    In this approach, leaks are identified as soon as they occur or within a short time of occurrence. A planned check of the locations susceptible to leaks using halide torches is the most commonly used approach. A more sophisticated and accurate method is to use fluorescent additives that are mixed in the oil. These additives glow when exposed to air in the case of a leak and are easily identified. Figure 3 shows one such device in use.
- **Training and Awareness**
  The technician on the ground is the one best positioned to identify conditions that can lead to leakage or understand system performance parameters that indicate a leakage in the system. However, unlike in the western countries where HVAC technicians require a license to operate, the technician managing the Chillers in the India context have only a basic training in HVAC and management of refrigerants is not a high focus area for them. The refrigerant management plan will only be effective if the technicians and shift engineers understand the impact that gas leaks have on the environment as well as on operating costs. This will require greater training of the team on refrigerant management which can come from in-house resources or the OEM's during routine servicing visits.
- **Safety and Storage**
  Modern refrigerants are not toxic and will not harm individuals exposed to leaks directly. However, as the refrigerants operate under pressure, proper safety pre cautions are essential to ensure that no accidents occur. There have been instances where the compressor of small split units has burst due to high pressure buildup as the out let values were not opened by the technician. Another important aspect to be kept in mind is the correct storage of refrigerant cylinders.

Modern Refrigerants have evolved with the need of the times, from having better efficiencies to being able to meet sustainability and environmental requirements. The later requirements have resulted in increases in the cost of the refrigerants. Therefore, arresting leaks before they lead to large depletion of gases is essential to keep operating costs low. Another imperative to manage refrigerant is the impact that leaked gases have on the environment. There is thus a case for building owners and Chiller operators to invest in a refrigerant management plan that addresses the points brought out in the article. There is also a need to bring in legislation to monitor the use of refrigerants so as to ensure that there is a regulatory mechanism minimizes wastage. ●

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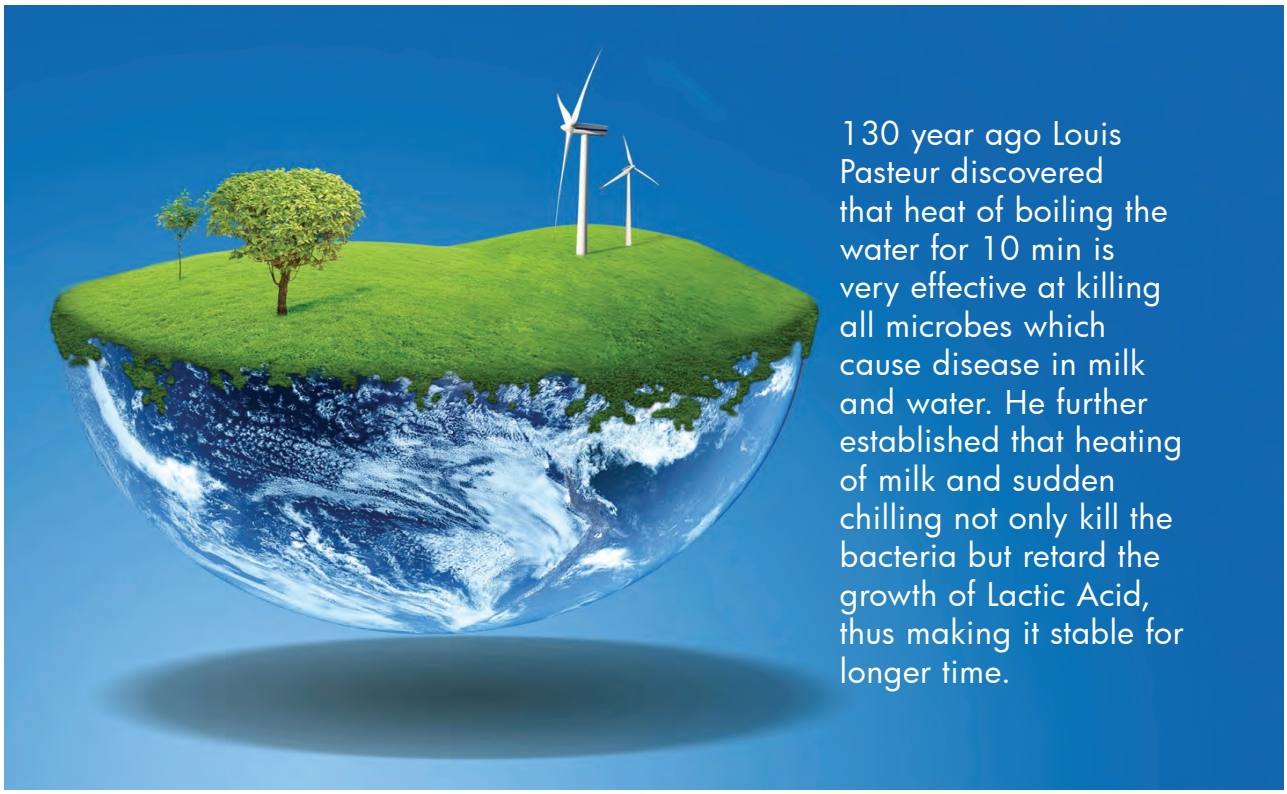
Renewable Energy for Pasteurization



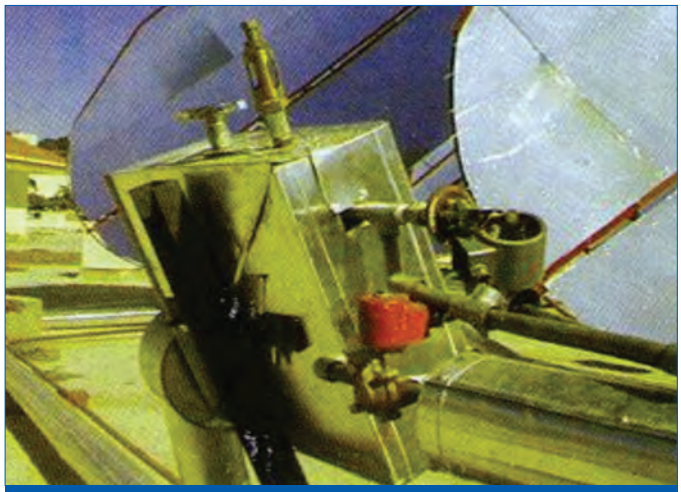
130 year ago Louis Pasteur discovered that heat of boiling the water for 10 min is very effective at killing all microbes which cause disease in milk and water. He further established that heating of milk and sudden chilling not only kill the bacteria but retard the growth of Lactic Acid, thus making it stable for longer time.

Dr. OmPrakash G. Kulkarni is recognized as Inventor of World's first Solar Thermal/ Renewable Energy Based Air Conditioning / Refrigeration system. He is Expert Invitee Advisor to MERC (GoM) on Renewable Energy, BOS member on Electrical Engg./ E & TC and Instrumentation Science, Referee for PG at Pune University. Also member of Governing body of 13 Engineering Educational Institutions. He has established three industries. He is State level chairman: Energy Forum - Institution of Engineers (India); National Chairman: Energy Forum - Laghu Udyog Bharati and life member of many National and International Associations and Institutions.

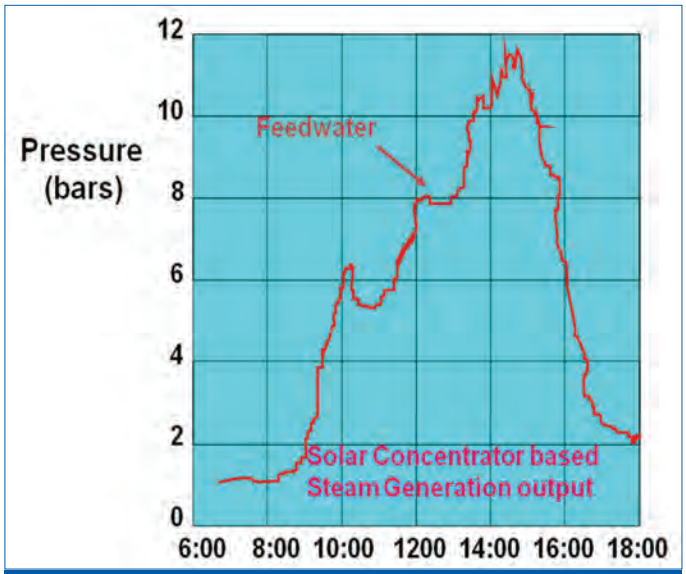
There are two methods which define the process - The act or process of heating and sudden chilling a beverage or other food, such as milk or beer, to a specific temperature for a specific period of time in order to kill microorganisms that could cause disease, spoilage, or undesired fermentation. The act or process of destroying most microorganisms in certain foods, such as fish or clam meat, by irradiating them with gamma rays or other radiation to prevent spoilage.

Normally, liquid under process is passed through heating process and then it is suddenly chilled. This thermal shock kills the harmful bacteria. The main purpose of pasteurization is to address critical health problems in consuming of those liquids it may even be drinking water also. Particularly in case of Milk it is heated to a temp of 65.56 Deg. C (150 deg F) and then is suddenly chilled to 4 deg C (39.2 deg F). The majority of diseases in developing countries today are infectious diseases caused by bacteria, viruses, and other microbes which are shed in human faeces and polluted water which people use for drinking or washing. When people drink the live microbes, they can multiply, cause disease, and be shed in faeces into water, continuing the cycle of disease transmission.

Worldwide, unsafe water is a major problem. An estimated more than one billion people do not have access to safe water. It is estimated that diarrheal diseases that result from contaminated water kill about



Shows the system installed at Brahma Kumaries, Talethi, Abu Road, Rajasthan. Scheffler Parabolic Solar concentrators are used for pasteurization of 3000 litrs. of drinking water per day for the devotees.



Solar Steam Pressure Curve

2 million children and cause about 900 million episodes of illness each year. As a microbiologist, I have always been perplexed as to why boiling is recommended, when this is heat far in excess of that which is necessary to kill infectious microbes in water. I presume the reason boiling is recommended is to make sure that lethal temperatures have been reached, since unless one has a thermometer it is difficult to tell what temperature heated water has reached until a roaring boil is reached. Everyone is familiar with the process of milk pasteurization.

This is a heating process which is sufficient to kill the most heat resistant disease causing microbes in milk, such as the bacteria which cause tuberculosis, undulant fever, streptococcal infections and Salmonellosis. What temperatures are used to pasteurize milk? Most milk is pasteurized at 71.7°C (161°F) for only 15 seconds. Alternatively, 30 minutes at 62.8°C (145°F) can also pasteurize milk.

Some bacteria are heat resistant and can survive pasteurization, but these bacteria do not cause disease in people. They can, however, spoil the milk, so pasteurized milk is kept refrigerated.

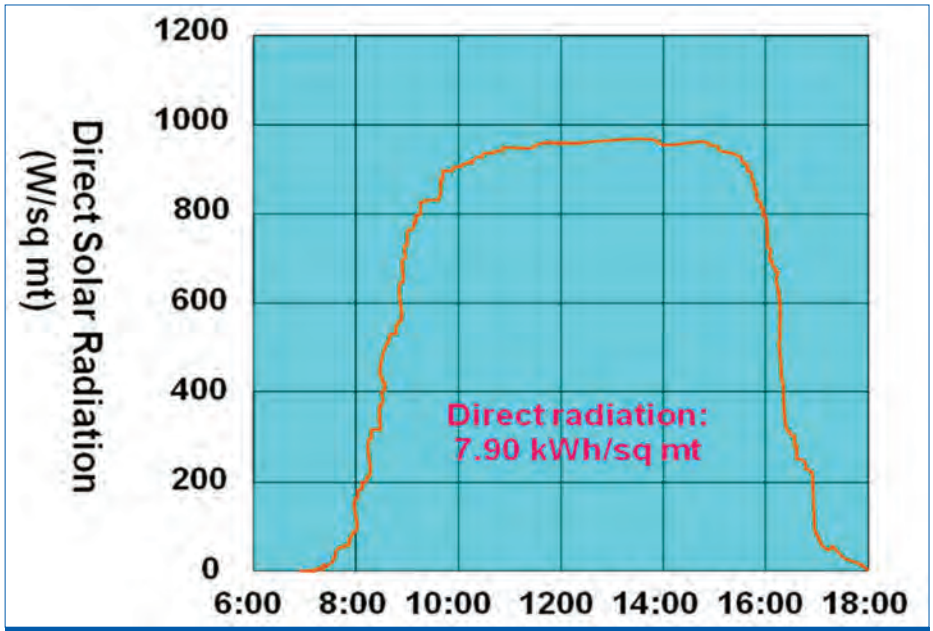
There are some different disease microbes found in water, but they are not unusually heat resistant. The most common causes of water diseases, and their heat sensitivity, are presented in Table. The most common causes of acute diarrhoea among children in developing countries are the bacteria Escherichia coli and Shigelia SD. and the Rotavirus group of viruses. These are rapidly killed at temperatures of 60°C or greater.

Testing water for faecal contamination

How can one readily determine if the water from a well, pump, stream, etc. is safe to drink? The common procedure is to test the water for bacterial indicators of faecal pollution. There are two groups of indicators which are used. The first is the Coliform bacteria which are used as indicators in developed countries where water is chlorinated. Coliform bacteria may come from faeces or from plants. Among the Coliform bacteria is the second indicator, Escherichia coli. This bacterium is present in

Solar Steam Generation System using Parabolic Concentrators which is installed on terrace of 4th floor of one building and Steam is transported through insulated pipes to the processing unit located at extreme far end on ground floor of adjoining building. Installed at Adharashram, Nashik

Single effect NH4 + H2O based VAM manufactured by the author in collaboration with IITB. Sub zero temperature of – 14 deg. C achieved with this VAM.



Solar Radiation (Steam generation is proportional to the radiation)

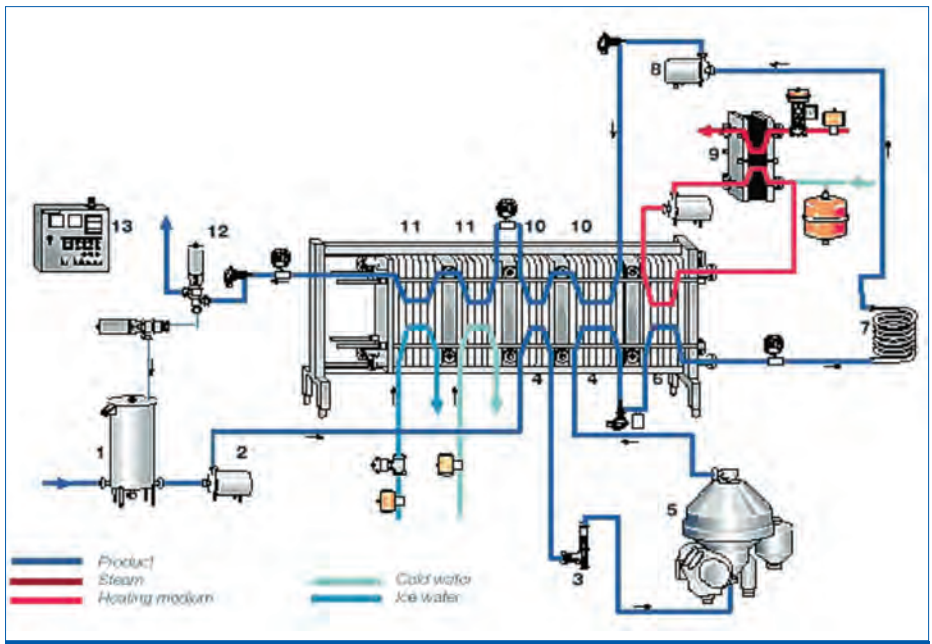
large numbers in human faeces (approximately 100,000,000 per gram of faeces) and that of other mammals. This is the main indicator used if water is not Chlorinated. A water source containing 100 E. coli per 100 millilitres poses a substantial risk of disease.

Why use of Solar Energy in pasteurization is essential ?

Some examples of the cost of boiling water are worth mentioning. If all residents to boil drinking water for 10 minutes then the cost of doing this would amount to 29% of the average household income.

Because the quantities of fuel consumed for boiling water are so large, approximately 1 kilogram of wood to boil 1 litre of water, and because firewood, coal, and coke are often used for this purpose, an inadequate water supply system significantly contributes to deforestation, urban air pollution, and other energy-related environmental effects. If wood, charcoal, or dung is used as fuel for boiling water, the smoke creates a health hazard, as it does all the time with cooking. It is estimated that 400 to 700 million people, mainly women, suffer health problems from this indoor air pollution.We seriously concerned about the 6 GHGs and their emission, preserving the Green vegetation (increasing Carbon Sink) and reducing burning of fossil fuel (reducing Carbon emission) From above details it is clear that Heat – Thermal energy is the main input source for heating and chilling process. Use of Solar Thermal energy for generation of hot air, hot water, hot tharmic fluid or Steam at any desired pressure and temperature is an established technology. The Author has invented world's first Solar Thermal Air conditioning system and has achieved sub zero temp upto -14 deg C. Combination of above heating and chilling technology using Thermal energy as input can revolutionize the pasteurization scenario.

This technology can bring great relief to units or milk producers located in rural area, where the energy dependency is highly unreliable. Solar Thermal, Methanization of any kind of



Pasteurization process flow diagram

15 kW waste wood based Gasifyer at Raipur (CG)

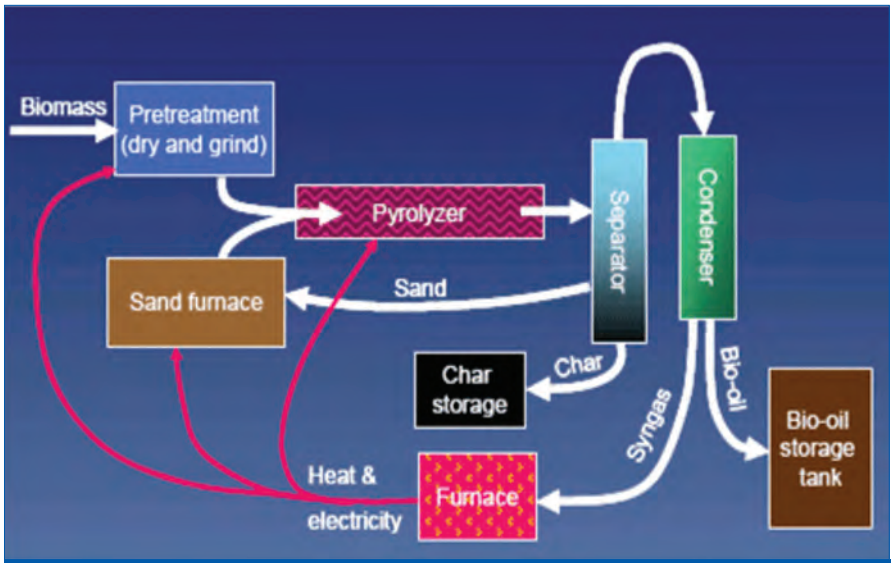
Cow dung + Bio degradable waste based Methanization plant at Phunda (CG)

Bio-degradable waste, Pyrolysis of non-recyclable waste rubber / plastic / wood, Gasification of any combustible waste material etc. have proven excellent source of heat input. Use of Vapour Absorption / Vapour Adsorption technology based VAM (Vapour Absorption./Adsorption Machines) may be single effect – using Ammonia – Water, double or triple effect using Li-Br are excellent for chilling needs.

Direct fired or Steam operated or Hot water operated VAMs are now common. Upto 5 deg. C ordinary water can be used as media and below that Glycol mix is always recommended.

Pasteurizer

- Balance tank
- Feed pump
- Flow controller
- Regenerative preheating sections
- Centrifugal clarifier
- Heating section
- Holding tube
- Booster pump
- Hot water heating system
- Regenerative cooling sections
- Cooling sections
- Flow diversion valve
- Control panel.

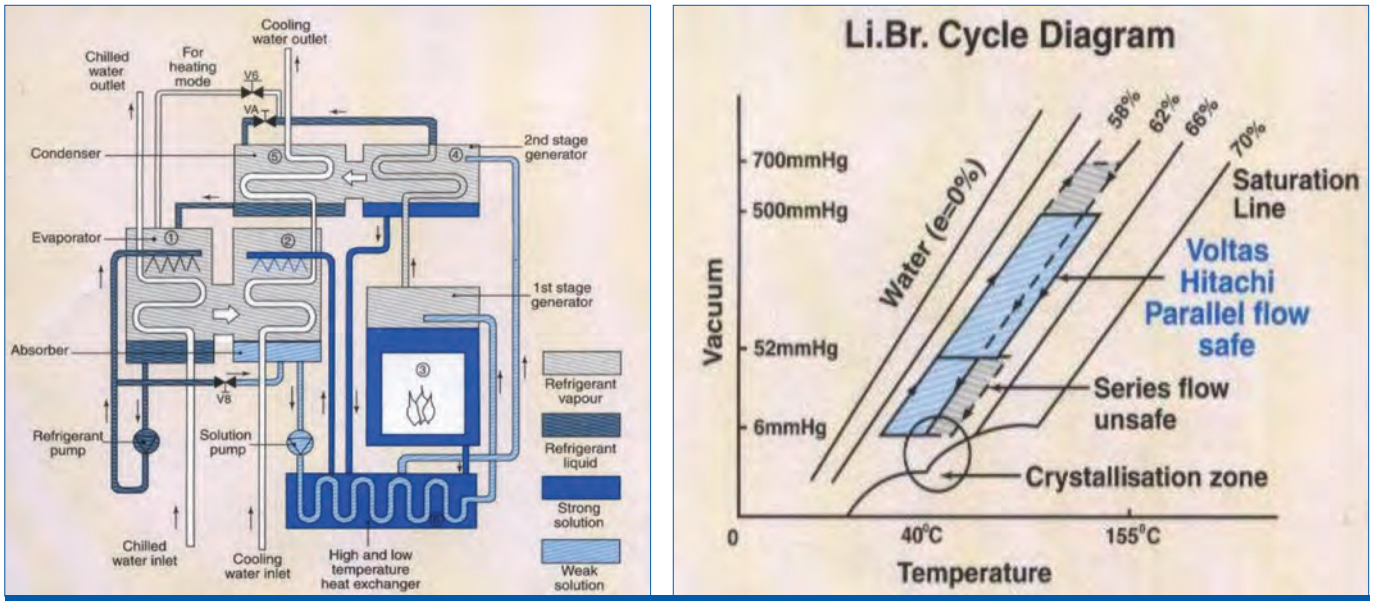


Pyrolysis of Bio-mass waste

A technology that eliminates the term Waste and says Resource

Pyrolysis is the physical and chemical decomposition of organic material that occurs at high temperatures in the absence of oxygen. The conditions created during pyrolysis causes complex organic molecules to break down into simpler molecules and thus fundamentally and irreversibly alter their properties at a molecular level. The outputs of pyrolysis are a carbon char (which can be almost pure carbon), a highly combustible hydrocarbon gas, consisting mainly of Carbon Monoxide, Hydrogen, Methane and alkenes and Distillate Oil. Broadly speaking, the gas and char produced by Pyrolysis have high calorific values and in most cases are purer than their natural counterparts as many naturally occurring contaminants can be destroyed by higher levels of heat or refining and conditioning processes employed as part of the overall process.

Pyrolysis of Non recyclable waste Plastic material



Functional diagram of Li+Br double effect VAM

Types of Solar Thermal Concentrators

Solar concentrators can deliver not only Hot water under pressurized or non pressurized state. Evan steam upto 62 bar pressure can be obtained.

For a normal VAM steam at 8 kg/ sqcm pressure is required at 170 Deg, C with a flow rate of 6.2 kg/ TR/hr – for a Glycol cooling media at 0 deg C. However the flow rate of the steam drastically change with the end temperature of chilling media temperature.

If cooling water is taken at a temp of 6 deg. C then the steam flow rate would have been 4.2 kg/TR/hr. Evan if the heat input method is changed then roughly we can assume that 2542 kCal/ TR/hr will be required. With the specification table of particular manufacturer the heat input can be worked out.

Once we know the total heat input required per hour then during Solar hours suitable type concentrator can be selected. The various established concentrators available in the market are:

Scheffler Parabolic concentrator – invented by Dr. Wolfgang Scheffler The unique feature of this technology is that, it is a fixed focus type. But the effective aperture area is about 72.85 % of actual reflector area (Mirror) area. i.e. we loose about 17.15% of the reflector area. Arun Parabolic Concentrator – invented by Dr. Shirish Kedare, IITB. The unique feature of this concentrator is the effective aperture area and actual reflector area are same. But the limitation is that it poses a point loading of 5 to 6 MT at about 1.5 to 2 SqM foot print. Parabolic trough Concentrator – In this the aperture and reflector area depends on the tracking method. But this technology is widely used globally.

Scalable heliostatic Concentrator – There are various designs – but one of the design invented by the author is having all the combined advantages of above types. i.e. the aperture and reflector area are same, the foot print is a distributed load posing maximum about 350 kg/ sqM, it is scalable depending upon site conditions i.e. from 9 sqM to 81 sqM or upto 225 sqM for one unit and as per need multiple units can be used for delivering desired flow rate / desired pressure.

There are some other types also in the market but to limit the topic they are not discussed in detail.

Operation during non sunny hours or non sunny days: For 24 hour operation during sunny days different types of storage methods can be adopted. i.e. thermal storage – one commonly used method is storage of heated thermic fluid/ oil upto a temp of 290 deg. C. But for non sunny days back system is essential and any of the above heat input source viz. Methane / Gasifyer / Green fuel (Agro briquettes) / Pyrolysis can be used.

Conclusion

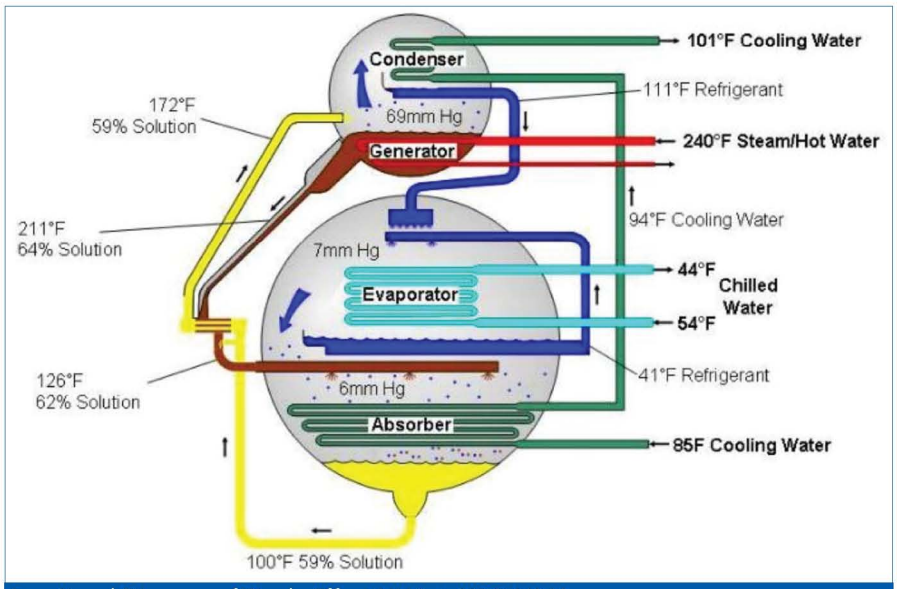
In India we blessed at least 300 days of bright Sun shine with radiation of above 700 W/sqM/hr. It is a technically accepted fact that the solar energy that is impinging on earth surface within 20 min. is more than adequate for annual energy need of 40 time of present world population. It is available Free – Clean – Forever – Everywhere. In our country various types of waste are available in large quantity and disposal is a social - health issue. If we adopt proper technology then the form of waste will change to recourse. It will an effective step towards ZERO land fill.

The need is to follow 'Acceptable - Adaptable and Affordable Technology' to harness it for our desired application. MNRE schemes are not stable and long term oriented, which becomes extremely discouraging factor for Inventors / Investors. The

public forums must take up this issue and follow up demanding an encouraging policy with mandate. The above technology can easily be modified to build Cold Storages at decentralized locations for Agro products. The main advantage will be Grid demand will be reduced, considering the need of DG for grid connected plants the CAPEX and OPEX will be very less and the total payback will be less than 5-6 years (without accelerated depreciation under IT clause).

With depreciation it would be much shorter. It will help in value addition of agro produce so that any farmer can store perishable agro yield and wait for appropriate rate to get good returns.

This is the only way to avoid suicides of farmers. Logistic cost to take the Milk or Agro produce to a long distance will be avoided and local facility will be available. Over all processing cost will be much less than conventional.



Functional Diagram of Single Effect NH4 + H2O VAM

As local opportunities at rural will be generated the problem of urbanization will be mitigated.

This technology will bring diversified employment opportunities at local level for rural part of the country. And this would be right way to fulful the Dream of Mahatma Gandhi for Rural Development; Lalbahadur Shastri For Jai Jawan Jai Kisan; Dr. APJ Abdul Kalam for Strong and Energy Secured India 2020. ●

Ammonia Refrigerant

Ammonia was used for refrigeration in 1876 for the first time, in a vapour compression machine by Carl Von Linde. Many years ago, the food and beverage industry embraced ammonia refrigeration.

The economic advantages alone made ammonia the refrigerant of choice for cold storage facilities and food processing facilities, as well as the dairy and meat packing industries. Almost all of the food on the family breakfast, lunch and dinner table passes through an ammonia refrigeration facility before reaching your grocery store including fresh fruits and vegetables, meat, poultry and fish, frozen foods, milk, cheese' ice cream, and beverages such as soft drinks, beer and wine.

Ammonia was first synthesized in 1823 by reacting air and hydrogen. The first commercial production of synthetic ammonia began in 1913. Presently, there are an estimated two billion metric tons of ammonia present in the world. Of this amount, approximately five percent is man-made. Approximately 18 million metric tons of ammonia are produced annually in North America alone, and of this amount, less than two percent is used for refrigeration.

Other refrigerants like CO_2, SO_2 also were commonly used till 1920s. Development of CFC's (Chlorofluorocarbons) in 1920s swung the pendulum in favour of these refrigerants, as compared to all other refrigerants used in those days. CFC's were considered harmless and extremely stable chemicals. The consequences to the outer environment of massive releases of refrigerant could not be foreseen in those days. "CFC" refrigerants were promoted as safety refrigerants, resulting in an accelerating demand and CFC's success. These refrigerants became known as God sent and man-made chemicals. Due to success of CFC's, Ammonia came under heavy pressure, but held its position, especially in large industrial installations and food preservation. In 1980's the harmful effects of CFC refrigerants became apparent and it was generally accepted that the CFC refrigerants are contributing to depletion of ozone layer and to global warming, finally resulting in Montreal protocol (1989) where almost all countries agreed to phase out CFC's in a time bound program. In view of seriousness of damage to atmosphere and resulting dangers due to CFC/ HCFC emissions as

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also due to global warming effects, the revisions in Montreal protocol (1990), 1992(Copenhagen) and 1998 Kyoto Japan demanded accelerated phase out schedule. Even HCFC's are also to be phased out and Europe has taken the lead. Ammonia refrigeration has been the backbone of the cold storage and food processing industries since the early 1900s. Ammonia refrigeration is the most cost effective and energy efficient method of processing and storing frozen and unfrozen foods. It is the workhorse for the post-harvest cooling of fruits and vegetables, the cooling of meat, poultry, and fish, refrigeration in the beverage industry, particularly for beer and wine, refrigeration of milk and cheese, and the freezing of ice cream.

Practically all fruits, vegetables, produce and meats, as well as many beverages and juices, pass through at least one facility that uses an ammonia refrigeration system before reaching our homes. Ammonia refrigeration is also used in the chemical industry. Recently, air conditioning provided by ammonia refrigeration systems has found applications on college campuses and office parks, small scale buildings such as convenience stores, and larger office buildings.

These applications have been achieved by using water chillers, ice thermal storage units, and district cooling systems. In Europe, where regulatory regimes have encouraged new applications, ammonia refrigeration systems are used safely for air conditioning in hospitals, public buildings, airports, and hotels. Ammonia is used as a refrigerant because it has several physical properties that make it almost ideal for use in many types of refrigeration systems. It's pressure is very low when evaporated to produce the temperatures needed for refrigeration. It condenses at pressures that are relatively low too. it carries much more heat per pound than most other refrigerants, around twice as efficient as HFC's in this respect. It is non-corrosive to commonly used metals such as steel, stainless steel, aluminum and bronze. It has a pungent odor that is easily detected by the human nose (most people can smell it at around 5 parts per million), leaks are easily detected. It is a completely natural occurring chemical, the human body actually produces several grams per day as a normal. Ammonia has a number of benefits, which has been proven by many decades of application of ammonia refrigeration systems.

Energy Efficiency

Ammonia is one of the most efficient applications out there, with the application range from high to low temperatures. With the ever increasing focus on energy consumption, ammonia systems are a safe and sustainable choice for the future. Typically a flooded ammonia system would be 15-20 % more efficient than a DX R404A counterpart. Recent developments of NH_3 and CO_2 combination contributed to increase the efficiency further. NH_3/CO_2 cascaded is extremely efficient for low and very low temperature applications (below -40'C), while NH_3/CO_2 brine systems are around 20% more efficient than traditional brines.

Environment

Ammonia is the most environmentally friendly refrigerant. It belongs to the group of "natural" refrigerants, and it has both GWP (Global Warming Potential) and ODP (Ozone Depletion Potential) equal to zero.

Safety

Ammonia is a toxic refrigerant, and it is also flammable at certain concentrations. That is why it has to be handled with care, and all ammonia systems have to be designed with safety in mind. At the same time, unlike most other refrigerants, it has a characteristic odor that can be detected by humans even at very low concentrations. That gives a warning sign even in case of minor ammonia leakages. In case it is necessary to reduce ammonia charge, combination of ammonia and CO_2 (as cascade or as brine) could be a good and efficient option.

Smaller Pipe Sizes

In both vapour and liquid phase ammonia requires smaller pipe diameters than most chemical refrigerants.

Better Heat Transfer

Ammonia has better heat transfer properties than most of chemical refrigerants and therefore allow for the use of equipment with a smaller heat transfer area. Thereby plant construction cost will be lower. But as these properties also benefit the thermodynamic efficiency in the system, it also reduces the operating costs of the system.

Refrigerant Price

In many countries the cost of ammonia (per kg) is considerably lower than the cost of HFCs. This advantage is even multiplied by the fact that ammonia has a lower density in liquid phase. Furthermore, as any leakage of ammonia is detected very quickly due to the odour, any potential loss of refrigerant will also be lower.

Properties of Ammonia

Ammonia is a chemical consisting of one atom of nitrogen and three atoms of hydrogen. It is designated in chemical notation as NH_3. Ammonia is extremely soluble in water and is frequently used as a water solution called aqua ammonia. Ammonia chemically combines with water to form ammonium hydroxide. Household ammonia is a diluted water solution containing 5 to 10 percent ammonia. On the other hand, anhydrous (without water) ammonia is essentially pure (over 99 percent) ammonia. Refrigerant grade anhydrous ammonia is a clear, colorless liquid or gas, free from visible impurities. It is at least 99.95 percent pure ammonia. Water cannot have a content above 33 parts per million (ppm) and oil cannot have a content above 2 ppm. Liquid anhydrous ammonia weighs less than water.

About eight gallons of ammonia weighs the same as five gallons of water. Anhydrous ammonia gas is considerably lighter than air and will rise in dry air. However, because of ammonia's high affinity for water, it reacts immediately with the humidity in the air and may remain close to the ground. Anhydrous ammonia is a clear liquid that boils at a temperature of -28°F. In refrigeration systems, the liquid is stored in closed containers under pressure. When the pressure is released, the liquid evaporates rapidly, generally forming an invisible vapor or gas. The rapid evaporation causes the temperature of the liquid to drop until it reaches the normal boiling point of -28°F, a similar effect occurs when water evaporates off the skin, thus cooling it.
This is why ammonia is used in refrigeration systems. Preserving purity of the ammonia is essential to ensure proper function of the refrigeration system.

Impurities can enter the ammonia system

- While charging the system
- Through inadequate evacuation of air from the system prior to charging
- From valve stem packing
- From piping repairs
- From piping leaks
- From the normal breakdown of ammonia

Potential Hazards

- Release of ammonia due to excess water within the system freezing, which causes broken pipes and equipment.
- Ineffective refrigeration due to excess oil within the system, causing the system to work harder than necessary, thus stressing the system components.
- Oxygen levels of more than a few ppm in liquid ammonia or a few thousand ppm in gaseous ammonia can promote stress corrosion cracking in steels.
- This may result in a catastrophic failure of bulk storage vessels.
- This may result in ammonia weeping from a crack within the refrigeration system.
- Stress corrosion cracking proceeds more rapidly at high temperatures.
- Ammonia, especially in the presence of moisture, reacts with and corrodes copper, zinc, and many alloys. Only iron, steel, certain rubbers and plastics, and specific nonferrous alloys resistant to ammonia should be used for fabrications of anhydrous ammonia containers, fittings, and piping. Ammonia will combine with mercury to form a fulminate which is an unstable explosive compound.
- Anhydrous ammonia is classified as nonflammable, however, ammonia vapor in high concentrations (16 to 25 percent by weight in air) will burn. Such concentrations will occur in confined spaces or in the proximity of large spills. The fire hazard from ammonia is increased by the presence of oil or other combustible materials.

Anhydrous ammonia is classified as nonflammable, however, ammonia vapor in high concentrations (16 to 25 percent by weight in air) will burn.

Health Effects

Ammonia is not a poison and repeated exposure to it produces no additive (chronic) effects on the human body. Because water can absorb ammonia so readily, it is a factor that contributes to human toxicity. Ammonia will keep spreading across contacted skin until the chemical is diluted by skin moisture. Therefore, even in small concentrations in the air it can be extremely irritating to the eyes, throat, and breathing passages. Everything from mild irritation to destruction of the eye can occur depending on whether a spray or gas is involved. Ammonia penetrates the eye more rapidly than other alkalis. In the lungs, liquid anhydrous ammonia causes destruction of delicate respiratory tissue. Exposure to ammonia vapor may cause: Convulsive coughing, Difficult or painful breathing, pulmonary congestion and even Death. Decontaminate the victim as quickly as possible. First, flush the eyes with clean water. Then flush the whole body or the exposed area with generous amounts of water; includes the hair, ears, under chin, and armpits. Any water source is acceptable; such as showers, hoses, or stock tanks. Remove contaminated clothing, after careful flushing and warming to prevent the previous problem of skin sticking to the clothing.

Conclusion

By using ammonia, refrigeration can be realized with the least possible energy requirement. In this respect, the endeavors to reduce the global greenhouse effect can also be best supported with this refrigerant.
In comparison to existing old systems, modern ammonia systems are designed for clearly reduced refrigerant charges. They correspond to ideas that do justice to today's environmental awareness. The fears of ammonia's risks, which are for a large part unnecessary, must not lead to exaggerated requirements by supervisory authorities. The consumption of anhydrous ammonia for refrigeration purposes is only a tiny fraction of the amount of ammonia manufactured each year. The amount would be in the order of a fraction of one per cent.
The total amount of ammonia manufactured worldwide each year runs to tens of millions of tonnes, whilst that used in refrigeration would be in the order of tens of thousands of tonnes. The world has been using ammonia as a refrigerant for 150 years; it has proven itself as a star performer from an efficiency, environmental and safety point of view. For these reasons, it can do nothing but grow in popularity into the future. ●

Air Pollution

Insights by Frost & Sullivan

Air pollution has no boundaries. Studies done in the past suggest that pollution, called 'atmospheric brown clouds' emanating from industrial and vehicular sources in China and South Asian countries, is known to travel thousands of miles from Asia to the US. These pollutants, thought to be a local phenomenon, are transported by air currents, high winds and are accelerating climate change globally. As of today, there are many sources of air pollution that damage human lungs causing diseases like asthma and bronchitis. India is currently battling three types of air pollution: Fugitive dust emissions due to construction and infrastructural activity, emissions from vehicles, and pollution from industries. Given that the country is on a growth path, it is imperative to balance economic growth and environmental protection.

In India, pollution from industries is a significant contributor to the overall CO_2, sulphur dioxide (SOX), and nitrogen oxides (NOX) levels. Regulations today are aimed at capturing and controlling Particulate Matter (PM) by installing electrostatic precipitators and bag filters. Other pollutants such as NOX and SOX are not controlled for no regulations. Hence, these pollutants are causing smog and acid rain. Technology to control these is available in the market but neither Government industry is proactive in mandating best available technologies to control these emissions. In India, existing installations of flue gas de-sulphurization systems (FGDS) in thermal power plants to capture SOX is purely done on a voluntary basis but not because of any regulations mandating it. A loophole in our air quality standards is that these norms are calculated and bench marked at ambient air levels over a given area or zone. Hence, when an industry releases pollutants from its smokestack, the emissions are dispersed and diffused over the entire area and appears that, it is within the ambient air quality standards. If there is a human settlement near a thermal power plant, it will certainly affect health and lives. Hence, in reality, it has to be targeted at the plant or facility level so that maximum emissions are captured before release into the atmosphere. In India, transport sector contributes to about 50% of air pollution resulting in exceeding levels of particulate matter and NOX emissions. Currently, Bharat Stage IV vehicles meeting stringent Euro IV emission norms for volatile organic compounds (VOC), carbon monoxide (CO), and NOX are being manufactured and sold in the four metros. But in non-metros and smaller towns, vehicles certified to less stringent Bharat Stage III norms are sold. The Government has to make standards uniform and shift to Bharat Stage IV across India to make our cities breathable and live-able. This will also allow vehicle manufacturers to have one production line for vehicles instead of two. For existing old commercial vehicles, after-market emission control equipment is available to control the diesel particulate emissions. Many technologies such as diesel particulate filters, diesel oxidation catalysts, selective catalytic reduction, exhaust gas recirculation and platinum, palladium and rhodium catalytic converters are present in the market. However, for some of these technologies to perform at their stated efficiency, sulphur content in diesel and petrol has to be brought down. This will entail massive investments by oil refining companies to produce low-sulphur diesel and petrol, ramp up distribution network, and prevent mixing or contamination of low sulphur with high-sulphur fuel.

Pollutant	Measurement
Carbon Dioxide	1.88 billion tons
Sulphur Dioxide	6.95 million tons
Nitrogen Oxides	7.9 million tons
Particulate Matter	9.93 million tons

Exhibit 1: Levels of Pollutants in India, 2013

Source: Frost & Sullivan analysis

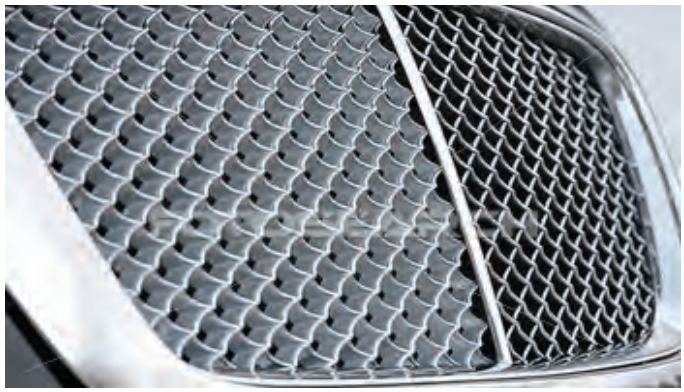
In order to reduce air pollution in the country, the Government should look into-

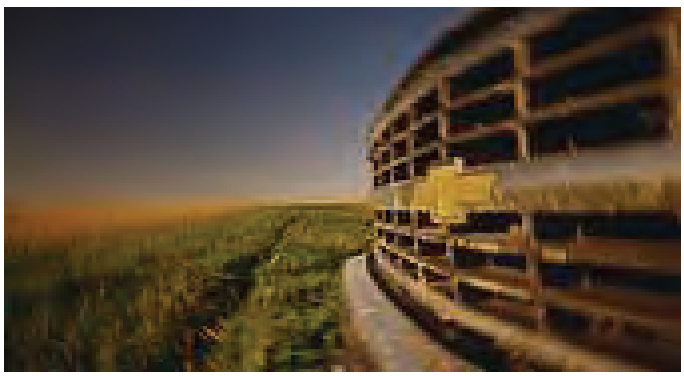
- Creating attainment and non-attainment districts/ zones across India - Freeze funding to states/districts if they exceed the national ambient air quality standards. It is followed by the EPA, U.S.
- Implementing standards for VOC, mercury, and SOX emissions in industrial sector, in thermal power plants.
- Removing vehicles (passenger or commercial) older than 20 years from the road through a vehicle buy-back program. Owners can avail tax rebate if they surrender their old pollutant spewing vehicles.
- Bringing in regulations to manufacture and sell only low-sulphur diesel in India.
- Working with schools that ply buses to shift to newer bus models or install after-market emission control systems.
- Engaging with auto-rickshaw unions to urge them to shift to CNG powered autos.
- Moving to Bharat Stage V norms for new passenger and commercial vehicles.
- Working with oil refiners, vehicle manufacturers, industrial and vehicular air pollution equipment manufacturers, and public to roll out the air quality improvement road map.

Courtesy:
Sasidhar Chidanamarri, Industry Manager, Environment & Building Technologies Practice, Frost & Sullivan.

Nanofluids
as Coolant in Radiator

With increase of power of various electronic components, good attempts have been made to enhance the heat transfer of those components. The use of metallic particle in base fluid is one approach to improve heat transfer rate. In recent years, the advances in manufacturing technology have caused the production of nanoparticles.





Chandan kumar is a research assistant at Army Institute of technology, pune. He has presented three paper in international conference and has published 1 journal national level paper.

Dr. P B Karandikar, PhD and ME is working as an Associate professor in Army Institute of Technology, Pune. He is associated with Bharati Vidyapeeth Deemed University, Collage of Engineering Pune as adjunct professor. He published 55 papers & one text book. He acquired three Indian patents.

The term 'nanofluids' refers to a two-phase mixture where the continuous phase is usually a liquid and the dispersed phase is composed of extremely fine metallic particles of size usually around 50 nm, called 'nanoparticles'. Nature is full of nanofluids, like blood, a complex biological nanofluid where different nanoparticles accomplish different functions, and functional components actively respond to their local environment. According to SciFinder Scholar, in 2008 alone 189 nanofluids-related publications journal articles and patents appeared as shown in Fig. 1 and it is estimated that more than 300 research groups and companies are engaged in nanofluids research worldwide.

According to the types of liquids (organic and inorganic) and kinds of nanoparticles, one can get different types of nanofluids like process extraction nanofluids, environmental (pollution-controlling nanofluids), bio-, and pharmaceutical nanofluids. A new class of polymer nanofluids, drag-reducing nanofluids, aims at enhanced heat transfer, as well as, flow friction reduction. A wide range of active self-assembly mechanisms for nanoscale structures start from

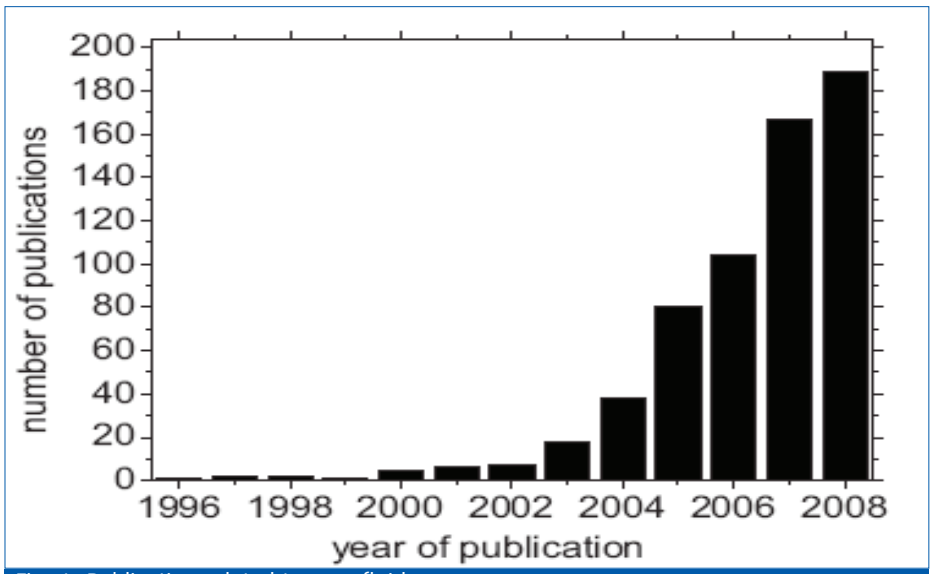


Fig. 1: Publication related to nanofluids

a suspension of nanoparticles in fluid. Addition of nanoparticles in liquid remarkably enhances energy transport process of the base liquid.

Nanofluid have some unique features that are quite different from conventional two-phase flow mixtures in which mm and/or mm particles are suspended Many researchers experimentally showed nanofluids have higher thermal conductivity than those of the base fluids and a lot of correlations have obtained. Recently, more attention has been paid to the convective heat transfer performance of nanofluids, due to the recognition that in practical applications nanofluids are likely to be used as heat transfer fluids in flowing systems, such as microchannel or minichannel heat sinks.

Three properties that make nanofluids promising coolants are increased thermal conductivity, increased single-phase heat transfer and increased critical heat flux.

Beneficial features of nanofluids:

- Enhancement of heat conduction
  Nanofluids demonstrate high thermal conductivity due to large surface area of nanoparticles per unit volume. It's small size lead to high mobility providing micro convection for further heat transfer.
- Eliminates clogging.
  Nanoparticles are about 1 ~ 100 nm in diameter and thousands in number as well as well-dispersed in nanofluids, so that they will not causing any clogging problem. It is used in microchannels, which promote the heat transfer rate.
- Stability of nanofluids
  Nanofluids are highly stable because of its small size. It can stay in liquid for year without sedimentation.
- Reduction in pump power
  Nanofluids have high thermal conductivity due to high specific surface area. Increasing the heat transfer by two folds pump power is increased by ten folds. Nanofluids have already high thermal conductivity so mixing it with conventional fluid will reduce the large amount of pumping power.
  Factors that could also contribute to the enhancement of the thermal conductivity are the ordered structure of the liquid at the solid-liquid interfaces, the interfacial resistance, Brownian motion of the nanoparticles enabling the formation of loosely packed clusters and convection-like effects at the nanoscale.

Use of Nanofluids in Radiator

All automobiles today have a type of heat exchanger called a radiator. The radiator is part of the cooling system of the engine and is a very important part of the vehicle which cools the circulated water going through engine shown in Fig. 2.

Design compact cooling system with smaller and lighter radiators will increase the overall efficiency of the vehicle. Increasing the heat transfer or cooling the water faster the area of radiator should be more as

$Q = h.A.\Delta T$.

Higher the value of A higher is heat transfer for a limited thermal conducting material. Nanofluids

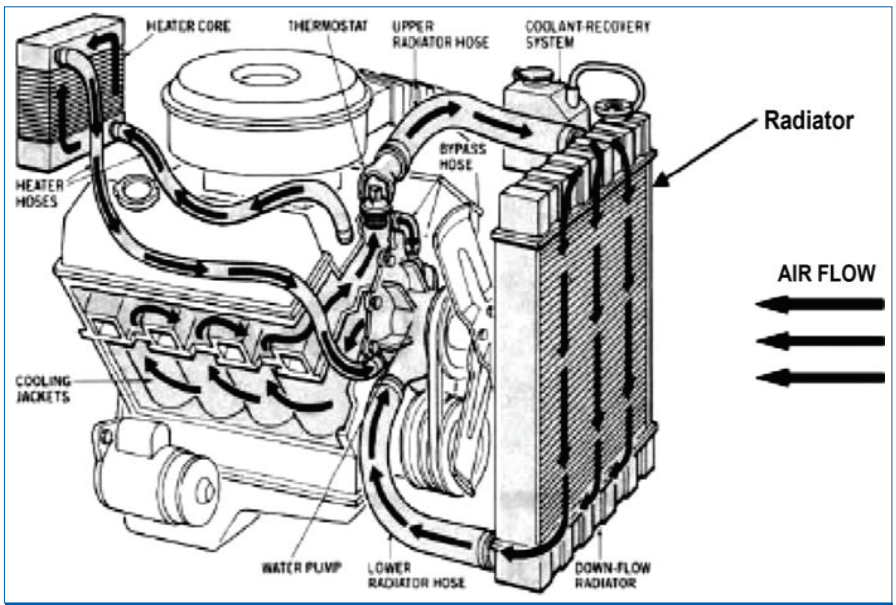


Fig. 2: General vehicle radiator

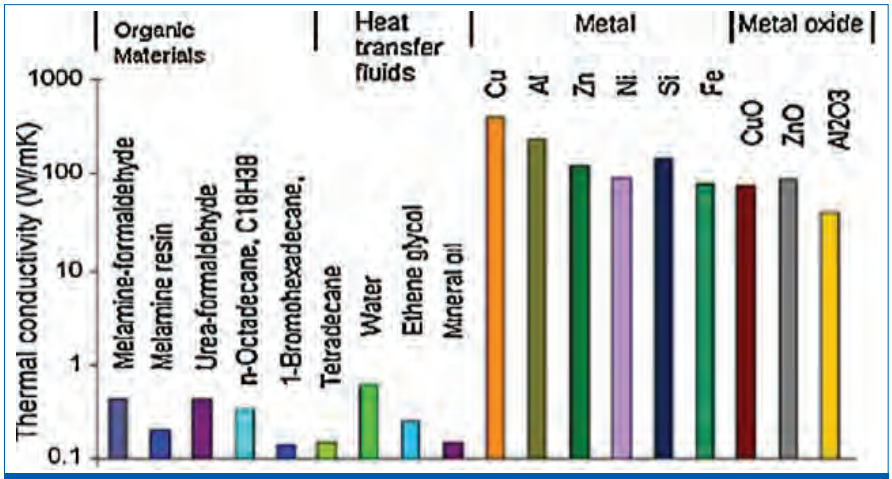


Fig. 3: Comparison of the thermal conductivity of common liquids, polymers and solids

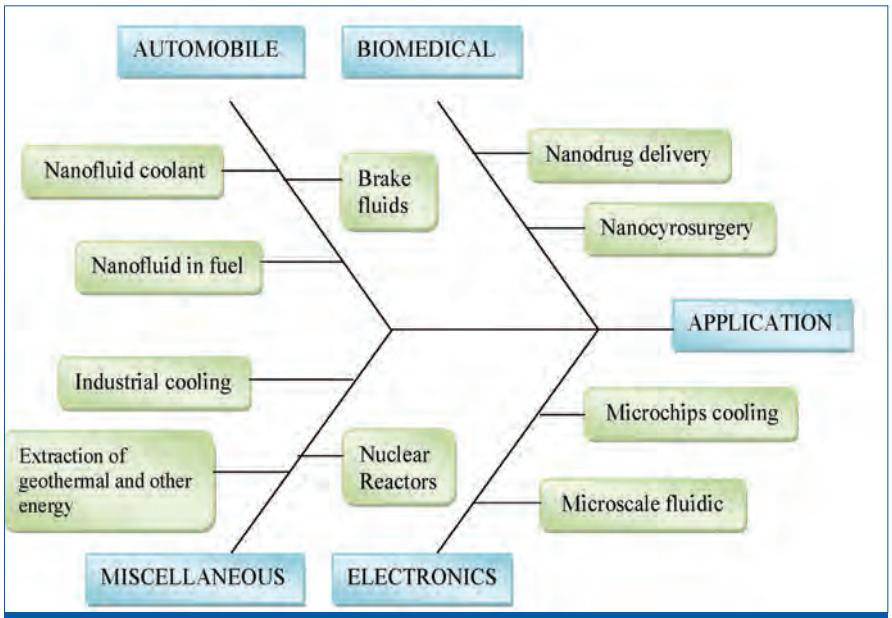


Fig. 4: Application of nanofluids

have high thermal conductivity as compared to other heat transfer fluids as shown in Fig. 3.

This factor can reduce the overall size of radiator. Nanofluids have application in many fields can depicted by Fig. 4. Singh et al. determined that the use of high-thermal conductive nanofluids in radiators can lead to a reduction in the area of the radiator by up to 10%.

This reduces the aerodynamic drag which can lead to a fuel savings of up to 5%. J sarkar et al studied the effect of nanofluids in radiator and done the mathematical modeling. He studied the variation of cooling capacity and effectiveness with air mass flow rate keeping constant average values for other input. He found that cooling capacity and effectiveness of nanofluids having base fluid of 80% water - 20% EG is much higher as compared to 80% water-20% EG mixture only.

Choi et al. showed that nanofluids have the potential of being recognized as a new generation of coolants for vehicle thermal management due to their significantly higher thermal conductivities than the base fluids.

The heat rejection requirements of automobiles and trucks are continually increasing due to trends toward more power output. Transformer cooling is important to the Navy as well as the power generation industry with the objective of reducing transformer size and weight. By improving aerodynamic designs of vehicles much amount of fuel can saved by reducing the amount of energy which is required to overcome wind resistance on the road.

At high speeds, approximately 65% of the total energy output from a truck is expended in overcoming the aerodynamic drag. This is partly due to the position of large radiator in front of the engine to maximize the cooling effect of oncoming air. After the use of nanofluids as coolants it becomes easy to get smaller size and better positioning of the radiators.

It is predicted that the next generation of computer chips will produce localized heat flux over 10MW/m^2, with the total power exceeding 300 W.

In combination with thin film evaporation, the nanofluids oscillating heat pipe cooling system will be able to remove heat fluxes over 10 MW/m^2 and serve as the next generation cooling device that will be able to handle the heat dissipation coming from new technology.

Conclusion

This article has given brief overview of the concept of "Nanofluids" followed by an account on the detailed research activities carried out around the world. The review focus is mainly on engineering application parameters, such as thermal conductivity and viscosity etc, without giving much emphasis on the theoretical aspects. In most cases anomalous behavior of heat transfer enhancement in nanofluids was observed.

Nanofluids have also been demonstrated for use as smart fluids. Problems of nanoparticle agglomeration, settling, and erosion potential all need to be examined in detail in the applications. It requires a deep and thorough study of nanofluids behavior for its selection in various applications. ●

Series of 'Climate Connect' Programs in India initiated by Emerson

Emerson Climate Technologies, the leading provider of HVACR solutions, has initiated a series of "Emerson Climate Connect" programs in India, keeping with company's commitment to focus on the unique and changing needs of India's HVACR industry. The programs tackle the pressing challenges the HVACR industry is facing today – which include developing and marketing energy efficient products while ensuring manufacturing costs do not shoot up inappropriately. The first two events from the series were held on March 14 at Chennai and March 21, 2014 at Bengaluru, sparking considerable interest. A galaxy of Emerson's OEM partners participated in the event. These included Blue Star, Climaveneta, Emerson Network Power, Hitachi, Ingersoll Rand, Mech World Eco and Swegon Blue Box. A host of HVACR industry professionals, including Architects, Estate Developers, Consultants and Institutional customers were present at these meets. Sridar Narayanswami, Vice President & Managing Director, Emerson Climate Technologies (India) Ltd said, "Globally, manufacturers are looking at optimizing costs and providing services more effectively. India market is no different. We are continually striving to develop more and more energy efficient solutions, while ensuring that our offerings are tailored for the unique requirements of the Indian industry. We are positioned just right in the industry currently with a perfect mix of a wide range of solutions and a great set of partners". The programs elaborated on the various environmental and energy challenges facing HVACR industry in India today. Highlight of the event was showcase of the entire range of Emerson Climate Technologies' products for various air-conditioning applications, for the benefit of the industry. The showcase included the Modulated Systems developed for commercial air-conditioning systems with VRF, Precision AC and Chillers. The program included a discussion on the increasing success of commercial airconditioning systems using Multi-scroll Chillers in European markets due to its superior energy efficiency performance and other benefits. Also, on the agenda was use of Heat Pumps for Water Heating & Cooling and its environmental and energy efficiency benefits. Detailed case studies demonstrating heat pumps usage at a hotel and on the campus of an IT major made the discussion interactive. The response of the industry to the two programs has been very encouraging. 'Emerson Climate Connect' series has similar programs planned in various other cities across India. ●

Industrial Cooling - EMERGING MARKET

In today's era of global warming, the average temperature are on the rise and summers are getting hotter every year, that leaves the people with no choice but to resort to some or the other cooling solutions including fans, air coolers or air conditioners for some comfort depending upon their requirement and budget.

For country such as India which is struggling with huge power deficit and where power cuts across the country is much more evident, air conditioning is certainly not the only solution for cooling need of the across the board from home to offices and commercial spaces to malls and air ports and neither economically feasible. Tomorrow's world needs environment-friendly, energy conserving solutions and products. With increased global warming and environmental degradation, people around the world recognize that businesses must act responsibly and offer green products to customers.

Air coolers is the best solution that comes to mind in the current situation, which is not only a green product and environment friendly as it consumes almost one tenth of the electricity as compared to air conditioners. Also unlike air conditioners, which release CFC gas, air coolers do not emit hazardous greenhouse gases responsible for global warming and other environment-related problems. Further with our environment continuously undergoing changes we need to constantly upgrade our structural designs and technology, incorporating excellent practices that result in environment protection, water conservation, energy efficiency with thoughtful use of natural resources while maintaining healthy indoor environment.

Symphony Ltd is one company that enables people across the World to capitalise on eco–friendly, energy-saving air cooling technologies as serious alternative to high energy consuming and not so eco-friendly air-conditioners. Symphony Ltd provides air cooling solutions for residential and industrial segment

Achal Bakeri,
Chairman & Managing Director,
Symphony Limited.

offering advanced, energy efficient cooling and humidification solutions. Having established a leadership position in the home air cooler segment, the company is all set to provide air cooling and humidification solution for industrial and commercial units.

Symphony pioneered branded air coolers in India by launching India's first branded air cooler in the year 1989 and since than it has never looked back. The air cooler industry today is estimated to be around Rs 2,500 crore in which Symphony commands 50% market share among organised players.

The uniqueness of Symphony Ltd is that it is the only company which is focused on 'Air coolers'. The strategy here has been 'One Product Many Markets' and over the years this strategy has paid off well and company today is world's largest air cooler company and truly an international brand selling its air coolers under its own brand name in over 60 countries.

Not only this, Symphony Ltd has continuously evolved its product portfolio to infuse freshness among channel partners and customers. The Company has created a basket of over a dozen air coolers in the residential segment with wide variety, created niche segments (Diet Cooler, Desert Coolers, Personal Coolers and Room Coolers) and enhanced product features (power saver technology, space saver range, four-side cooling, humidity control and fully functional remote operability). In the current summer season company has launched India's first branded 'Window Range' of air coolers to strengthen its product range in residential air coolers.

Symphony possesses largest number of trademarks and registered designs in the international air cooler industry with 108 trademarks, 49 registered designs, 7 copyrights and 8 patents. The company has been awarded Guinness World Record for creating the world's largest functioning air coolers.

At Symphony Ltd, design-driven innovation and green engineering is a sustainable competitive advantage. Symphony Ltd is an ISO 9001 certified company has earned various prestigious certifications such as European Conformity, Norma Official Mexicana, German Safety of Equipment etc.

Technology: Evaporative Cooling

Among all air cooling techniques evaporative cooling is most natural as well as environment friendly. It constantly provides natural, cool, clean, fresh and filtered air. Uses 100% air from outside and provides a complete change of air every few minutes.

Air Coolers vs Air Conditioners

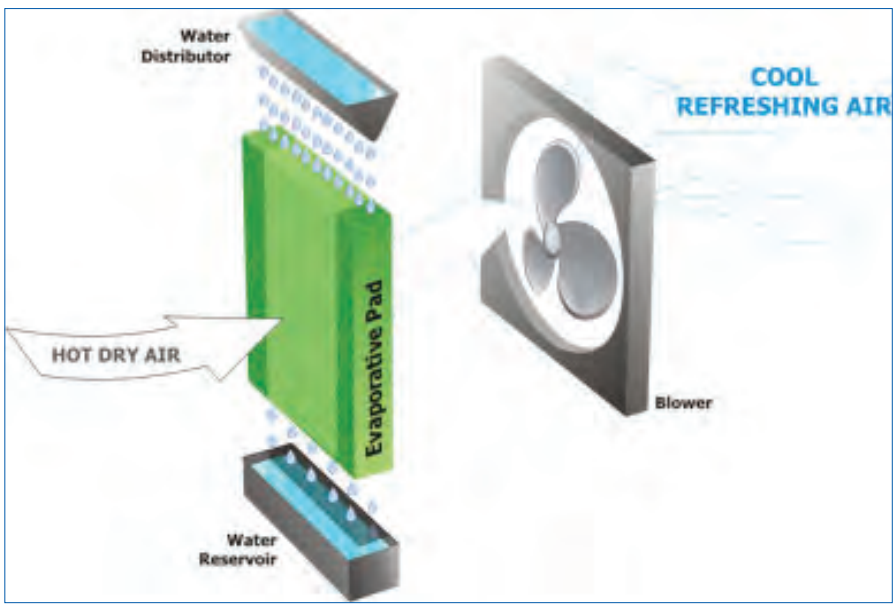
Air coolers use fresh, clean air from the environment. They also allow you to keep windows open for better air circulation whereas ACs circulate stale air inside a sealed room.

- **Green Product:** Air coolers are green product and unlike air conditioners, air coolers do not emit hazardous greenhouse gases responsible for global warming and other environment-related problems.
- **Energy-efficient:** Further air coolers consume up to 10 times less energy than ACs. They can also work in low voltage areas.
- **Low on Maintenance:** Air coolers require low maintenance; you rarely need to summon a mechanic for maintenance as in the case of ACs.
- **Environmental Friendly:** Air coolers present significant environmental benefits with no harmful Chlorofluorocarbons (CFC) emissions and offer energy saving green cooling solutions.

Symphony: Leading organised player in Industrial cooling

Industrial coolers are comprehensive cooling solutions, addressing cooling needs for large enclosed areas, factories, warehouses, retail chains, banquet halls, auditoriums, etc. Industrial cooling is gaining increasing importance as corporate houses are looking to create a congenial working environment for their shop floor teams. Large and small factories are the most pertinent examples as corporate houses can ill-afford centralised air conditioning due to open-air areas as well as prohibitive capital and operating costs.

In earlier years due to lack of awareness and non-availability of the air cooling solutions for industrial undertaking, the penetration was low but it is improving rapidly. Further looking at the size of Indian market and growth potential we can say the segment has immense opportunities in years to come. The market for industrial coolers in India is huge and growing



Recent trend indicates that big businesses across various sectors are opting for industrial cooling for spaces which are difficult to centrally air condition.

rapidly. Recent trend indicates that big businesses across various sectors are opting for industrial cooling for spaces which are difficult to centrally air condition. The installation of AC system in these areas may not be feasible or is a huge capital and operational expense. By providing better working condition to employees one can create a safer and more productive working environment. Cooler staff is more alert, efficient and productive. Cooler machines last longer and can produce more.

Symphony is at a nascent stage in industrial cooling segment but going forward, increased focus on strengthening product awareness and the corporate brand in domestic and international markets for this product are expected to generate sizeable volumes over the medium-term. The Company has a decent project pipeline, which provides assurance of a healthy business growth. Our expertise in large metal Air Coolers and central air cooling provides us with the capability to implement large scale industrial cooling solutions for a large number of industrial customers in India. The company believes that the market for centralized Air Coolers is larger than for centralized air conditioning systems. Symphony strengthened its leadership team, widened its distribution network, and collaborated with many large opinion-driving HVAC consultants and large nationally renowned HVAC contractors for industrial cooling solutions.

Expanding its presence in Indian industrial and commercial cooling market, company has completed many prestigious installations of central air cooling systems in last 12 months. Symphony Ltd has completed installation of central air cooling systems for renowned clients, namely Asian Paints, DHL, Dixon Technologies, Swaminarayan Temple, ISKCON Temple, Marico in India and Walmart, GE, Prestolite, Lear Corporation, among others. Company's clientele includes leading Textile, Auto, FMCG, Healthcare, Retail & Hospitality, Engineering, Logistics & Warehousing, Chemical, Consumer Durable companies among many others. Affordability and low maintains cost of Industrial air coolers also likely to play a big role in growth momentum for the segment in coming years. Industrial air coolers are attractively priced, for a large residential house (approximately 2,000 to 3,000 sq ft) investment for cooler ranges between Rs 1 to Rs 2.5 lakh - about one-third, or 40% of investment required for centralised air conditioning.

Electric consumption of central air cooling system is only about 10% of the consumption of centralised air-conditioning. In other words, payback period from centralised air cooling is less than one year, just from saving of electricity of air cooler vis-a-vis airconditioner.

Retail is one big potential industry for the industrial cooling solution in India. Indian retail industry has expanded by 10.6% between 2010 and 2012 and is expected to increase to US$ 750-850 billion by 2015, according to another report by Deloitte, hence it offers tremendous growth opportunity for central air cooling in years to come.

Growth drivers of Industrial cooling:

- Firstly, it is proven that better work condition has helped increase productivity considerably. Same is supported by a NASA report which stated that at 38 degrees temperature, there is a 62% loss of work output and at 41 degrees, it goes up to 79%. Hence, there is an immense potential for industrial air cooling in India, wherever air conditioning is just not feasible.
- Further shifting to air cooling for commercial and offices, retail and hospitality industry over air conditioning has helped big time in saving costs to the companies as air coolers use 90% less energy than an air conditioner does.
- Industrial cooling also provides solutions to air cool segments such as airports, malls, retail chains, factories, banquet halls, which are difficult and very expensive to air conditioned.
- For certain factories, centralised cooling becomes mandatory due to operational process or product characteristics like textile applications, certain dyes and intermediates and certain chemicals, industrial coolers emerge as the most cost-effective solution.
- In factories that house large boilers, large furnaces and other equipments, that generate lot of heat. Air cooling emerges as the only cooling solution in these areas. Air coolers also find application in warehouses that need to store material at controlled temperatures. In large commercial space and retail malls which have expansive open areas, industrial air coolers are the only workable cooling solution. Interestingly, wherever central air conditioning is used, there is potential even of using central air cooling or ducted air coolers.

Industrial High Performance Premium Coolers:

Symphony's latest technology high capacity evaporative coolers are designed for maximum cooling with minimal energy consumption. Each industrial High-performance Premium Cooler is capable of providing very high air volume, and can withstand static pressure up to 2 inches.

Symphony High-performance Premium Coolers are second-to-none in performance and cooling capacity and ideal for use in large factories, warehouses, agri-businesses, and other applications that require industrial-grade evaporative cooling solutions. ●

Energy Saving Opportunities in Outdoor Unit

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

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

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

up with dust.

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

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

Measures to Improve Specific energy consumption

With regular maintenance of these outdoor units, the Specific Energy consumption of the system can be easily maintained at 1.3 kW/TR. The scenario would be as below.

Sr. No.	Designed Capacity TR	Load TR	Compressor Power, kW	Specific Energy Consumption, kW/TR	Reduction in Energy Consumption (%)
1	22	12.8	16.7	1.3	20
2	22	9.7	12.6	1.3	11
3	22	10.9	14.2	1.3	08
4	22	9.5	12.3	1.3	13

Using Evaporative Pre-Cooler

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

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

shall reduce the specific energy consumption to 1.0 kW/TR. The Scenario would be as above. ●

Sustainable Pipe Joining Explained:

Mechanical Grooved Systems and Increased Efficiency

Grooved piping systems have a union at every joint for easy re-routing during system expansion"

Sustainable design should involve more than just site orientation and energy saving construction techniques. What goes into a building in the way of infrastructure is equally important. Well planned HVAC, plumbing and other mechanical engineering systems are essential to making a building sustainable throughout its life cycle.

Pankaj Soni
Victaulic Country Manager, India.

Mechanical piping systems are increasingly used in India on HVAC, fire protection and a range of commercial and industrial applications due to the time and cost savings associated with installation. They are an effective alternative to welding and flanging for potable water distribution, equipment connections on pumps, water softeners and filters as well as drain, waste and vent piping, and other industrial applications.

Mechanical pipe joining systems employ a proven grooving process to join pipes, valves and other components. Using a two-bolt coupling design, pipe fitters can

make rugged, secure joints quickly and easily using only basic hand tools. And with a union at every joint, contractors have maximum field flexibility for on-site decision making. All couplings are sealed for optimum integrity with a durable elastomeric gasket designed to withstand years of sustained high compressive and cyclical loads.

Grooved pipe joining technology is rooted in sustainability; its inherent qualities naturally make it environmentally friendly. Even before the evolution of green building the grooved piping system has been providing a more efficient, cleaner and safer system when compared with other pipe joining methods, such as welding, soldering or brazing.

Reducing the need for welding, soldering or brazing means better air quality, less particulate matter released into the atmosphere and decreased fire risk. There also is less material waste, reducing site impact. Indoor and outdoor-air quality is preserved because there are no fumes or particulate matter to endanger workers or the environment.

Reduction in On-site Waste

During installation, mechanical grooved piping systems significantly reduce or eliminate waste, emissions and noise pollution on the jobsite providing a safer and healthier environment.

The reduced need for soldering lowers emissions on the job site. By-products of solder fumes can contain lead oxide, carbon monoxide, V.O.C. (volatile organic compounds) and hydrochloric acid in addition to many other harmful particles and gases.

A grooved mechanical pipe joint does not require the use of electricity during installation, reducing the draw on burdened power resources. Pipes that are joined by welding or soldering require the use of vast amounts of electricity for prolonged periods of time, consuming up to 4000 watts of energy per hour on a 200 mm (DN200) joint. The installation of a grooved mechanical joint is cleaner than soldered joints, and therefore reduces on-site job waste. Unlike soldering and brazing methods, grooved mechanical joints do not require flux to seal the joint, which must be flushed and cleaned from the system prior to operation.

Additionally, soldered systems often require as much as 35 percent re-work for failures discovered when pressurizing and testing the completed system, which requires additional resources.

For instance, Victaulic grooved mechanical pipe joints can be visually inspected for proper installation so re-work is minimal, saving energy, resources and time on the job. And grooved systems generally are easier to align and rotate.

Future of Building

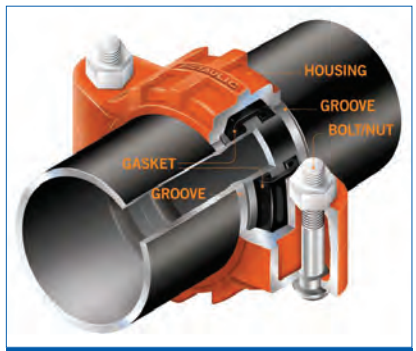
Energy costs typically represent 30 percent of a building's annual budget and are the single largest operating cost (Energy Star). The Energy Systems Lab at Texas A&M University indicated that energy use in buildings could be reduced from 10 to 40 percent by improving operational strategies in buildings, including maintenance strategies. Less deferred maintenance means a higher level of energy efficiency.

With welded and flanged piping systems, accessing valves, strainers, pumps and water softeners is often a time-consuming and inconvenient process due to system shutdown and drainage. The more difficult the process the more likely the maintenance will be deferred. Mechanical pipe joining systems provide an optimal way to effectively maintain piping systems in structures, thereby reducing the deferral of maintenance and promoting operating efficiency and saving money.

Their ease of installation and ability to disassemble and reinstall the same components make them a simple solution for the frequent performance of both routine and unscheduled maintenance. For access to a grooved piping system, a maintenance person simply loosens the two coupling bolts. Less deferred maintenance means peak energy efficiency and operation of buildings, and reduced overall costs. Repairs for equipment and buildings that have not been well-maintained are often far higher than the estimated maintenance costs.

Given the busy agendas and budget constraints in India today, it is easy to see why familiar procedures are replicated. But in reality, tried and tested alternatives to traditional pipe joining techniques can have huge impact on both the immediate and future economic and sustainability returns. ●

Flame free installation of mechanical pipe joints are inherently safer and easier to work with leading to safer jobsites for workers and less impact on the environment



The anatomy of a grooved mechanical pipe joint

Optimising Radiant Cooling Applications

Radiant cooling refers to a temperature-controlled surface that cools indoor temperatures by removing sensible heat through thermal radiation, ensuring comfort for the users of the cooled space. This article looks at how radiant cooling works and how to configure a radiant cooling system and it gives an example of an optimal variable primary pumping radiant cooling system.

Srinivasa Rajkumar,
Application Manager,
Grundfos Pumps, India.

Radiant cooling systems are usually hydronic cooling using circulating water running in pipes in thermal contact with the surface. Water is a better heating and cooling transfer agent than air. Air requires a much larger volume to transport the same amount of heating and cooling capacity.

Chilled water which is just 2-4 °C (36–39 °F) below the desired indoor air temperature is circulated through pipes either buried under the floor or in the ceiling. Heat is removed by the water flowing in hydronic circuit once the heat from different sources are absorbed by the actively cooled surface – ceiling, floor or walls. The latent loads (humidity) from occupants, infiltration and processes generally need to be managed by an independent system.

Sensible Cooling

Space cooling requires sensible and latent cooling. Sensible cooling involves reduction in temperature whereas latent cooling involves removal of humidity from air.

The figures above show the benefits of the cooling required to reduce the temperature of water without condensation. This shows two clear advantages of radiant cooling:

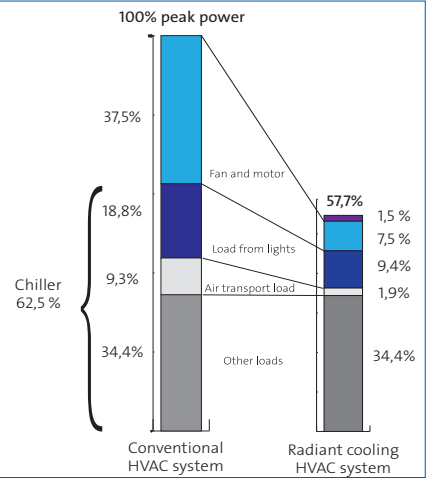
- The chiller output can be 16 °C (61 °F) instead of the expected 7 °C (45 °F). This offers an immediate reduction in energy required.
- Less energy is required to transport water than air.

How Radiant Heat Transfer Works

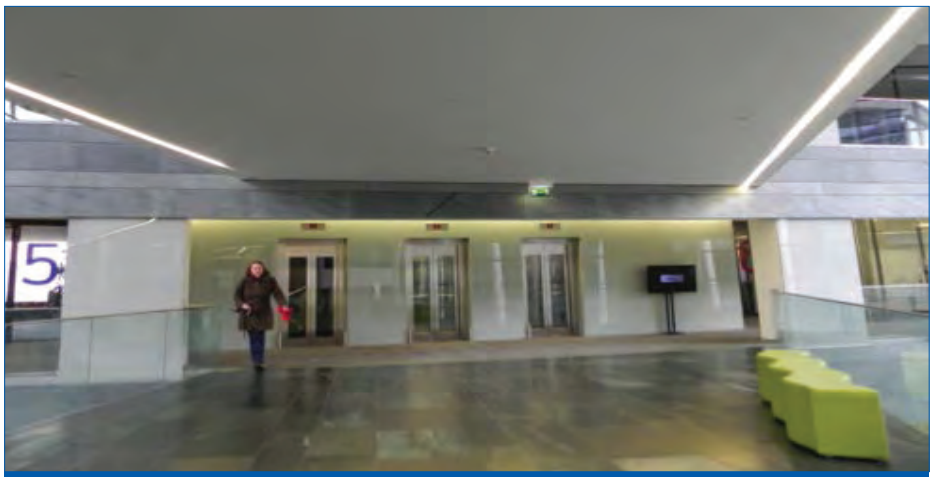
Heat will flow from objects, occupants, equipment and lights in an area to a cooled surface, as long as their temperatures are warmer than that of the cooled surface, and they are within the line of sight of the cooled surface.

The process of radiant exchange has a negligible effect on air temperature, but through the process of convection, the air temperature will be lowered when air comes in contact with the cooled surface.

Air	
Specific head capacity	1 kJ/kgK
Specific volume	1.25 Kg/m³
Heat transfer of one m³	**1.25 kJ/K**
Water	
Specific head capacity	4.2 kJ/kgK
Specific volume	1000 kg/m³
Heat transfer of one m³	**4200 kJ/K**



Laying of PEX chilled water pipes. Pipes are fastened to the steel reinforcement net before the concrete is casted.



Example of a chilled gypsum board ceiling. Here chilled water pipes are fastened on the backside of the boards. The ceiling's surface temperature must not be lower than the air dew point in the room.

Condensation caused by humidity is a limiting factor for the cooling capacity of a radiant cooling system; the surface temperature should not be equal to or below the dew point temperature in the chilled zone. For example, an air temperature of 26 °C (79 °F) at a relative humidity of 60 % would mean a dew point of 18 °C (64 °F). Decreasing the surface temperature to below the dew point temperature for a short period of time may not cause condensation. Also, the use of an additional system, such as a dehumidifier, can limit humidity and allow increased cooling capacity.

Types of Radiant Systems

Chilled Slabs

Chilled slabs are delivering cooling through the building structure, usually slabs, and are also known as thermally activated building systems (TABS). In TABS, water pipes are integrated into a concrete slab or a screed in the surface of a floor or a ceiling during construction.

Water inlet temperature is usually around 14-18 °C (57-64 °F) and therefore the surface temperature is 17-21 °C (63-70 °F) Cooling delivered through the floor makes the most sense when there is a high amount of solar gains from sun penetration, as the cool floor can more easily remove those loads than the ceiling. Chilled slabs, compared to panels, offer more significant thermal mass and therefore they can take better advantage of outside temperature swings. Chilled slabs cost less per unit of surface area, and are more integrated with the structure.

Chilled ceilings

Chilled Ceilings are an alternative to Chilled Slabs and are typically used when:

- Ceiling cooling needs to be implemented in an existing building
- Cooling needs to be controlled by using zones

There are different ways chilled ceilings can be implemented. Pipes or mats can be embedded in gypsum plaster or cement plaster in the ceiling. Alternatively, they can be embedded in gypsum board ceilings. For better performance of chilled ceilings, thermally conductive boards are also available.

A steel chilled ceiling panel seen from the backside. The chilled water pipes are glued directly onto the panel for ensuring conduction between pipe and panel. Copytight www. durlum.de

Cooling panel

Radiant cooling panels in commercial buildings are usually directly integrated with continuous dropped ceilings. Modular construction offers increased flexibility in terms of placement and integration with lighting or other electrical systems.

Chilled panels are also better suited to buildings with spaces who have a greater variance in cooling loads. Perforated panels also offer better acoustic dampening than chilled slabs. Ceiling panels are very suitable for retrofits as they can be attached to any ceiling.

Chilled ceiling panels can easily be integrated with ventilation supplied from the ceiling. Ceiling panels tend to cost more per unit of surface area than chilled slabs.

Chilled water distribution

From chillers, branch headers are separated to feed individual building loops. Each individual floor plate or installation will be connected to manifolds which further distribute to the PEX pipes either buried or fitted on to the ceiling. Each pipe has fixed spacing between them to ensure proper heat transfer to the adjoining thermal mass. Temperature regulation of the supply of chilled water needs to be done as follows:

- To avoid condensation on pipes and surfaces, the supply temperature should be maintained above the dew point temperature of the conditioned area.
- In case of varying dew point temperature in the conditioned area, the chilled water temperature should also be variable in accordance with the dew point temperature with a temperature off-set of for example 2° C (4 °F).
- In case of rapid and short dew point temperature changes (for example by undesired opening of a window), it is possible to shut off the chilled water supply.

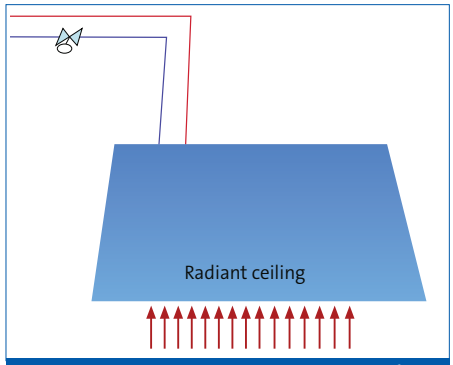
Controlling water flow and temperature

2 port valve control

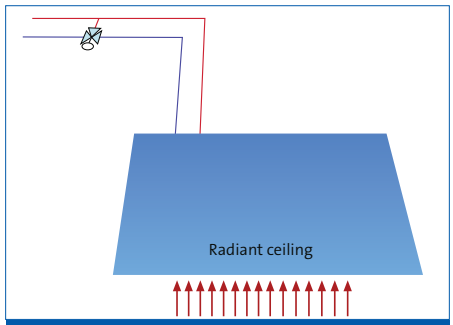
Traditionally, room air temperature is controlled by modulating the water flow rate using a 2 port valve with an on/off actuator.

A 2 port valve allows a variable flow approach to the system, which will save on pumping costs. With a 2 port valve the water temperature has to be controlled by a central mixing loop, covering more zones, or by adjusting the chiller water leaving temperature.

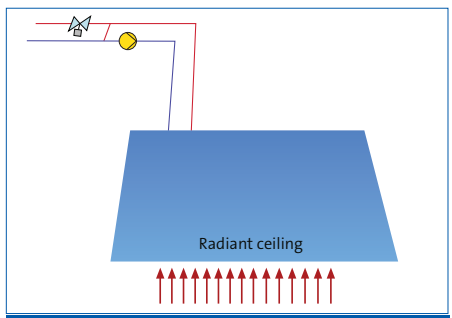
Water flow rates are adjusted using balancing valves in each zone and/or sub zone.



A steel chilled ceiling panel seen from the backside. The chilled water pipes are glued directly onto the panel for ensuring conduction between pipe and panel. Copytight www. durlum.de



A radiant ceiling controlled by a 3 port valve. This allows a variable flow in the radiant circuit ensuring improved and smoother performance. The drawback of this control is that water temperature cannot be controlled locally at the conditioned space and the primary side is a constant flow system.



A radiant ceiling zone supplied from a mixing loop. With a mixing loop both water temperature and flow can be adjusted according to the actual need.

3 port valve control

A more advanced system for controlling water flow rates is a 3 port control valve for each chilled ceiling loop. The benefits of this advanced system are better control of the system and reduced costs for commissioning. This is a typical approach in systems designed for constant flow on the primary side. A

drawback is that this system does not allow primary pumping energy savings and nor can the flow temperature be adjusted locally.

Mixing loop control

Mixing loop is the superior approach for control of radiant ceilings. Here flow rate and temperature can be adjusted according to the desired performance of the radiant ceiling. Also mixing loops allows for variable flow on both the primary and secondary side, which ensures reduced pumping costs.

How to Serve Latent Loads in a Radiant Cooling System

Radiant cooling systems can only cater to sensible cooling loads in the conditioned area. To ensure comfort for occupants both sensible and latent loads have to be satisfied. For this Dedicated Outdoor Air Systems (DOAS) are installed in parallel to Thermally Active Building Systems (TABS) or Radiant Celling panels. A dedicated outdoor air system uses a separate unit to condition all of the outdoor air brought into the building for ventilation. Then it is delivered directly to each occupied space or to the individual local units or air handlers serving those spaces.

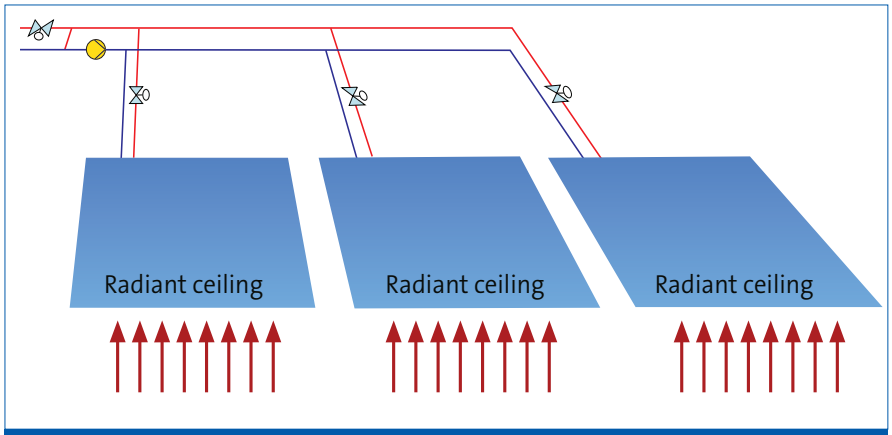
How Does DOAS Work?

Outdoor air (OA) is preconditioned with an enthalpy wheel, using room return air (RA) cooling the outdoor air. The heat recovery and dehumidification efficiency of an enthalpy wheel can be as high as 90 %. If further air cooling or dehumidification is needed, a cooling coil is used. The supply air temperature leaving the cooling coil is controlled. The cold and dry 100 % outdoor ventilation supply air is delivered to the space via high induction overhead diffusers. The dew-point temperature for the area is maintained low enough for the radiant panel to never form condensation when radiant cooling is used to meet the balance of the space sensible cooling load. A 3-way control valve is modulated as necessary to meet the space dry bulb temperature set point, limited by space dew point temperature. The room return air temperature (RA) and relative humidity are used to compute the space dew point temperature.

Advantages of Zoning

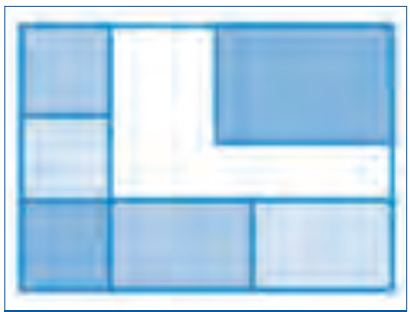
Zoning is recommended when there is:

- Different occupancy patterns
- Different temperature requirements
- Different activities in the space
- More than one floor (particularly when top floor is poorly insulated)



A radiant cooling system with three zones covering areas where there are different requirements to temperature or where the internal load from occupants is different. As occupant load is variable and hence moisture load is variable, each zone should be provided with an enthalpy sensor for monitoring air moisture level in to avoid condensation on the ceilings.

Multi-storey buildings can be zoned floor by floor



Multi-tenanted buildings provide an ideal opportunity to zone on the basis of tenants requirements

Additional investment in zoning can be recouped over time through energy savings. However, the most obvious improvement is increased staff comfort.

Using Variable Primary Pumping Scheme in Radiant Cooling System

Variable Primary Pumping (VPF) system

Variable primary flow systems coupled with mixing loop control at radiant cooling zones offer a higher degree of control and comfort. Primary pumps vary the flow through evaporator coils as commanded by field Differential Pressure (DP) Sensors. When 3-way valves modulate to recirculate the zone return supply temperature back to the space area, the differential pressure across the riser shaft increases, resulting in the speeding down of the primary pumps.

DP sensors across the chillers ensure that pumps do not drop below the safe minimum flow as recommended by chiller manufacturer. Also when the load demands a flow rate much less than the safe minimum flow, VPF controller ensures the excess flow is recirculated back to the plant by opening of 2-way valve in a de-coupler line.

Mixing loop control

When the return chilled water from the radiant cooling panels is less than the design, 3 way valves are modulated to recirculate the chilled water to the space areas.Similarly, when the supply temperature for any reason drops below the dew point temperature, chilled water supply from the main plant is cut off and the MAGNA3 pump is stopped immediately to avoid condensation.

Zone circulation pumps

MAGNA3 pumps operating at constant temperature mode ensure the right supply temperature to radiant cooling panels. With the return temperature sensor in the zone connected to the MAGNA3 pump, BTU spent on the zone can be monitored in the MAGNA3 itself without any additional instrument. With soft communication to the Building Management System through Modbus/BACnet, the MAGNA3 pump can run from an external reference, which can be based on realistic weather data, so the flow is controlled in such a way to maintain space temperature which is based on relative humidity and dew point of the installation.

Radiant Cooling in India

Grundfos has in partnership with Oorja energy installed MAGNA3 in radiant cooling as a pilot project in one of the IT companies based in Hyderabad.The project involves a 100 TR chiller (old) connected to a lab area where in 2 floor cooling and 2 ceiling cooling areas are connected to a main circulation system.

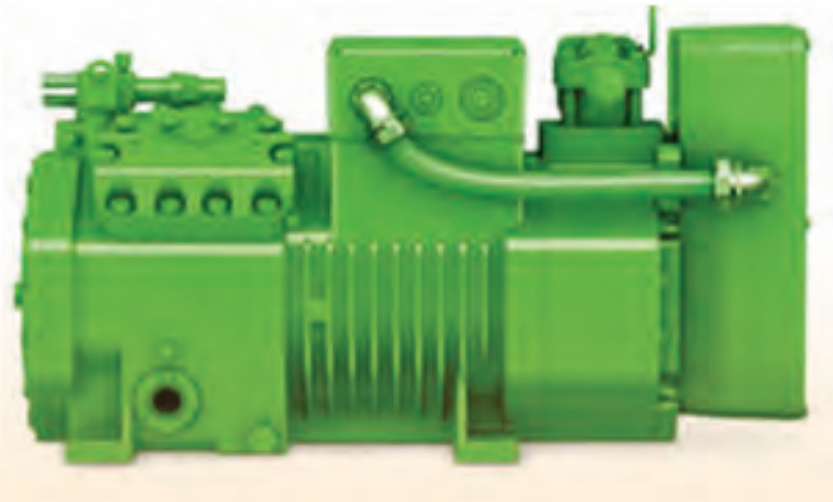
The MAGNA3 pump is presently working in constant curve mode but after a modification in the system software of the plant, it will be programmed to operate on 4-20 mA signal from the PLC which is a result of installation's dew point temperature, relative humidity and dry bulb temperature. Space temperature is maintained at 18 °C, 2 °C above the dew point temperature to avoid condensation. The system has been working satisfactorily for the last year.

Why MAGNA3 was Selected

MAGNA3 with flow limiting functionality bundled with temperature control and BTU metering can effectively control flow in each individual radiant panel and thereby avoiding the risk of condensation. MAGNA3, operating with temperature control mode, is an ideal choice for the chilled water flow distribution systems described earlier, and for advanced systems for controlling water flow rates. ●

BITZER

New technology for Scroll Compressors at Nordbygg trade fair



BITZER company appears at Nordbygg in Stockholm for the first time during April 2014, where it showcases a newly developed oil management system for scroll compressors.
With this development, the world's largest independent manufacturer of refrigeration compressors is optimising the characteristics of its ORBIT scroll compressors.

BITZER displays its new patent-pending BITZER Advanced Header Technology (BAHT) at Nordbygg. The innovative suction gas distributor technology for ORBIT multi-scroll systems makes it possible to combine multiple compressors – each header package now facilitates up to 20 capacity combinations. The new technology also allows compressors of varying cooling capacity to be configured as uneven tandems with no active oil equalization. According to BITZER, this is a unique selling point, as no other modifications need to be made to the scroll unit. BITZER's two compressor series, ORBIT 6 and 8, can now be combined in a single air conditioning system, thus increasing the number of capacity combinations and reducing the costs, for instance, of operating 12 and 32-tonne compressors in a tandem. This in turn also reduces storage costs.

One of the benefits is that the system can be incorporated into the lean production concepts of OEM manufacturers.

Consistently high energy efficiency

The five models of the ORBIT 6 scroll compressor range for R410A with 10 to 20 hp feature displacements between 20 and 38 cu. m/h at 50 Hz. The cooling capacity varies between 27 and 51 kW, whilst maintaining low sound levels. As a result, ORBIT 6 compressors are ideal for use in air conditioning systems and heat pumps in particular, and optimally complement the scroll compressors of the ORBIT 8 series with higher cooling capacity.

Optimised ECOSTAR series sets new benchmarks

BITZER is also showcasing its optimised ECOSTAR condensing unit at Nordbygg, which due to many improvements to the control and evaluation software offers greater operating convenience. For example, the ECOSTAR can be monitored remotely on a laptop or tablet using Modbus. A data log checks the operating parameters every two minutes, which are stored in a circular buffer for four weeks.

ECOLINE: the next generation of reciprocating compressors

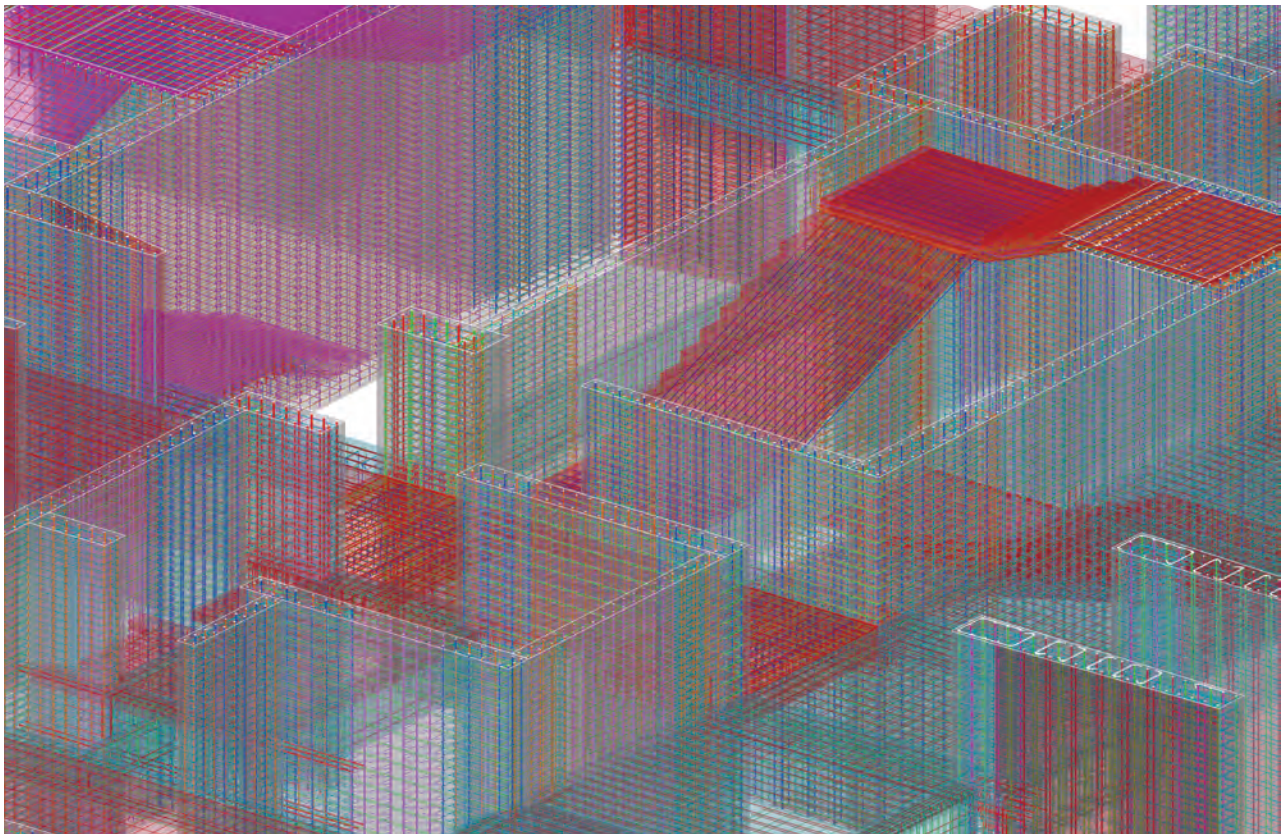
The semi-hermetic ECOLINE reciprocating compressor series combines higher efficiency with an increased range of applications. It's compatible with its predecessor models and designed for use with a whole host of refrigerants. The ECOLINE VARISPEED's reduction in suction pressure fluctuations and cycling rates also minimises energy costs.

CSVH screw compressors: variable and efficient

Three screw compressors of the CSVH series were designed for use in air conditioning systems, heat pump applications as well as industrial and process cooling. They feature an integrated frequency inverter and offer exceptional energy efficiency. With an ESEER (European Seasonal Energy Efficiency Ratio) of over five, the series sets new standards for air cooled chillers with dry expansion. The CSVH series can be combined with the CSH compact screw compressors in a single system, thus increasing flexibility in full and part-load performance. •

BIM for Efficient Building Construction

Building Information Modeling (BIM)also known as VDC -Virtual Design and Construction, is known in common terms as "digital representation of the physical and the functional characteristics of a building/ facility".



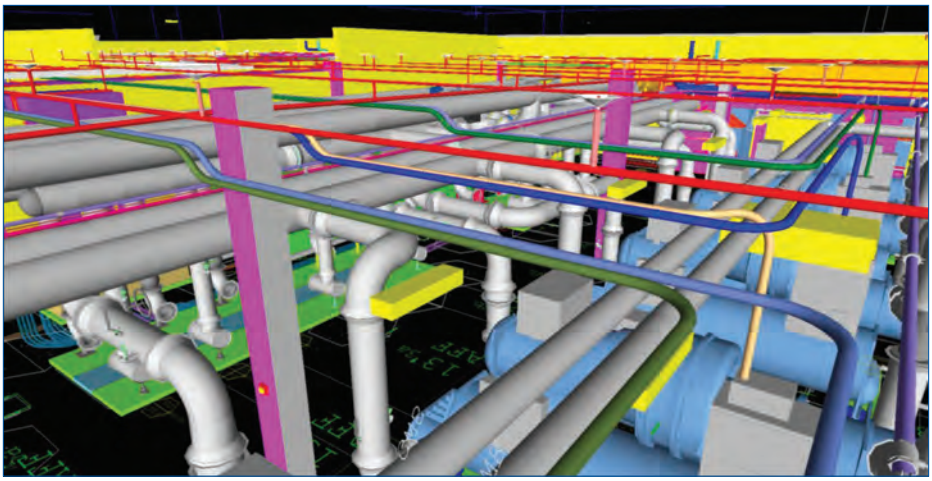
Parveen Sharma, Associate Vice President with Intec Infra Technologies Pvt Ltd, Gurgaon is an Architect with MSc & MCA). His keen interest in technology has led him in BIM industry. He is one of the veterans on BIM in Asia and has implemented BIM on more than 100 projects across globe.

Dhiraj Rastogi, Associate Vice President with Intec Infra Technologies Pvt Ltd, Gurgaon is a Mechanical Engineer from NIT, Warangal. He has extensive overseas experience and has worked for Blue Star, Quark, IREO & JLL in India. He is a Certified Energy Auditor and Energy Manager.

In simplistic terms, BIM or VDC uses engineered 3D, real-time, dynamic modeling technology to increase Productivity, coordination and efficiency in Building Design, Construction and Facility Management. BIM delivers information or intelligence about project design (all disciplines), scope, quantities, construction/ installation guidance, procurement phasing, facility management information etc, in an integrated manner. In a BIM model, every drawing sheet, 2D and 3D views, bill of quantities are captured or built in a single repository and the outputs are coherent and accurate as they get generated from the same underlying Building model database.

BIM is a Technology, which is 'Process and Information Driven and Not a Tool'

Building Information Modeling (BIM) is an "Information-based" process (vs. Drawing-based process – Traditional way) that builds long-term value and advances innovation. Further, BIM is about integrating the information from various participants and streamlining the design and construction processes. Thus, it's a collaborative approach beyond only



the Software usage. There are still some new Industry players thinking of BIM as simply creating 3-D drawings in CAD helping in Clash Detection, but that thought needs to change as it's the "I" for information in BIM that sets the process apart from simple 3-D modeling. Stanford University Center for Integrated Facilities Engineering (CIFE) figures based on 32 major projects using BIM indicates benefits such as (*CIFE, 2007):

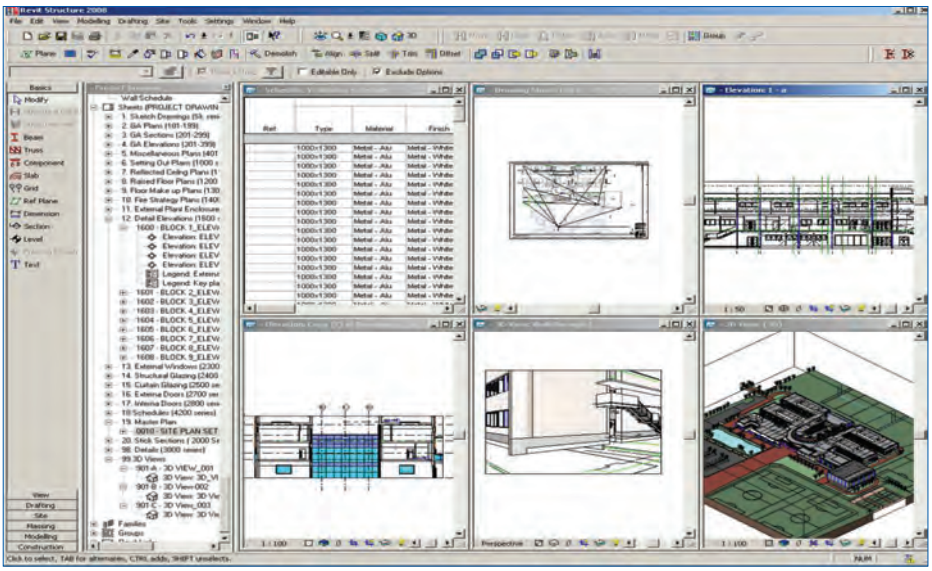
- Up to 50% elimination of un-budgeted change.
- Cost estimation accuracy within 3%.
- Up to 80% reduction in time taken to generate a cost estimate.
- Savings of up to 10% of the contract value through clash detections.
- Up to 7% reduction in project time.

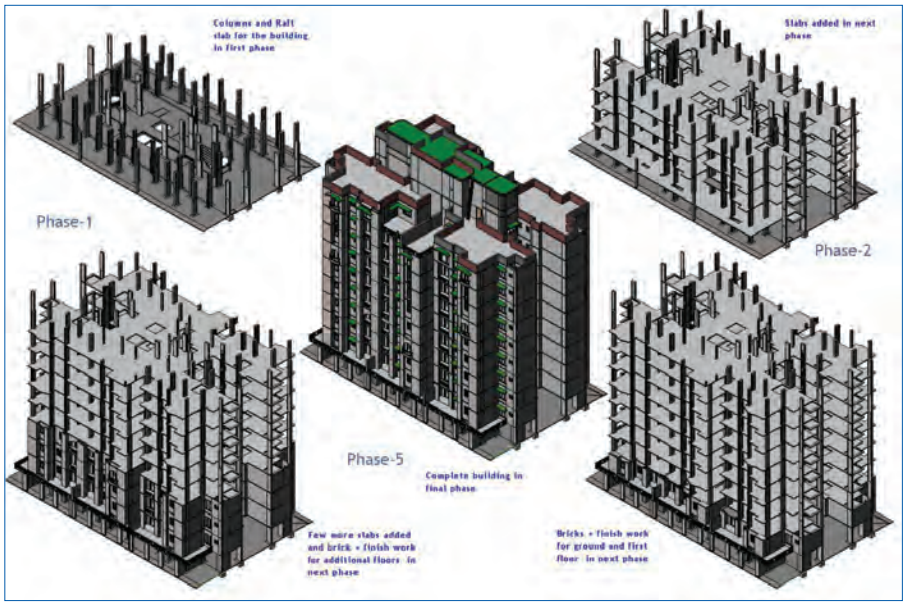
A BIM consultant works exactly like a contractor and seeks all the information which is generally required by a contractor at the time of award of a work, such as drawings, specifications etc. to build the Model. The advantage is, since all the ASMEPF disciplines are modeled on a single platform, it facilitates in better co-ordination and avoids drawing errors, coordination issues because of drawing revisions being shared between different agencies. Further, the poor visualization of all elements of a project also hampers the coordination, which is avoided in a 3D BIM environment. Also it has been observed that in the traditional CAD way, the Plans, Elevations and Sections are sometimes drawn by different drafting persons; the change in Plan or Elevation may get missed out in Section or vice-versa, resulting in RFIs during project execution. This gets eliminated in a BIM process as the same 3D model generates Plans, Sections and Elevations.

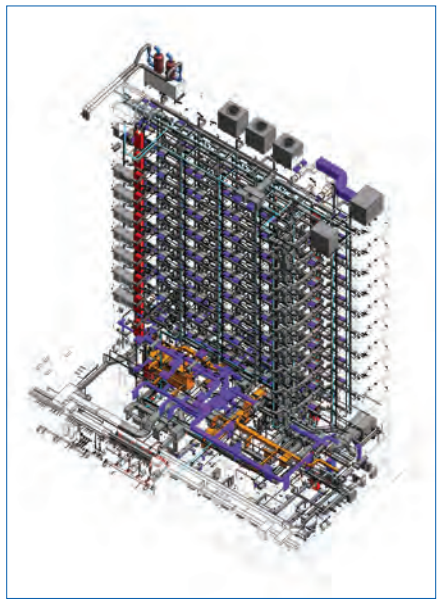
Upon completing modeling of all the disciplines, a BIM consultant produces a clash report within ASMEPF disciplines. While hard clashes are easily identifiable by the software tools, but soft clashes, constructability issues and facility management issues are tricky to highlight and needs sufficient technical skills and BIM software programming skills to resolve the clashes or suggest resolutions to the identified clashes. This is one of the factors which differentiates BIM consultants from one to the other.

Another visible benefit is the accurate Quantity take-off. The quantities of ASMEPF and Rebar extracted (you read it right, the Rebar modeling is possible in BIM and catching up fast) from the model are highly accurate and can easily be used for generating precise cost estimations and phased procurement. The designs and the quantity are linked together in the model and any change in the design automatically refers the change in Quantity take-off and has been proven to save 80% of the effort required in generating the revised costing through traditional methods.

4D or Time Integration (construction sequencing) is an added benefit from BIM. Now tools are available to integrate Primavera®, MS-Project® schedules with BIM models and show the progress of work in a movie format or milestone snapshots. This 4D could further be linked to planned vs actual work progress at site, captured through cameras and/or the updated project schedules. In current traditional scenario, errors in drawings and coordination challenges cause wastage of labour, material and time,





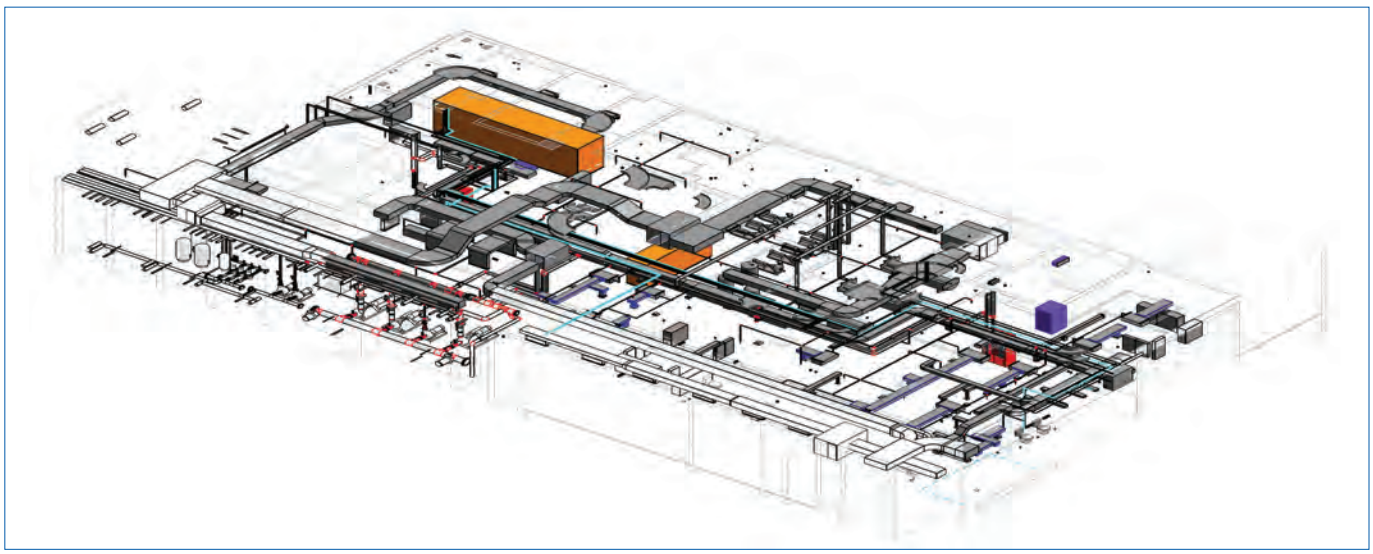


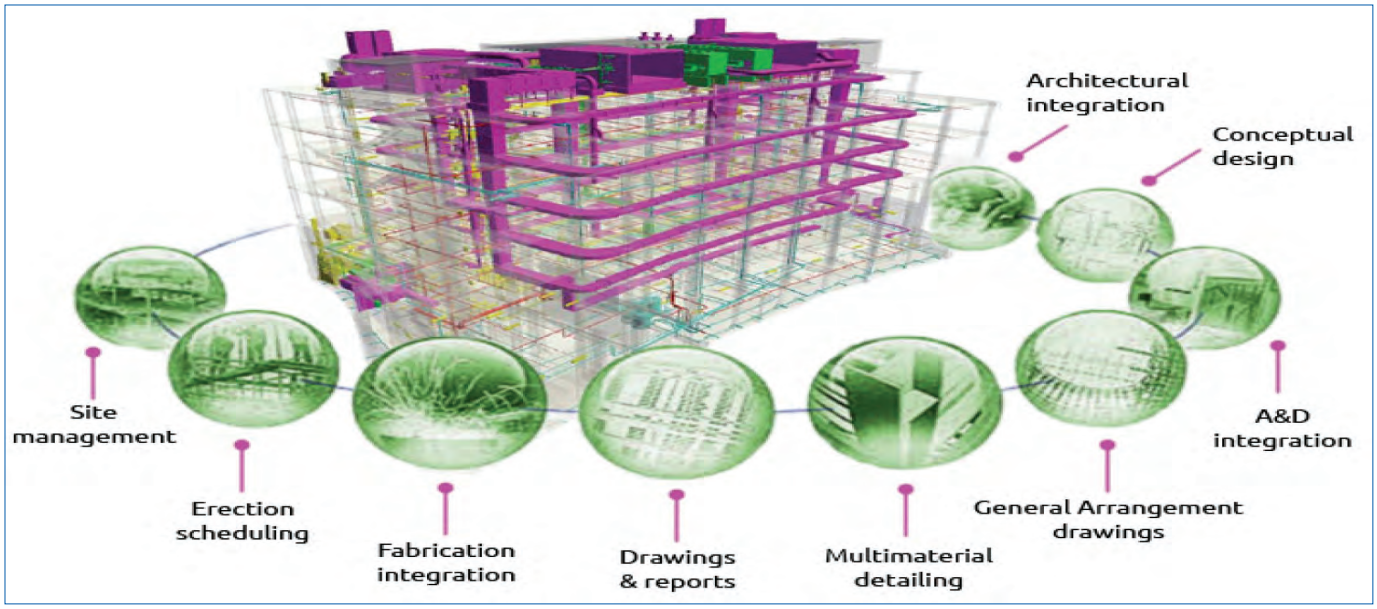
resulting in delayed project completion and cost overruns. As per the published survey reports, the global average wastage in construction industry is whopping ~42% and BIM has proven time and again in reducing these wastages considerably.

While BIM offers many tangible and intangible benefits, however, in Indian scenario it requires lots of hand holding and education to the end user. Each stakeholder in a project is important and as in actual building construction, delay in one discipline could delay the entire project, similarly in BIM the modeling cannot be completed without the availability of adequate information about all the elements. Question arises, when world over BIM is providing big dividends to its users, then why is it not widely used in India. In our opinion, the following are the major reasons for this:

- Non-availability of trained manpower
- The high cost of the hardware & software, making the technology costly to deploy
- Owners' awareness of the BIM technology and defining the correct BIM scope and validations.
- Hesitation of design consultants to adapt to the new BIM platforms.
- Incomplete/ insufficient design details from Design consultants.
- Design consultants not timely revising their drawings as per clash detection reports.
- BIM consultants taking undue advantage of the ignorance of the Owners&Design consultants on the scope of BIM deliverables and winning the projects only on low costs with limited delivery capabilities, thus resulting in loss of confidence of end user on the technology.

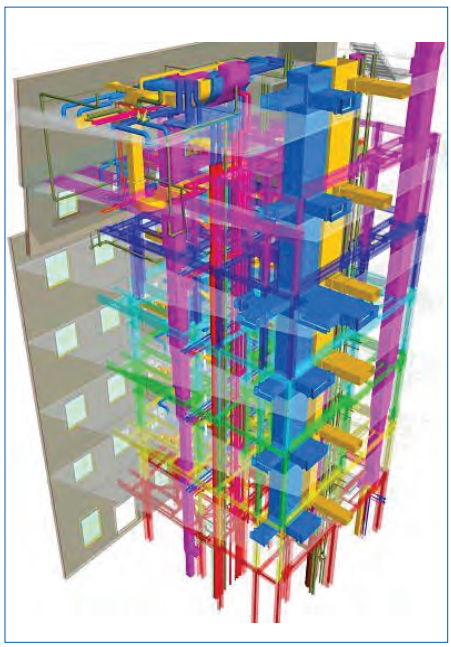
While opting for BIM we must know what to ask for from the BIM consultant. The American Institute of Architects (AIA) document E-202 defines the amount of details incorporated into a building information modeling environment. As per this document five levels of detailing/ development (LOD 100 to LOD 500) are defined and the broad

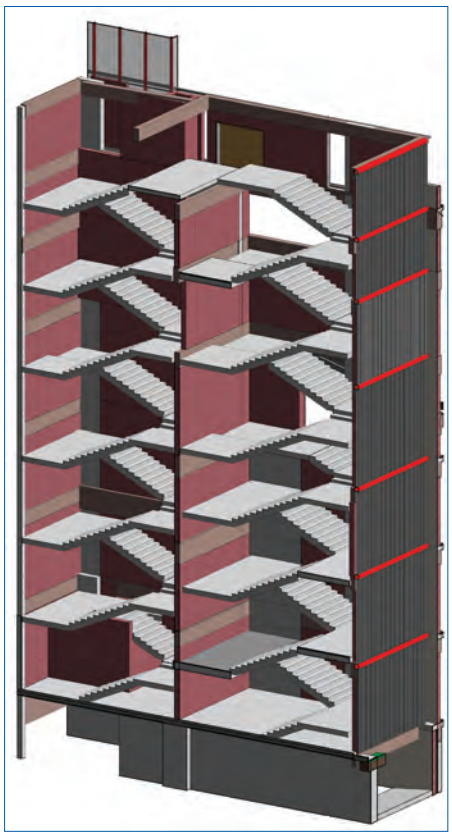




Information captured in each of these levels are as given below:

- LOD 100: Conceptual
  This includes Building Location, Building Height with each floor height and Building/Floor Configuration/Outline.
- LOD 200: Approximate Geometry
  This includes Basic Architectural walls, Basic Floor Slab (with shaft openings), Door & windows (opening sizes), Room Numbers and usage, finishing schedule.
- LOD 300: Precise Geometry
  This includes detailed structural design (columns, beams, slab & footing etc.), core area detailed design (including lifts, staircase etc.), complete internal finishing (including plaster, flooring etc.), RCP, MEP services including lights, ducts, conduits& pipes etc. From LOD 300 model, exact quantity of modeled elements can be obtained and may be used for tendering purposes.
- LOD 400: Fabrication
  In this stage shop drawing and detailed geometries are created.
- LOD 500 As Built: This level contains the complete information about all As-Built building elements.





LOD 500 model can be further enhanced with commissioning data, warranty details etc. and used for facility management.

BIM is a great technology(not a tool) and provides a platform for all the stakeholders to gain benefits/ intelligence and hence it is important that everyone is involved thoroughly in its successful implementation.

BIM models must flow from one stage to another and keep the "I" part growing in the BIM model and finally the As-Built BIM model as deliverable is a beauty and can serve the Owner till the project/ product life cycle. BIM is an amalgamation of many software tools talking to each other and each contributing its strength and outputs.

Some of the common software tools supporting BIM are: Autodesk Revit, Bentley BIM/ AECOSIM, ArchiCAD, Tekla, Rhino, Navisworks, Solibri, Intergraph SP3D, Syncro etc. (all software are owned by respective brand owners) and many other software applications are integrated with BIM tools to deliver the end results to the Client. ●

Cost and Energy Efficient Innovative HVAC Technologies

Many factors affect health, attitude and productivity of the people who respond to their work environment. Air quality is one of these factors. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) has established standards which outline air quality for indoor comfort conditions that are acceptable to 80% or more of a commercial building's occupants.

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An HVAC system is simply a group of components working together to move heat to where it is wanted (the conditioned space) or remove heat from where it is not wanted (the conditioned space) and put it where it is unobjectionable (the outside air)". It is an acronym that stands for heating, ventilation, and air conditioning and is sometimes referred to as climate control.

It is the technology of indoor and vehicular environmental comfort. HVAC system design is a sub-discipline of mechanical engineering, based on the principles of thermodynamics, fluid mechanics, and heat transfer. The use of HVAC systems in residential and commercial complexes has been rising considerably over the past decades throughout the world. In India people are using HVAC mainly in large commercial complexes. The main purpose of commercial HVAC systems is to provide the people working inside buildings with 'conditioned' air so that they will have a comfortable and safe work environment. 'Conditioned' air means that air is clean and odor free, and the temperature, humidity, and movement of the air are within certain comfort ranges.

What Constitutes a HVAC?

Heating: A central heating system provides warmth to the whole interior of a building (or portion of a building) from one point to multiple rooms. Central heating differs from local heating in that the heat generation occurs in one place, such as a furnace room in a house or

a mechanical room in a large building. The most common method of heat generation involves the combustion of fossil fuel in a furnace or boiler.

The resultant heat then gets distributed: typically by forced-air through ductwork, by water circulating through pipes, or by steam fed through pipes. Increasingly, buildings utilize solar-powered heat sources, in which case the distribution system normally uses water circulation.

Ventilation: Ventilation of building required to supply fresh air for respiration of occupants, to dilute inside air to prevent vitiation by body odors and to remove any products of combustion or other contaminants in air and to provide such thermal environments as will assist in the maintenance of heat balance of the body in order to prevent discomfort and injury to health of the occupants.

Air conditioning: The process of treating air so as to control simultaneously its temperature, humidity, purity, distribution and air movement and pressure to meet the requirements of the conditioned space.

When these three systems are combined in order to control the building climate, the whole system may be an HVAC (heating, ventilation and air conditioning) system.

HVAC System Components

The basic components in a common central HVAC system are:

- An indoor fan to circulate the supply air (SA) and return air (RA).
- Supply air ductwork in which the air flows from the supply fan to the conditioned space (room).
- Air devices such as supply air outlets and return air inlets.
- Return air path or ductwork in which the air flows back from the conditioned space to the mixed air chamber (plenum).
- An outside air (OA) device such as an opening, louver or duct to allow for the entrance of outside air into the mixed air chamber.
- A mixed air chamber to receive the return air and mix it with outside air.
- A filter section(s) to remove dirt and dust particles from the mixed air.
- Heat exchanger(s) such as hot water coil(s), steam coil(s), refrigerant evaporator(s), or chilled water coil(s) to add heat to or remove heat from the circulated air.
- Auxiliary heating devices such as natural gas furnace(s) or electric heating element(s).
- A compressor(s) to compress the refrigerant vapor and pump the refrigerant around the system.
- Condenser(s) to remove heat from the refrigerant vapor and condense it to a liquid.
- An outdoor fan (blower) to circulate outside air across air-cooled condenser(s).
- Pump(s) to circulate water through water-cooled condenser(s); condenser water pump (CWP); and condenser water supply (CWS) and return (CWR).
- Pump(s) to circulate hot water from the boiler(s) through the hot water coil(s) and back or to circulate chilled water from the chiller(s) through the chilled water coil(s) and back to the chiller(s).
- For central systems, water or steam boiler(s) as a central heating source.
- For central systems, water chiller(s) as a central cooling source.
- For central systems, cooling tower(s) with water-cooled condenser(s).
- Controls to start, stop, or regulate the flow of air, water, steam, refrigerant and electricity.

Energy Efficiency in HVAC

Since the 1980s, manufacturers of HVAC equipment have been making an effort to make the systems they manufacture, more efficient. This was originally driven by rising energy costs, and has more recently been driven by increased awareness of environmental issues.

Advancements in technology and unit engineering now provide a variety of cleaner and more efficient options for heating and cooling in a building. There are several methods for making HVAC systems more efficient. These include heat pumps, dual-fuel heat pumps, geothermal heat pumps, dual-source heat pumps and radiant heat and cooling systems.

- **Radiant Heat**
  Radiant heat and air conditioning system is a good option if the

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New HVAC technology are being developed to make more energy efficient systems better and affordable and to provide high indoor air quality, comfort and lower energy bills.

building is off of the power grid or located in an area with high electricity costs. This technology supplies heat or cooling directly to the floor or to wall panels, the heat or cooling then radiates outwards. These units are more efficient because no energy is lost through a duct system, saving money and eliminating energy waste.

- **Heat Pumps and Dual-Fuel Heat Pumps**
  Heat pumps and dual-fuel heat pumps are other attractive ways to trim your fuel bills and reduce energy usage. A high efficiency heat pump works well for homes that already heat with electricity in mild climates, cutting the electricity these households use by 30%-40%. Dual-fuel heat pumps uses both electric and gas power to heat or cool a home, satisfying more than 70% of a home's heating or cooling needs. A dual-fuel pump is one of the most versatile units for heating or air conditioning. Contractor services regularly install this technology in areas of the county typically above freezing with low electric rates.
- **Geothermal Heat Pumps**
  Geothermal heat pumps are similar to ordinary heat pumps, but instead of using heat found in outside air, they rely on the stable, even heat of the earth to provide heating, air conditioning and, in most cases, hot water. The heat extracted through a geothermal heat pump can come from any source, despite the temperature. It uses the ground or water to absorb and spread heat and cooling. As a HVAC system, either of these technologies work more efficiently, last longer, run more quietly and emits fewer pollutants than older units.
- **Ventilation Energy Recovery**
  Energy recovery systems sometimes utilize heat recovery ventilation or energy recovery ventilation systems that employ heat exchangers or enthalpy wheels to recover sensible or latent heat from exhausted air. This is done by transfer of energy to the incoming outside fresh air.

New HVAC Technologies

One of the largest energy expenses in a building is the HVAC or heating, ventilation and air conditioning systems. New HVAC technology are being developed to make more energy efficient systems better and affordable and to provide high indoor air quality, comfort and lower energy bills. The new HVAC technologies will save enough money over time to pay for the system and installation. Some of the new technologies are briefed as under:

- **Passive Dehumidification**
  Passive dehumidification is a proven technology and works by using a system of three evaporator coils. In the first coil, the air is moved over a coil filled with cooled refrigerant, just like a regular air conditioner. Condensation forms and drains to the outside. The heated refrigerant is sent to a reservoir for use in the last part of the system. In the second set of coils, the air is passed over coils filled with super-cooled refrigerant. Condensation forms a second time. The air is dry, but entirely too cold to go into the house. In the third part of the system, the air passes over the last coils filled with the warmed refrigerant from the first part. The heat warms the air to the desired temperature. Since the air is dry, the thermostat can be set higher. Ceiling fans also help circulate the air, which feels cooler still.
- **Desiccant Enhanced Evaporative Air Conditioner (DEVAP)**
  The Desiccant Enhanced Evaporative Air Conditioner system uses membranes filled with liquid desiccant. A desiccant is a substance that removes moisture from the air, and then sends the air over regular evaporator coils. The difference in the air temperature between the air and the super cool refrigerant in the coils causes condensation, which dries the air further. Dry air feels cooler, so the occupant can turn the thermostat up and save money. This system works wonderfully well in hot and humid climates. In dry climates, evaporative coolers blow moist cool air into the building. In a humid climate, adding moisture has the opposite effect. The best thing about the DEVAP system is that the desiccant uses no electricity at all. Savings are estimated at 80 to 90 percent. Examples of desiccants are rock salt, Damp Rid, Dri Z air and other products.
- **Heat Recovery Systems**
  Air conditioners remove the heat from the air through the evaporator coils. In basic physics, heat wants to move to cooler areas. The heat from the air moves into the cooled refrigerant. The warmed refrigerant normally travels to the condenser coils which are cooled by a fan in the outside unit. In a heat recovery system, the heat from the warm refrigerant is used to heat water in the house. Here money can be saved as one has to pay for the energy to use the HVAC system and get hot water with no extra energy use.
- **Residential Zoning Systems**
  This is the most inexpensive of the new technologies. It does not involve replacing the entire HVAC system. Several zoning units are placed in the ducts and vents. These units have dampers similar to what a fireplace uses. Each unit has a thermometer attached to it. Sensors in the unit feed information to a central

control panel. The user programs the desired temperature into the control panel; the system opens and closes the dampers as necessary. Money is saved by heating or cooling only the rooms in use at the time.

- **Building Automation**
  Building automation involves HVAC system, artificial and natural lighting and other systems. Everything is wired to a central computerized control system. It includes systems like entertainment system, HVAC system, interior and exterior lights, security system and door and window locks etc.
  This technology provides help when you are not there. One can control the system from cell phone, laptop or computer.
- **The Nest Learning Thermostat**
  Digital thermostats save money by raising or lowering the temperature you program into the unit. If you go on vacation, you can adjust the settings from a cell phone or computer, depending on the unit. The Nest learning thermostat is an innovation that is revolutionizing thermostat control. It has a computerized memory that learns what your favorite settings are throughout the day and week. It senses when you are not there and sets an away temperature. It monitors the outside temperature, indoor humidity and much-much more. It can also be programmed from phone or laptop.
- **Solid State Cooling**
  Conventional air-conditioners employ refrigerants such as chlorofluorocarbons to absorb heat from the room to be cooled. That heat is then expelled outside, requiring electrically powered pumps and compressors. One idea to conserve energy is to replace coolant fluids and gases—which are often super-powered greenhouse gases capable of trapping more than 1,000 times more heat than CO2 with solid materials, such as bismuth telluride. ARPA-E awardee Sheetak is developing a low-cost, solid-state compressor technology that could allow for more cost effective, energy efficient air conditioning systems that use no polluting refrigerants.
  This device uses electricity to change a thermoelectric solid to absorb heat, and could lead to cheaper air-conditioners or refrigerators.
  Such refrigerators, which lack moving parts and are therefore less likely to break down, can be lifesavers in remote, rural areas for keeping medicines cool or food fresh.

Benefits of HVAC Systems

People like to use such systems since they help to combine all options in order to keep comfortable all around the year and also save lots of money in terms of energy costs. Major benefits of HVAC systems are:

- **Save Fuel and Electricity:** Efficiently running heating and conditioning systems require less fuel and electricity to keep place warm during the winter season and cool during summer.
- **Tax Incentives:** Apparently, most energy efficient products in the market today are eligible for energy tax credit in many countries. This is an element that can benefit you and your workplace or organization largely if where you have installed or going to install a HVAC. But before purchase a HVAC, it needs attention to ensure the eligibility because not all HVAC systems available in market qualify the criteria for getting these incentives.
- **More Comfortable Office and Home:** HVAC systems are automatic or programmable thermostats that help to automate temperature control in the room.
- **Quiet Operation:** Modern HVAC systems provide comfortable and calm working environment or living situations while old heating systems and window box conditioners were normally loud and therefore they do not promote quiet environment.

Conclusion

Air conditioners consume much of electricity in the developed as well as developing countries. The development of new technologies for efficient HVAC systems is progressing due to increases in regulated energy-efficiency standards. HVAC systems and products can effectively reduce operating costs up to 30%, while still maintaining a comfortable room climate. These systems work at their best with regular maintenance. Taking care of any leaks in the ducts, insulation and energy conservation will help produce the greatest savings. ●

Energy Efficiency

for Refrigeration and Air Conditioning

Over the years, all parts of a commercial refrigerator, such as the compressor, heat exchangers, refrigerant, and packaging, have been improved considerably due to the extensive research and development efforts carried out by academia and industry. However, the achieved and anticipated improvement in conventional refrigeration technology are incremental since this technology is already nearing its fundamental limit of energy efficiency. And described one is 'magnetic refrigeration' which is an evolving cooling technology.

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The word 'green' designates more than a colour. It is a way of life, one that is becoming more and more common throughout the world. An interesting topic on 'sustainable technologies for a greener world' details about what each technology is and how it achieves green goals. Recently, conventional chillers using absorption technology consume energy for hot water generator but absorption chillers carry no energy saving. With the aim of providing a single point solution for this dual purpose application, a product is launched that can provide simultaneous chilling and heating using its vapour absorption technology with 40% saving in heating energy. Using energy efficiency and managing customer energy use has become an integral and valuable exercise. The reason for this is green technology helps to sustain life on earth.

This not only applies to humans but to plants, animals and the rest of the ecosystem. Energy prices and consumption will always be on an upward trajectory. In fact, energy costs have steadily risen over last decade and are expected to carry on doing so as consumption grows. This article discusses the potential for such integrated systems in the

stationary and portable power market in response to the critical need for a cleaner energy technology for communities. Throughout the theme several issues relating to renewable energies, environment and sustainable development are examined from both current and future perspectives.

Introduction

This section describes the different methods and techniques for providing energy for heating and cooling systems. It also, covers the optimisation and improvement of the operation conditions of the heat cycles and the performance of the 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. With development and enlaragement of the cities in cold regions, the conventional heating methods can severely pollute the environment. In order to clean the cities, the governments drew many measures to restrict citizen heating by burning coal and oil and encourage them to use electric or gas-burning heating. New approaches are being studied and solar-assisted reversible absorption heat pump for small power applications using water-ammonia is under development (Luo, Tondeur, Le Gall, and Corbel, 2007). An air-source heat pump is convenient to use and so it is a better method for electric heating. The ambient temperature in winter is comparatively high in most regions, so heat pumps with high efficiency can satisfy their heating requirement. On the other hand, a conventional heat pump is unable to meet the heating requirement in severely cold regions anyway, because its heating capacity decreases rapidly when ambient temperature is below -10°C. According to the weather data in cold regions, the air-source heat pump for heating applications must operate for long times with high efficiency and reliability when ambient temperature is as low as -15°C. Hence, much researches and developments have been conducted to enable heat pumps to operate steadily with high efficiency and reliability in low temperature environments (Luo, Fan, and Tondeur, 2007). For example, the burner of a room air conditioner, which uses kerosene, was developed to improve the performance in low outside temperature (Philappacopoulus, and Berndt, 2001). 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 (Jo, Katsumi, Benson, and Edil, 2001). 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 (Anandarajah, 2003).

Earth Energy Systems (EES)

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 (next page).

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

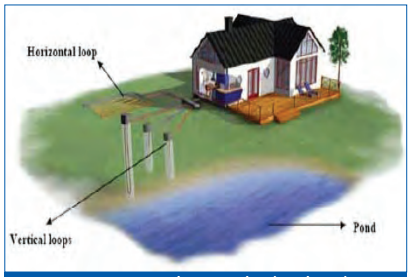


Fig. 1: Using the soil, bedrock or groundwater as the heat source.

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 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).

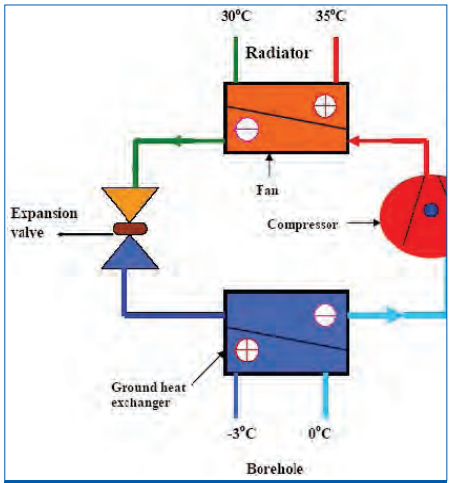


Fig. 2: Detail of the GSHP circuit.

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 0.5oF/100 ft (30oC/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 (Malin, and Alex, 2000). 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 (Omer, 2008). 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 (Brain, and Mark, 2007; Omer, 2009a; and Omer, 2009b). 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.

- **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.

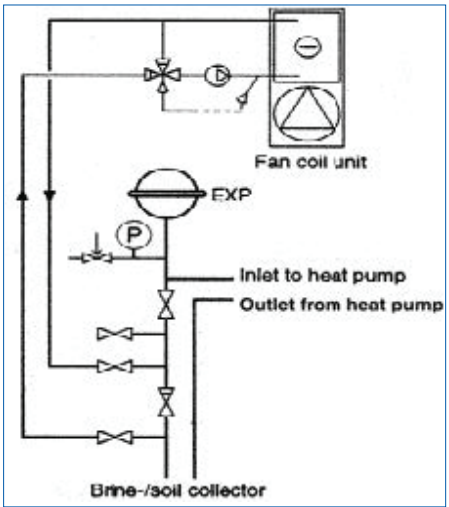


Fig. 3: Diagram of cooling system.

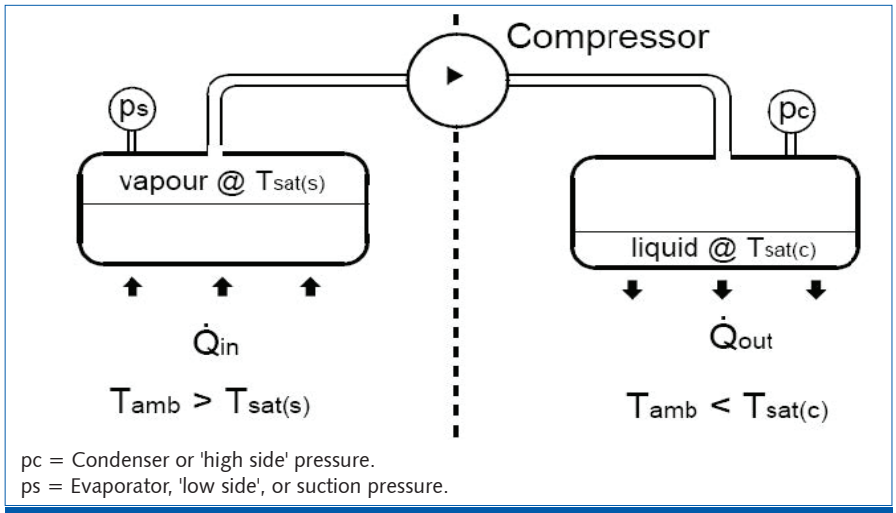


Fig. 6: Heat pumps.

- **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)

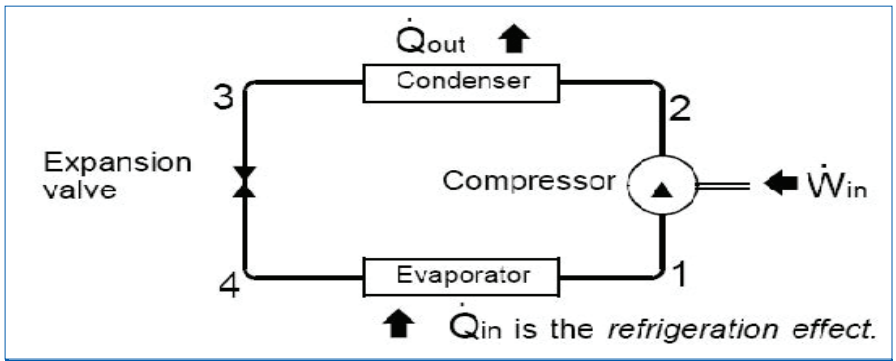


Fig. 7: Simplified refrigeration system diagram.

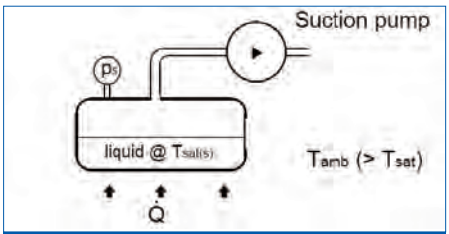


Fig. 4: Refrigeration Cycle.

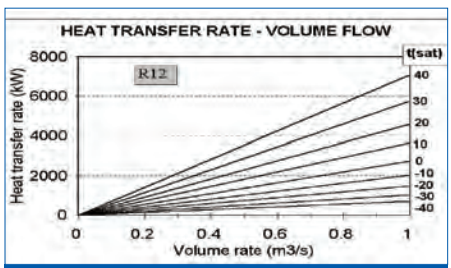


Fig. 5: Heat transfer rate versus volume rate.

determines the pressure and hence Tsat(s) (Figure 4). This is governed by the following set of equations.

$Q = m\ hfg$ (1)

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

$Q = \rho\ g\ V\ hfg$ (3)

$Q = V\ hfg/vg$ (4)

Both hfg and vg 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).

pc = Condenser or 'high side' pressure.

ps = Evaporator, 'low side', or suction pressure.

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, 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

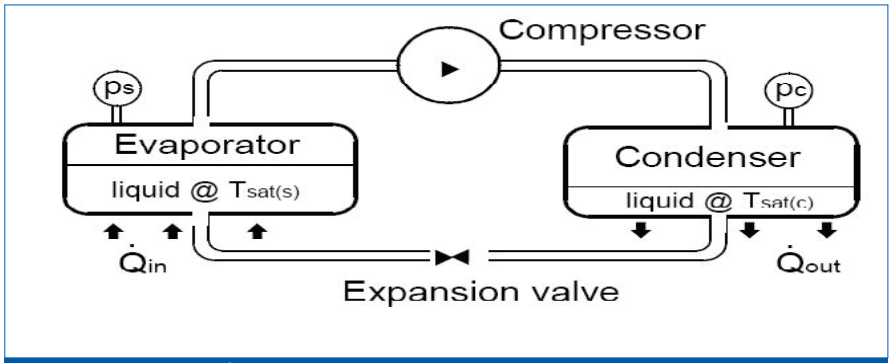


Fig. 8: Heat pump refrigeration cycle.

used by the system. Hence,

$Q_{out} - Q_{in} = W_{in}$ (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 (Omer, 2009c).

$COP_{ref} = Q_{in} / W_{in}$ (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 (Omer, 2009d).

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

It follows that (for the same system):

$COP_{hp} = COP_{ref} + 1$ (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. Ideally, a refrigerant will have the following characteristics.
- Non-toxic - for health and safety reasons.
- Non-flammable - to avoid risks of fire or explosion.

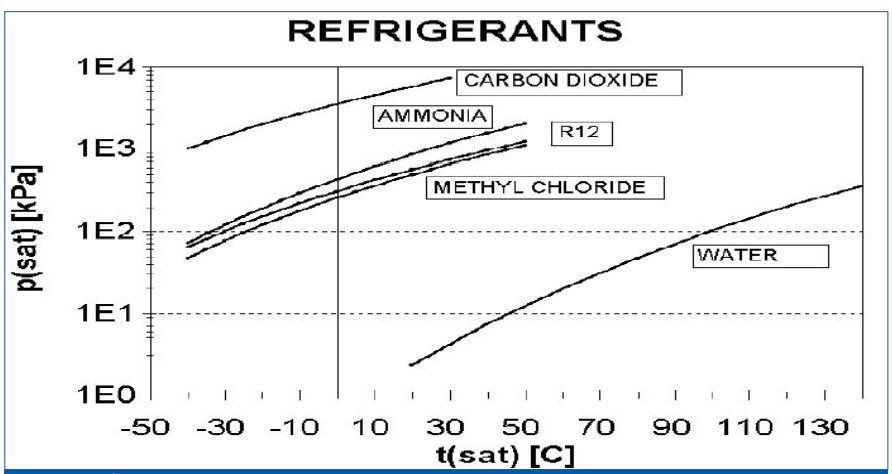


Fig. 9: Refrigerant chart.

- 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 recyclable, 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

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

Table 1. Cost and risk factors for heat pump antifreeze (Heinonen et al., 1996)

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.

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 Heinonen et al., (1996) (Heinonen, Tapscott, Wildin, and Beall, 1996). These authors evaluated total energy consumption, corrosion due to the antifreeze, and the operational and environmental effects 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, Heinonen et al., 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 (Sims, 2007).

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

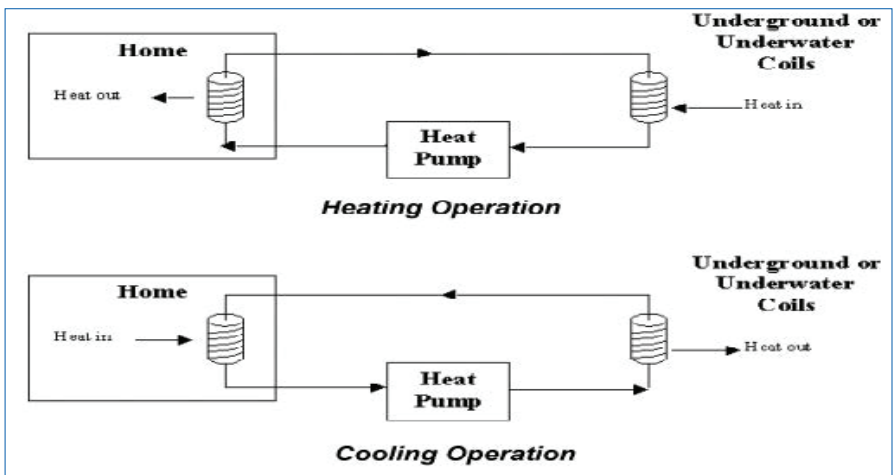


Fig. 10: Heating and cooling operations.

System	Primary Energy Efficiency (%)	CO2 emissions (kg CO2/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

Table 2. CO2 emissions

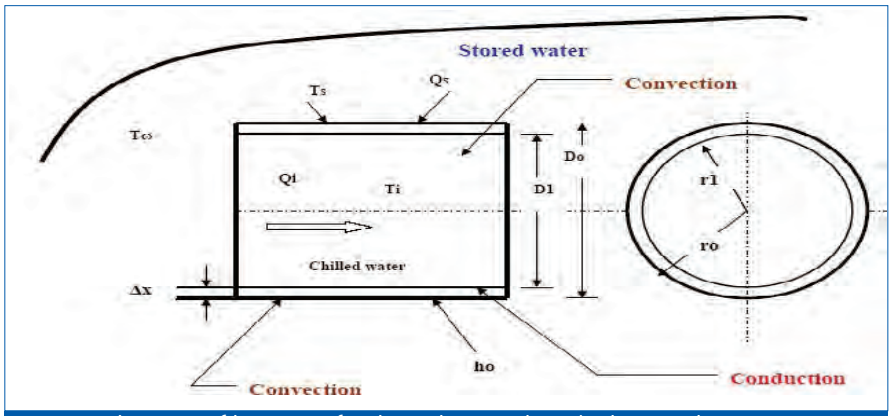


Fig. 11: Schematic of heat transfer through a circular tube heat exchanger.

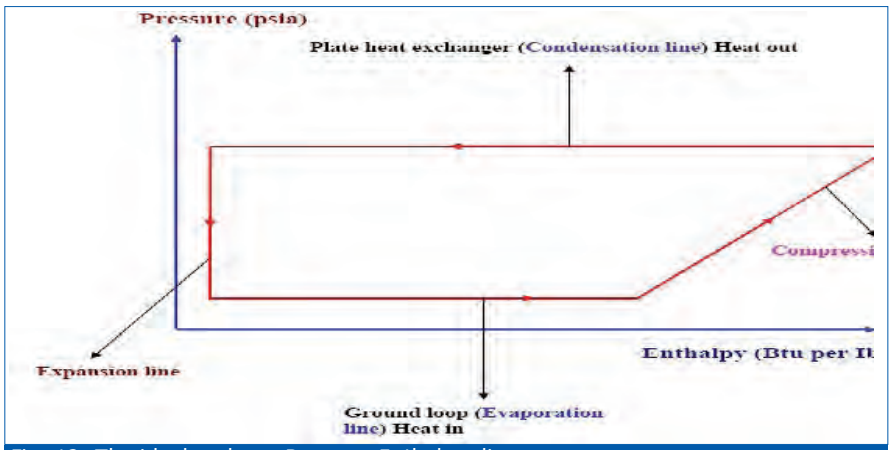


Fig. 12: The ideal cycle on Pressure-Enthalpy diagram.

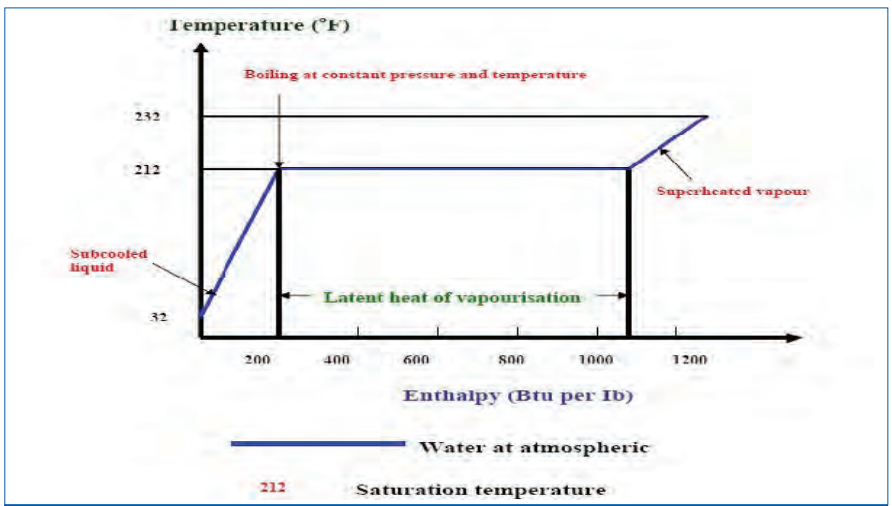


Fig. 13: Water undergoing a charge of state.

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 CO_2) 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.

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 (Trevor, 2007; and Steele, 1997). 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). 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).

Some Definitions

- The word "Efficiency" is defined as the 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.
- 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).
- 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.
- 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.
    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:

$\therefore Q = 0$ (10)

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

Or

$Win = m\,(h2-h1)$ (12)

Condenser:

$W23 = 0$ (13)

$\therefore Q_{out} = m\,(h2-h3)$ (14)

Expansion valve:

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

$\therefore h3 = h4$ (16)

Evaporator:

$W41 = 0$ (17)

$\therefore Q_{in} = m\,(h1-h4)$ (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 specific enthalpy values will be needed. Because refrigerants work in the liquid/vapour

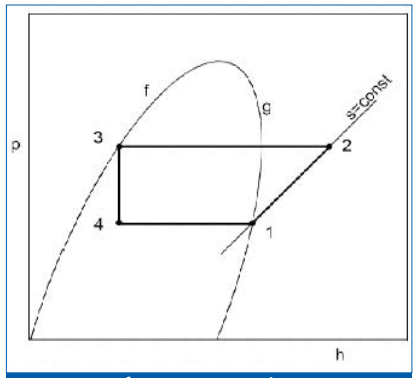


Fig. 14: Refrigeration cycle.

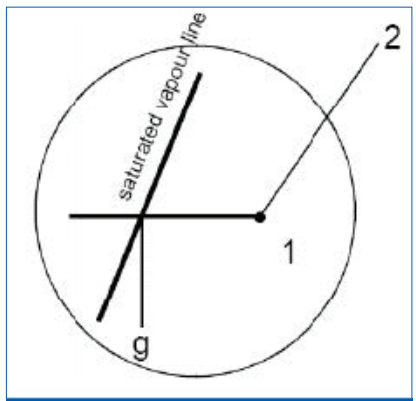


Fig. 15: Evaporator superheat.

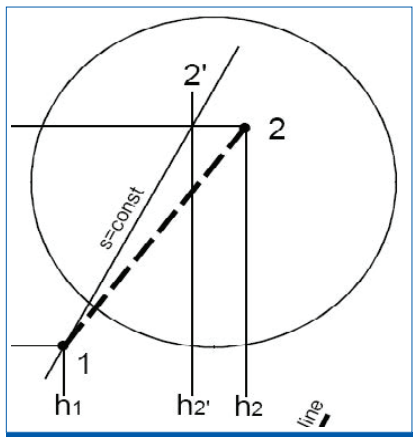


Fig. 16: Isentropic compressor.

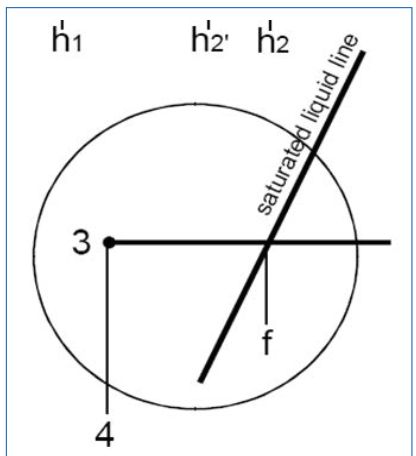


Fig. 17: Condenser sub-cooling.

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.

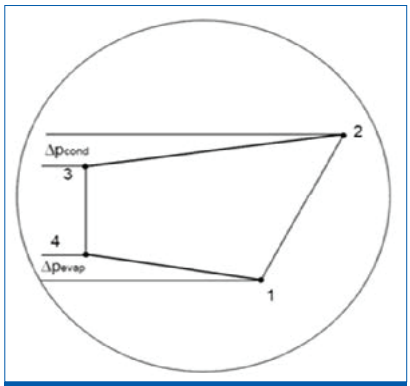


Fig. 18: Pressure drops in evaporator and condenser.

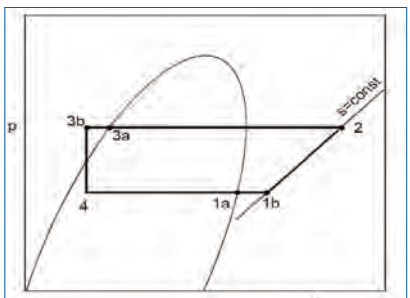


Fig. 19: Diagram of liquid-suction heat exchanger.

- **Real Refrigeration Systems**

  Evaporator superheat

  g →1 given in K above Tsat(s)

  - Isentropic Compressor Efficiency

  $\acute{\eta}_{isen}$ = h2'-h1/h2-h1 (21)

  - **Condenser Sub-cooling**

  f →3 given in K below Tsat(c)

  NB: s1 = s2'

- **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).

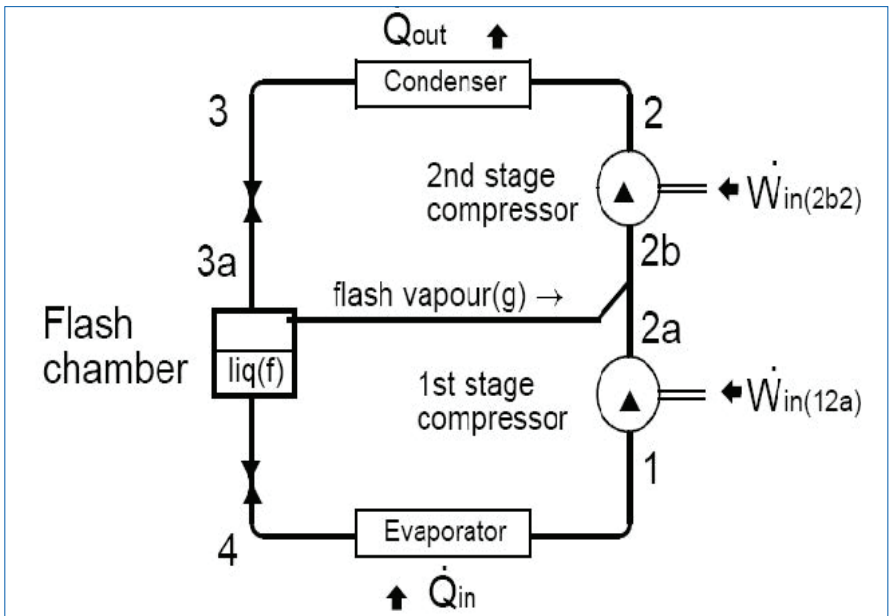


Fig. 20: Liquid-suction heat exchanger cycle.

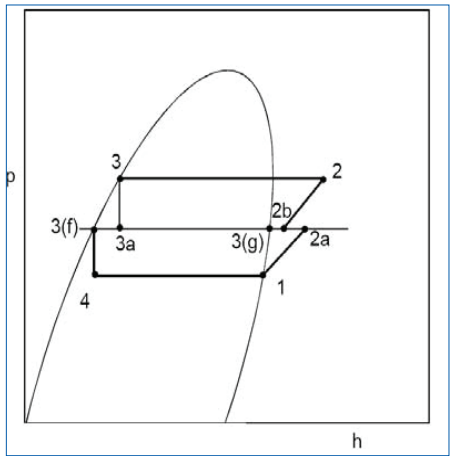


Fig. 21: Cycle of multiple compressions using flash chamber.

- **Refrigeration System Performance Improvement**

  Liquid-Suction heat exchanger (Figure 19-20)

  Assuming no losses:

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

- **Multiple Compression Using Flash Chambers**
- **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:

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

$1^* h_{2b} = x_{f\,h2a}+(1-_{xf})\,h3_{(g)}$ (24)

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

Finally the COP is given by:

$COP = (x_f\,(h_1-h_4))/\,(x_f\,(h_{2a}-h_1)+(h_2-h_{2b}))$ (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. The 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 25oC, 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 CO_2 emissions. Ground source or geothermal heat pumps are a highly efficient, renewable energy technology for space heating and cooling.

This technology relies on the fact that, at depth, the Earth has a relatively constant temperature, warmer than the air in winter and cooler than the air in summer. 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. ●

New Inverter Split ACs

using Next-Generation Refrigerant HFC32 by Daikin

Daikin Air-conditioning India Pvt Ltd, a 100% subsidiary of Daikin Industries Ltd, Japan – the world's No. 1 air-conditioning company launched a variety of Inverter split air conditioning units powered by next generation refrigerant HFC32 manufactured at Neemrana, Rajasthan. As global leaders in air-conditioning, Daikin took this pioneering step to mitigate the environmental impact from refrigerants, with the adoption of HFC32.

Daikin products, using HFC32 based products bear only one-third of the global warming potential (GWP) when compared with R410A & R22 refrigerants. Daikin considers that HFC32 is very suitable for split air conditioners and heat pumps and is an excellent alternative to replace R410A in terms of performance. In addition to having a lower global warming impact, HFC32 can help curtail greenhouse gas emissions originating from energy sources when equipment is in use by its better energy efficiency. Furthermore, it is also a refrigerant that reduces the amount of refrigerant needed per air conditioning unit, has the advantage of enabling components such as heat exchangers, to be made compact, and is suitable for refrigerant recycling.

Speaking on the launch, Kanwal Jeet Jawa, Managing Director, Daikin Airconditioning India Pvt Ltd said, "As responsible HVAC global leaders, we are aware that rampant usage of refrigerants has so far contributed to extreme weather patterns causing destruction of crops & property, massive flooding followed by draughts, etc, so HFC32 is the only solution to protect our future. I am foreseeing a rise in ACs to 30 million by 2030 from 5 million today, pushing a 100 fold rise in demand for electricity." He further added,' HFC32 based energy friendly AC's are finding a huge acceptance amongst consumers & we are in the process of increasing our product range for our discerning customers during 2014.

According to UNEP Technology and Economic Assessment Panel, HFC-32 is not only considered as an alternative to HCFC-22, but also as an alternative to R-410A. As per International Refrigeration and Air Conditioning Conference, Purdue, on the basis of efficiency and cost, HFC32 offers an attractive Low-GWP/Low-LCCP solution for mainstream A/C and H/P applications with performance comparable to R410A.

Hydro fluorocarbon 32 (HFC 32) advantages
• Low carbon dioxide emission
• Zero ozone depletion potential
• Lower global warming potential
• Energy efficient

HFC 32 Inverter Split AC key features
• Highest Energy Efficiency
• Humidification & Dehumidification
• Purification & Ventilation
• Intelligent Eye
• Coanda Airflow

The new range of Inverter split air conditioners from Daikin offer a host of features that aid in creating an ambient cooling environment for a comfortable experience. The new Inverter range also boasts of new designs matching the Indian aesthetics in addition to a giving an unparallel performance. This new range of Inverter split ACs are available at a starting price point of Rs 35,400 onwards

The company intends to provide technical information for the widespread use of HFC32 to meet the demands of each region across India as much as possible. Daikin will continue to contribute to the prevention of global warming in the future by promoting the widespread use of the refrigerant.

Daikin India has plans to expand its National Dealership Network to 2500 from the current number of 1800 plus and develop 100 new Daikin Exclusive Solution Plazas across the country in the coming months. The newly launched Daikin HFC32 based range of air-conditioning solutions which will now be available to the consumers through 1800 plus dealer network - that has been specially trained to provide after-sales services. •

Full View of Zhengzhou Kaifu Hotel

Danfoss Turbocor & Haier build Efficient AC systems

for KAI FU JIAN GUO Hotel at Zhengzhou International Airport, China and save 1,500 CO_2 emissions

As for energy consumption in hotel operations, air-conditioning systems take a large proportion due to long operation times, i.e. running around the clock. Statistics show it accounts for 30-50% of the energy consumption of the hotel. For large hotels, air conditioning systems are more complex due to the huge volume of the buildings, the multi-functional areas, as well as the varying cooling load affected by the occupancy rate, seasonal variations, diurnal variations and other factors.

How to meet load variations of a hotel while being energy efficient has become a major issue in the design of air conditioning systems for large hotels. Therefore, from the beginning of its construction, Zhengzhou KAI FU JIAN GUO Hotel was determined to seek a superior energy-saving solution for the air conditioning systems of the hotel.

Energy efficient and stable operation all year round

Across from Zhengzhou International Airport, Zhengzhou KAI FU JIAN GUO Hotel is just a road's width away from the waiting hall of the airport, and is the only five-star hotel in the airport area. The hotel covers an area of 90,000 m^2 with a landscape-style architecture, in which the main building has two floors and the annex building five floors. It has 172 guest rooms, large and small meeting rooms, Chinese and Western restaurants, private compartments, recreation centers and a 460m^2 Grand Ballroom. The building structure of the hotel is lower than high-rise buildings but on a larger surface. Meanwhile, Zhengzhou's climate is typical continental monsoon climate characterized by obvious seasonal and daily temperature difference. The air conditioning system operates from April to September each year in part-load and only in peak load for one month between July and August, during which the highest outdoor daytime temperature can reach 40 degrees Celsius. Finally, the water-cooled chiller unit solution with magnet oil-free variable-speed centrifugal compressor jointly developed by the Central Air Conditioning Division of Haier Group with Danfoss Turbocor® Compressors stood out from many other solutions.

Meeting IPLV of 11.5

The hotel operates with two chillers that totalize 2110kW of cooling capacity globally.

Each chiller is equipped with two Danfoss Turbocor inverter centrifugal compressors TT400 with oil-free magnetic bearings. Danfoss Turbocor compressors utilize integrated variable speed technology with drive control. When the condensing temperature and/or heat load changes, the cooling capacity can be adjusted to the actual need by the drive, which regulates the compressor motor speed impeller. This reduces energy consumption and improves stability of the unit so as to ensure the unit can run smoothly even in a load condition as low as 10%.

The IPLV of the unit can reach 11.5 in part load conditions. In compressors, traditional oil-lubricated bearings are replaced by magnetic bearings. Traditional oil-lubricated bearing chillers may hinder heat transfer of heat exchangers and consume more energy because of the lubrication process. The ASHRAE research report shows that a chiller unit with every 3.5% oil increase will consume 8% more of electricity; magnetic bearings help chiller units achieve the goal of 100% oil-free operation, enabling higher energy efficiency during the unit functioning.

Designed for endurance

The unit is designed with two compressors and both can run independently. Before one of them reaches full-load capacity, the other one starts to operate based on the left load, adjusts to the required capacity and avoids the full-load operation of the first compressor. This unit design enhances the lifetime of the compressors and improves overall system safety.

CO_2 emissions reduced by 1,500 tons in 5 years

More than five years have passed since the unit was carried into operation by the hotel in June 2008, and the air conditioning system is running stably. "After one year, the monitoring data showed that compared to traditional screw chillers, the variable speed centrifugal chiller had saved us about 50% energy. We are very satisfied with its energy efficiency", says Mr. Ma, Director of Operations of KAI FU JIAN GUO Hotel Zhengzhou. "The magnet variable speed central air conditioner also addresses the problem of constant and stable functioning of air conditioning in low-load operating conditions", he adds. "The monitoring data also shows that the current system using Turbocor inverter oil-free centrifugal compressors help saving 300,000 kWh of electricity and up to RMB 230,000 in electricity costs per year compared with an unit equipped with screw chillers. It reduces the CO_2 emissions by about 300 tons annually".

The other fantastic news is that the energy efficiency of this chiller exceeds the efficiency of systems like water pumps. Usually, the energy consumption of chiller systems can be twice the one of water pump systems. Based on measurements done at Kaifu Hotel, the energy consumption of these chillers is only half of the one of a traditional water pump system.

During both the installing and operating period of the solution, the hotel's management team and system installation group measured other advantages with this oil-free magnetic bearing variable-speed system.

The size of the compressor is only half of the screw machine, saving a lot of room space needed for air conditioners. Besides the very low noise, vibration-free operation of only 72 dB eliminates the need for insulation equipment and facilitates the unit construction, but also saves on system installation costs; the oil-free principle further saves after-sales maintenance cost, which is expected up to RMB 400,000 for the entire life cycle. These additional advantages also won the recognition from the hotel management team. ●

Analytical and FEA Investigation

of Natural Mode Shape Frequencies of Air Compressor Crankshaft - A Comparative Approach

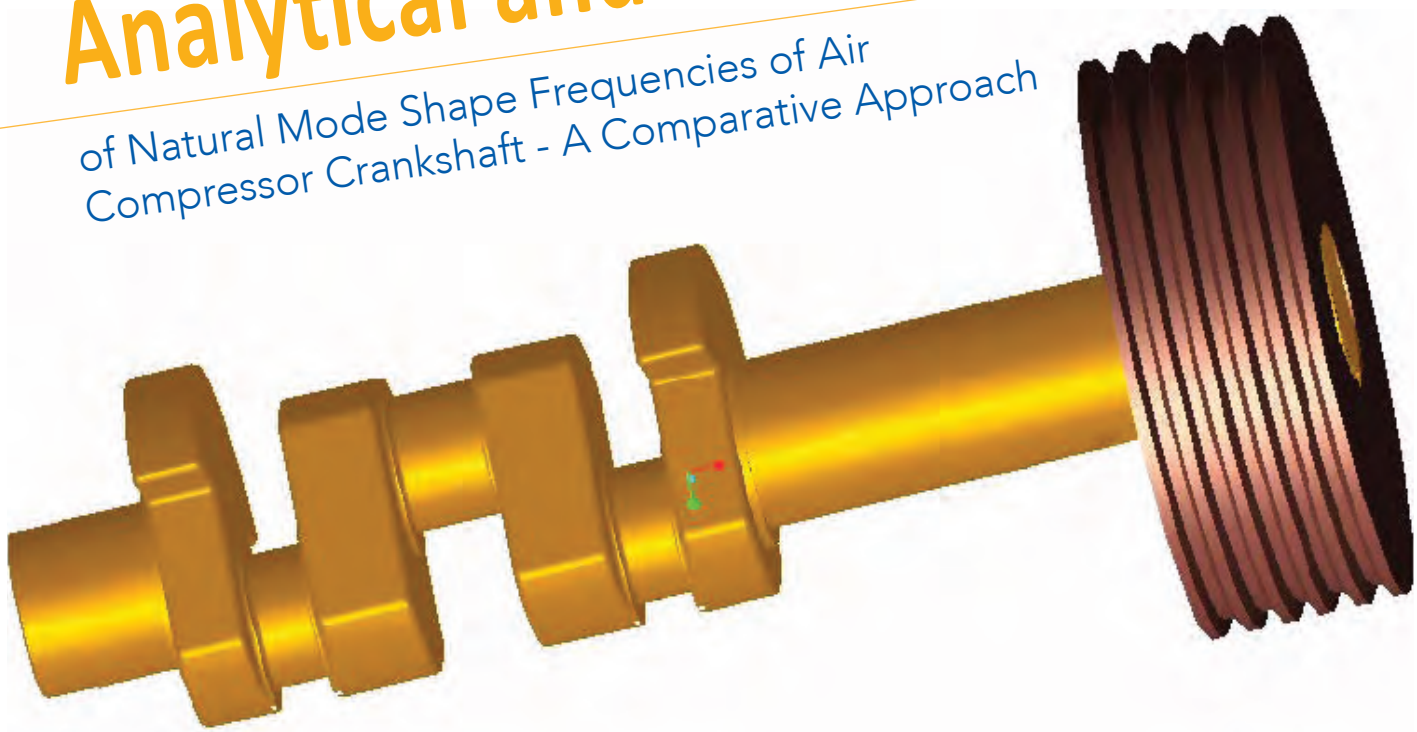


Fig. 2: Assembly of Crankshaft and Flywheel

This article presents the analytical method as well as Finite Element Method to find mode shapes crankshaft of reciprocating air compressor. Basic analysis is done by considering the crankshaft as a two rotor system so to calculate its natural frequency. The three dimensional Finite Element Model is constructed in PRO-E. Further meshing of the geometric model is done in ANSYS Workbench. Using FEA (Finite Element Analysis), frequencies corresponding to first three mode shapes is evaluated.

The results indicate that the natural frequency for crankshaft is much higher compared to excitation frequency (normal running speed). Hence, there are no chances of resonance effects. The results of Finite Element Model are in good agreement with the analytical results. Hence, the Finite Element Model can serve as a baseline model for further analysis and design/ optimization/ modifications of the crankshaft for future needs.

Introduction

Crankshaft is a vital rotating element in a reciprocating air compressor. It converts the rotary motion (usually received from prime mover like electric motor) into reciprocating motion of the piston in the slider-crank mechanism. Binyan Yu et al. have depicted that any material system with individual mass and stiffness distribution is susceptible to mechanical vibrations. They have used 3-node Timoshenko Beam Element for analysis of crankshaft used in compressor.

Analysis of free vibrations is essential so as to determine the natural frequencies and mode shapes of the system. If the load frequency matches with the natural frequency, then the dangerous and undesirable condition of resonance will

occur. The design engineer should take utmost care in the design so that condition of resonance will never occur in the working range of operating speeds. Analysis and performance studies related to crankshaft vibrations are difficult due to the complexity of crankshaft structure.

Jian Meng et al have suggested methodology and steps of FEM (Finite Element Method) Approach for analysis of crankshaft. C. Azoury et al have explained experimental verification by impact testing method. In this article, detailed analytical and FEM approach for mode shape analysis of the air compressor crankshaft is explained. The results are compared and percentage errors are highlighted for the case study under consideration. The steps given here can form the basis for further design and optimization of crankshaft an can aid in the design of other mechanical elements of the system.

Data used for a typical crankshaft used in reciprocating air compressor is given below:

- Crank Pin Diameter = 3.5 Inch (89 mm)
- Shaft Diameter = 110 mm
- Flywheel Diameter = 385 mm

Equivalent Length of Crankshaft for analysis considering it as two rotor system

A crankshaft with two webs and a crankpin provides single throw. Generally, there are one or two or more throws for a crankshafts. The equivalent length of crankshaft is given by equation (a).

$$L_e = 2b + 0.4(t_1 + t_2) + 3.288\, l_{p1}\frac{d_j^4}{d_p^4} + 1.284\, R\left(\frac{d_j^4}{t_1 w} + \frac{d_j^4}{t_2 w}\right) \quad (a)$$

Where, t_1 and t_2 are the web thicknesses, w is web width, dp is crankpin diameter, R is crank radius. The equivalent length of crank (Le) is calculated by taking diameter of shaft dj as 110 mm. Substituting appropriate values in equation a we get,

Leq = 950 mm

Thus, equivalent length of crankshaft assembly from the flywheel to the centre of the crankshaft is 950 mm.

Moment of Inertia

The mass moment of inertia for each throw depends on the inertia of rotating as well as reciprocating mass. The total reciprocating mass comprises of the small end of the connecting rod, nuts, cross head and piston assembly. The mass moment of inertia of reciprocating components is given by equation (b).

$$I_{Rec} = 0.508 \times \text{Reciprocating Mass} \times R^2 \quad (b)$$

The connecting rod is usually heavier at the big end (crankpin end) and lighter at the small end (reciprocating end). The mass distribution of the connecting rod is taken as two-third of total mass as rotating and one-third as reciprocating. The mass moment of inertia due connecting rod is given by equation (c).

$$I_{rot} = \text{connecting rod big end Mass} \times R^2 \quad (c)$$

Crankpin rotates about the "throw radius" and not about its centre; rotational inertia of shaft and crankpin is calculated using Theorem of Parallel Axis. The mass moment of inertia of crankpin around crankshaft axis (using Theorem of Parallel Axis) is given by equation (d).

$$I_{cp} = \left(\left(\frac{\pi}{32} d_p^4 l_p\right) + \left(8R^2 d_p^2\right)\right) \times 0.0000072 \quad (d)$$

On similar lines, we can calculate inertia of crank web, as given by equation (e).

$$I_{cwb} = (\text{M.I. of crankweb}) \times T \times 0.0000072 \quad (e)$$

Using equations b, c, d and e, we get,

MI of Reciprocating Parts = 40436.80 kg-mm^2

MI of Rotating Parts = 14005.33 kg-mm^2

MI of Crankpin = 11877.86 kg-mm^2

MI Crank Web = 271991.75 kg-mm^2

By adding all the above mass moment of inertias, we get the total mass moment of inertia of crankshaft unit. The same is given below.

I_2 = 357525.69 kg-mm^2.

The mass moment of inertia of flywheel is,

I_1 = 2046614.96 kg-mm^2.

The polar moment of inertia of a shaft of diameter 110 mm is given by equation (f).

$$J_1 = \frac{\pi}{32} d_j^4 = 14373768.14 \text{ mm}^4 \quad (f)$$

Natural Frequency of Crankshaft Considering It As Two-Rotor System

For ease of analysis, the crankshaft assembly is considered as a two rotor system (shown in Fig. 1 below).

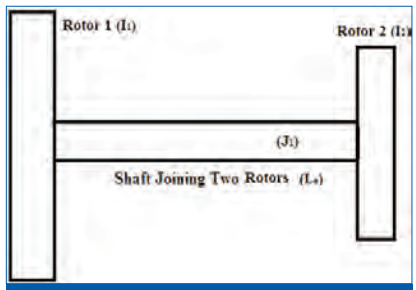


Fig. 1: Two Rotor System

The first natural frequency of crankshaft is given by equation (g). Nodal point of this system is N = 808.53 mm from Rotor 2.

Substituting all values in the

$$f_n = \sqrt{\frac{G\, J_1}{N\, I_2}} \quad (g)$$

equation (g), natural frequency corresponding to first mode shape is obtained as fn = 294 Hz.

Finite Element Analysis

Now, in this section, we describe the geometric modeling of crankshaft, finite element analysis using 4-node elements and necessary boundary conditions for FEA.

Finite Element Method (FEM) employs a method of dividing the geometry of a component into a number of small elements of standard shapes (called as elements) and then applying necessary boundary conditions or constraints. Here, we have created geometric model of

crankshaft using modeling software Pro-E. The step file of model so generated is then imported in ANSYS Workbench, which is easy to use and most popular FEM software. In order to determine the natural frequencies and mode shapes of crankshaft, we have incorporated Finite Element Method with the aid of CAE Tools.

The material properties are required in CAE so as to perform analysis for a specific real life component / part. In this paper, the material used for analysis of crankshaft is cast iron. Standard properties for Cast Iron (like density, modulus of rigidity, etc) can be taken from Meta Data or from Standard Materials Handbook. Here, we have used data supplied by Design Data Handbook.

Geometric Modeling of Crankshaft

Using modelling software Pro-E, we have created a solid model of crankshaft with cast iron as its material. The same is shown in Fig. 2: Assembly of Crankshaft and Flywheel

The flywheel is modelled in Pro-E with appropriate dimensions. The individual parts are then assembled by applying appropriate constraints (routine Pro-E Procedure) so as to use the final model for calculation of mode shapes and natural frequencies.

The advantage of such model creation and using FEM on the generated model is that we can get higher and higher order mode shape and natural frequencies with same model and within very small processing time.

Meshing of Crankshaft Assembly

The geometry is meshed in mechanical model window of an ANSYS Workbench. The Finite Element Model of the

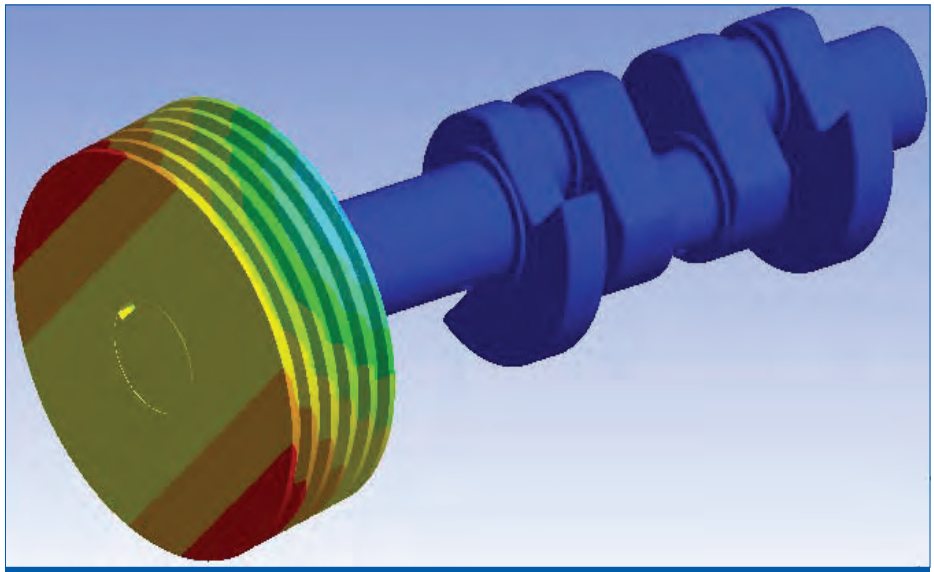


Fig. 3: First Natural Mode Shape of Crankshaft Assembly

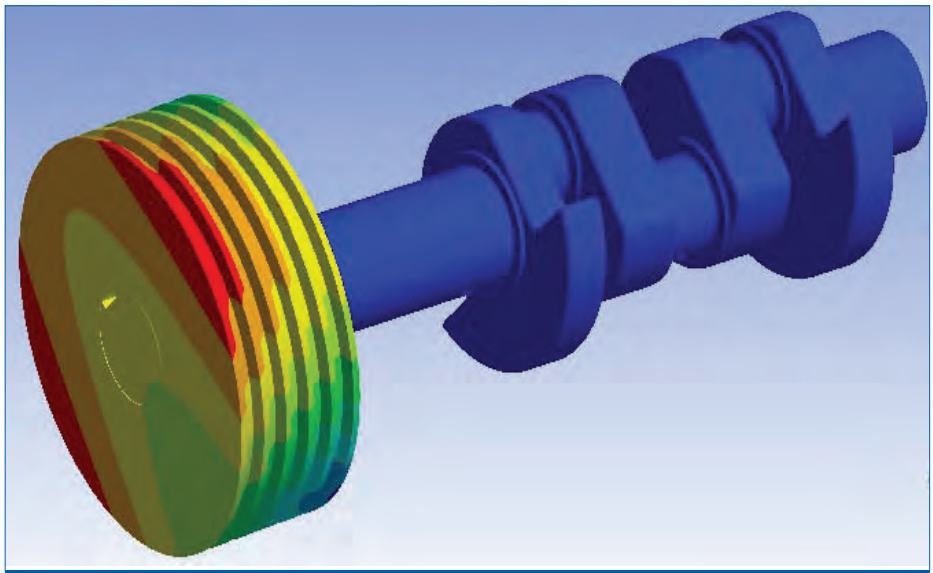


Fig. 4: Second Natural Mode Shape of Crankshaft Assembly

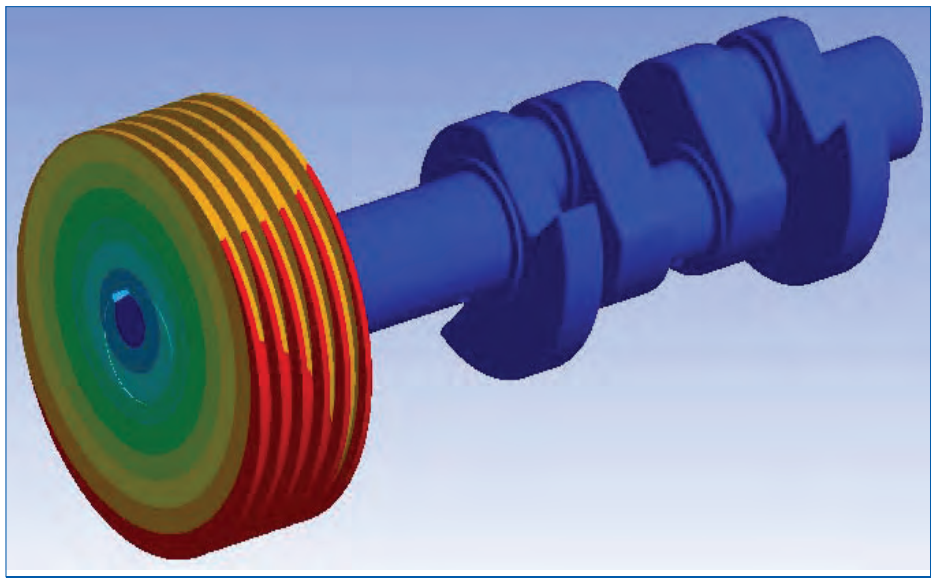


Fig. 5: Third Natural Mode Shape of Crankshaft Assembly

crankshaft geometry is meshed with tetrahedral elements (popularly known as 4-node elements). The global element length was chosen to be 5 mm and local element length was chosen as 0.342 mm at the fillets. A fine size mesh is used at all such fillet locations. This ensures better accuracy of results. The meshed crankshaft with 1839204 Nodes.

Boundary Conditions for FEA

Boundary conditions in any Finite Element Model are based on the actual geometric configuration. In this paper, compressor crankshaft mounted on three bearings is considered. The three bearing are considered as simple supports and their displacements are blocked in the model. Also, displacement of one end of crankshaft (which is connected to electric motor) is also blocked.

Result

Using Finite Element Model, the crankshaft can be vibrated at various orientations. The first mode of vibration is the important mode. If frequency of any externally applied torque is close to the frequency of first mode of vibration, a condition of resonance will occur. This is undesirable as catastrophic failure can occur due to resonance. In the analysis of crankshaft using the method depicted above, first three mode shapes and natural frequencies are extracted. Their values are 312.12 Hz, 316.03 Hz, and 328.4 Hz respectively. The results are given below. The figures III, IV and V shown below portray the first three natural frequencies.

Conclusion

In this article, Analytical Method to calculate natural frequency of crankshaft of reciprocating air compressor is depicted. The crankshaft is assumed to behave like a Two Rotor System with mass of flywheel as one rotor and mass of other crankshaft components acting as another rotor. The first mode shape frequency or natural frequency is calculated in order to check if the condition of resonance is likely to occur or not. The crankshaft is the modeled in PRO-E and the generated geometric model is analyzed using four-node Finite Element Mesh in ANSYS Workbench. Frequencies corresponding to first three mode shapes are generated using Finite Element Model. The difference between first frequency by Analytical Method and by FEM Approach is approximately 6.16%. The reciprocating air compressor crankshaft under consideration is driven by single phase induction motor running at 1440 rpm approximately, which corresponds to a forcing frequency of 24 Hz. This value is much lesser compared to natural frequency (first mode shape) of 312.12 Hz approximately. Hence, the condition of resonance will not occur. The crankshaft is thus not running in speed which is near to critical speed. This will ensure overall dynamic stability of the system. The accuracy of FEM results can be further increased by using higher order mesh.However, this will increase processing time and costs and those may not be justified in comparison to the improvements obtained in results.

Analytical as well as FEM Results can also be verified by Experimental Methods as suggested by C. Azoury et al. The same is beyond the scope of this article. ●

Prof. S K Yadav, BE and ME is currently working as Asst. Prof., All India Shri Shivaji Memorial Societies' College of Engineering, Pune.

Prof. Y B Karandikar, BE and MTech is currently working as Asst. Prof., All India Shri Shivaji Memorial Societies' College of Engineering, Pune.

Interview

In the process of setting helium testing

Prem Sakhuja, Managing Director, Blue Cold Refrigeration Pvt Ltd, Bangalore, in an exclusive interview with **Cooling India** says, our facility is designed in a way that it can accommodate a very high degree of customization.

BLUE COLD Refrigeration Pvt Ltd is an OEM manufacturer and supplier of Refrigeration Systems & Heat Exchangers. All the systems are designed and manufactured for maximum efficiency, henceforth, BLUE COLD promises to be a world class condensing unit manufacturer. It offers complete range of refrigeration systems with all types of compressors.

Could you share your experiences while working with prestigious global companies?

I started my career with Pearl Polymers, Delhi, where I was Project Engineer, and within three months I got involved with setting up of a new factory for Pearl Polymers at Gurgaon.

My experience at Ingersoll Rand, USA, and India was indeed the one of the most defining experiences of my career. Whilst experience in USA was about learning the best practices from the best, the experience in India was all about leadership and ethics.

According to you what is the status and scope refrigeration in the country?

Our focus is primarily refrigeration related to Cold Chain (not Industrial Refrigeration). The Refrigeration Industry is growing in the range of 12% - 15%. This industry can be very promising for a focused business model.

Let me elaborate, if you look at the food retail market, clearly this is one of the most promising areas with tremendous growth potential, and so is the transport refrigeration. Whilst the market is still at its infancy the growth potential can easily be in the range of 18% - 22%. Similarly the refrigeration business for dairy, meat, fish are all witnessing a healthy double digit growth.

Of course, there are roadblocks, like, availability of employable manpower, government investments and policy initiatives, infrastructure bottlenecks, etc. Nevertheless, business potential is strong, and promising.

Could you highlight the product range your company is dealing with?

The products that we supply are typically customer and their application centric, i.e. we provide

refrigeration systems that are most appropriate for the type of application that the equipment is used for. It could be used for cold storages, freezer rooms, blast freezing of fish & meat, banana ripening, mushroom storage, and other varied application.

From technology point of view, at the end of the spectrum we can provide very high energy efficient small condensing units, and heat exchangers, which are highly reliable. On the other end of the spectrum we provide sophisticated Screw systems and the most energy efficient compressor packs which can save a lot of money for our customers. Just to name a few of our product range that we manufacture and supply are-

- Condensing Units
- Compressor Racks
- Screw Systems
- Cubic Evaporators
- Dual Discharge Evaporators
- Process Room Evaporators
- Blast Freezers, etc.

What are the various refrigeration systems of company much in demand in Indian market?

Almost all of the above are very much in demand and highly appreciated by our customers. Of course, there are always some products that are much more in demand, that is true to any market or product line up.

Tell something about your manufacturing facilities and quality standards being adhered to? Do you have intentions to increase manufacturing sites?

Our office and manufacturing facility are located in Bangalore. We recently expanded and increased our current production facility. The most important thing about our product and ability is the focus and rigor that goes into designing of our products.

Our facility is designed in a way that it can accommodate a very high degree of customization that may be needed for customers' application. We test 100% of our products before they are shipped. We are also in the process of setting helium testing station that will ensure world class testing process for our products. Our current facility was recently expanded, we do not, at present, intend to increasing the manufacturing sites.

What are you views about foreign ventures, tie-up and collaboration?

Collaboration certainly has many advantages. There are some obvious advantages and benefits which could be in terms of sourcing technology, processes and products, and brands, but the not so obvious is the generation of employment in our country.

If we could get these best in class foreign manufacturers in India, it does help generate employment, and also helps in bringing Foreign Direct Investment in our country.

Your company BLUE COLD promises to be a world class condensing unit manufacture. What main characteristics would you attribute to support this promise?

Our brand BLUE COLD promise is to be manufacturer of world class refrigeration system, which comprises condensing units, compressor racks, screw systems, as well as evaporators, and blast freezers. ●

Trane office in Virginia earns Environmental Protection Agency's ENERGY STAR Certification for Superior Energy Efficiency

Trane office building located in Roanoke, Va., and owned and managed by Newbern Properties, has earned the U.S. Environmental Protection Agency's (EPA's) ENERGY STAR certification, which signifies that the building performs in the top 25 percent of similar facilities nationwide for energy efficiency and meets strict energy efficiency performance levels set by the EPA. Trane is a leading global provider of indoor comfort solutions and services and a brand of Ingersoll Rand. Commercial buildings that earn EPA's ENERGY STAR certification use an average of 35 percent less energy than typical buildings and also release 35 percent less carbon dioxide into the atmosphere. "Trane is pleased to accept EPA's ENERGY STAR certification in recognition of our energy efficiency efforts," said Dave Pierson, district manager for Trane in Virginia. "Through this achievement, we have demonstrated our commitment to environmental stewardship while also lowering our energy costs." Trane will host a media event on Monday, March 31, to celebrate the ENERGY STAR certification. U.S. Rep. Bob Goodlatte will be on hand to present Trane with a letter of recognition for this energy efficiency achievement at 1:30 pm. A tour of the building will follow. "Improving the energy efficiency of our nation's buildings is critical to protecting our environment, " said Jean Lupinacci, chief of the ENERGY STAR Commercial and Industrial Branch. "From the boiler room to the board room, organizations are leading the way by making their buildings more efficient and earning EPA's ENERGY STAR certification." The Environmental Protection Agency (EPA) ENERGY STAR energy performance scale helps organizations assess how efficiently their buildings use energy relative to similar buildings nationwide. ●

World's first CO_2 Refrigeration Interactive Course

elearning-training.com, the award winning training solution for HVAC/R and Building Services engineering continues to innovate by delivering a new and pioneering e-learning course in the use of CO_2 in refrigeration systems. CIBSE and The Construction CPD Service have accredited this highly instructive Carbon Dioxide course.

This CO_2 Refrigeration course provides a broad introduction to the fundamental knowledge required to work on CO_2 systems and also helps prepare the student for further study of advanced CO_2 Refrigeration Systems. The course covers design, installation and maintenance considerations, including advantages in using CO_2, and functionality of the different refrigeration systems, including volatile secondary with DX, volatile secondary/cascade, trans critical and direct expansion. This will be of great assistance to those already working with CO_2 and those about to use these systems.

Interest in Carbon Dioxide technology has rapidly grown in the last few years as it provides exceptionally high refrigeration capacities for compressor size while CO_2 itself is ozone friendly and has a low global warming potential (GWP) of 1. Regulations have further restricted the use of CFC and HFC refrigerants due to their damaging effect on the environment and the Industry believes that Carbon Dioxide technology will become even more important in the near future.

Star Refrigeration's experienced engineers have developed this Carbon Dioxide course. The information abou the use of CO_2 in refrigeration systems was collected from many sources around the world and put together into a superior two-module course, including CO_2 Fundamentals and CO_2 Refrigeration System Basics. Danfoss has also contributed to the development of the course by providing valuable learning material.

Star Refrigeration has been working on the development of CO_2 technologies and solutions that reduce users' environmental impact and running costs for more than 15 years. It has, over the years, collected many awards for pioneering environmentally friendlier technologies.

Star has played a leading role in the development of carbon dioxide refrigeration in the UK and overseas. Andy Pearson, MD –Contracts of Star Refrigeration is also co-founder and chairman of The carbon dioxide interest group (c-dig).

This group was formed in Europe in July 2000 to provide a platform for the exchange of news, ideas, information and experiences between refrigeration engineers in industry and research/teaching organisations. Al this knowledge and shared experiences in the use of CO_2 has been brought together to create this ground-breaking course, providing very clear and useful information abou the use of CO_2 as a refrigerant. Students achieving an 80% or more in the final test will receive a Diploma certified by CIBSE and the Construction CPD International Service.

Currently, elearning-training.com counts with a student community of more than 2000 members. The Chartered Institution of Building Services Engineers and The Construction CPD Service have accredited this Carbon Dioxide, which is already being successfully used by major retail Operators as their standard requirement for contractor training.

ACREX India 2015, Bangalore

25 years of excellence in HVAC/R

ACREX India is returning to Bangalore after show at Delhi where the event saw participation from over 400 exhibitors and nearly 30,000 visitors. Being organized by Indian Society of Heating, Refrigeration and Air Conditioning Engineers (ISHRAE) and produced by NuernbergMesse India Pvt Ltd, ACREX India 2015 will be conducted at India's only LEED Certified Green Exhibition Centre – Bangalore International Exhibition and Centre (BIEC) with over 40,000 sq mtr of air conditioned space. ACREX India is growing phenomenally every year and is becoming the launch platform for many International Organizations like, UNEP, CIBSE, REHVA, EBTC, AMCHAM, US Commercial Services, VDMA Germany, KRAIA Korea and CAR China to network with the Indian Industry.

The expo in its 2014 edition, for the first time, garnered support from the Ministry of New and Renewable Energy, Government of India. With ACREX India 2014 as the beginning of these relationships, ACREX India 2015 will create new benchmarks by developing on these industry associations. The expo is also getting support from the prestigious Indian associations like IGBC and BEE. On the launch event of ACREX India 2015, Madhava Rao, Chairman, ACREX India 2015, said "ACREX India is now South Asia's largest exhibition on Air Conditioning, Ventilation, Refrigeration and Building Services. With 25years of showcasing excellence in HVAC&R industry, the expo has grown beyond airconditioning and has now become all-encompassing by including fire safety, automation, cold chain products, solutions for smart homes and the allied building services as well. A testimony for the expo's growth is the addition of two new dedicated pavilions on Cold Chain and Smart Homes & Buildings. With the fast paced and evolving construction landscape of Bangalore, ACREX India 2015 will be a perfect platform for the industry to leverage the latest technologies and innovations in the sector."Giving an insight to the HVAC industry, Nirmal Ram, President, ISHRAE, said, "Bangalore is a home to 39 green buildings out of a total of 41 in the state of Karnataka. Besides, in 2013, Bangalore's construction industry saw a growth trend as compared to other metros with many new launches, good demand and resilient prices. As India still relies on Diesel Generator sets for uninterrupted power supply, which is not a very cost effective solution, the end users need HVAC&R systems which are not only energy efficient but also help reduce operational costs, more so in high energy consuming buildings like commercial, retail and hospitality. With increasing need for energy efficient HVAC&R solutions, it is just the right time for ACREX India 2015 to come to Bangalore."

Ms. Sonia Prashar, Managing Director, NuernbergMesse India said, "Entering its successful 25th year, ACREX India has become an exposition which the entire architect, consultant and developer community looks forward to. With a focus on increasing the international participation each year, ACREX India 2014 witnessed exhibitors from 25 countries including USA, Germany, Italy, Korea, Belgium, France, Japan, Malaysia, Singapore and China and this year at ACREX India 2015 we are looking forward to an even increased number." ACREX India 2015 will have an infinite product range to offer, starting from Water Distribution, Electricals, Water Treatment, Air Handling and Distribution, Refrigeration, Packaged Chillers, Services, Air Conditioners, Cold Chain Solutions to System Integrators. These HVAC&R and Building Services solutions would cater to Residential & Commercial Buildings, Automobile & Aviation, Railways & Airports, Hospitality, Healthcare, Cold Storage & Transportation, Defence, Malls, Data Centres & Institutions and Pharmaceutical/Industrial Manufacturing Facilities. The visitors would also have an access to Insight Driven Technical Workshops & Conferences. •

Antifrogen® heat-transfer fluids by Clariant

Clariant presents its Antifrogen® line of heat-transfer fluids. Antifrogen products are versatile heat transfer fluids based on glycols (Antifrogen N, Antifrogen L and Antifrogen SOL HT) and / or potassium formate (Antifrogen KF). All types offer freezing protection and reliably protect cooling and heating systems against corrosion. They offer customers an "all-round carefree package", including performances checks, sample analysis at no charge and technical consulting as part of the service provided. Antifrogen fluid demonstrate this commitment in action, offering long-term improvements to systems performance and contributing to the overall sustainability of the HVAC industry.

Website: www.clariant.com

Mitsubishi Electric VRF ODU by Mitsubishi Electric India Pvt Ltd

Air Handling Unit Package Type(AH-series) AH-series is for large capacity demand application such as shopping mall, airport, gym, etc. Its high air flow operation fulfill the various demand of air conditioning. Along with wide range of airflow, static pressure, and piping length up to 165 mtr. AH- series also provides optimized solution for both large capacity demand piping & installation burdens. The unit is available with one to one connection (1 AHU 1 ODU) with the additional accessories like controller interface and LEV KiT developed by Mitsubishi Electric, Japan. AH-series can be connected with both PUHY-P & PUHY-EP(high efficiency) series outdoor unit. This offers small footprint and lightweight. Control of AH-series is common with standard IDU and covers each controller's standard features. No need of separate centralized control, it can be controlled centrally with other VRF circuit through any of their centralized control. It is easy to maintain.

Website: www.mitsubishielectric.in

Honeywell GmbH brings Valves Series

Thermostatic Expansion Valves series TMX

Features

TMXL and solder base, two-way construction or angle construction; TMXB: TMX and flare base, two way construction; damped gas charge with pressure limiting MOP; liquid charge; adjustable superheat setting and is durable; solder connections or flare connections; external pressure equalization is integrated in the valve body; balanced port construction; interchangeable orifice cartridges; refrigerants: R22,R23, R124, R 134a, R227, R404A, R422D etc and further refrigerants on request.

Applications

Thermostatic expansion valves series TMX are used in general refrigeration and for original equipment. Plants with one or more refrigerant circuits such as refrigerated cabinets, deep freezing plants, milk cooling units, water chillers, air conditioning systems, cold stores and heat pumps. For plants with single and multiple injections, with high or low flow resistance, for all kind of distributors.

Automatic Expansion Valves Series AEL

Features

Smallest dimensions, high performance, hermetic construction, wide evaporating pressure range, adjustable evaporating pressure setting, solder connections, internal pressure equalization, extreme durable, fixed orifice, bypass on request, refrigerants: all CFC, HCFC, HFC, not for ammonia.

Applications

Automatic expansion valves (constant pressure valves) series AEL are used in general refrigeration and for original equipment. For plants with single injected evaporators and without a distributor, such as air conditioners, dehumidifiers, air driers, water coolers or ice-making machines.

Specification

Nominal capacity range: 1.4 to 29.1 kW R22; evaporating pressure range: 1 - 7 bar (a); maximum pressure PS: 25.5 bar (a); maximum test pressure maximum ambient temperature: 100 °C.

Website: honeywell-cooling.com

Insulated PUF PANEL for cold storage by Jindal

Jindal Mectec Private Ltd was earlier known as Jindal Mectecno pvt ltd. Cold storage has high specification and quality system providing reliable thermal, structural, fire safe and hygienic solutions. It is suitable for application with various types of supporting structures-steel, concrete, and existing building refurbishment. It has panel joint methods which helps preventing thermal bridging and condensation. The system is environment-friendly; Internal surfaces are manufactured with hygiene safe specification coating systems, which are approved for food stores and processing, and suitable for "wash and clean" down. Food & hygiene, safe insulation core resists moisture ingress and any risk of toxic mould and bacteria growth. No release of "fugitive fibers" into thermal environment. If installed correctly the system guarantees complete gas and vapor tight seal. It ensures against air gaps in the structure thus cutting down the operational cost of the cooling process. Insulated puf panels are used due to its lowest thermal conductivity and it is also used as structural insulation panel (SIP) eliminating the need of masonry construction. It has closed cellular structure which is water resistant and it has long service life.

Applications

It is applicable for the processed fruits and vegetable, ice-cream and dairy plants; refrigerated warehouses; poultry and sea food applications; slaughter houses and meat processing; cold rooms; retail warehouses; cold store pharmaceutical; bio-technology industry.

Website: www.jindalbrothers.in

Tecumseh introduces variable speed on Wintsys® and AJ silence fan motors

Control of condensing pressure to optimize performance of the expansion valve and therefore of the cold room. Noise level reduction at night and during low consumption time. Direct connection between the liquid line and the fan without electronic interface. Facilitated operation with easy adjustment of manual variation trimming. Increase in variation range up to 15 %. Reduced power consumption up to 5 times.

Ready to mount kits

Tecumseh has developed a simple solution for each Wintsys® and AJ Silence fan motor technology: AC, ESM, and EC. This solution is present in the factory and specifically optimized to ensure a simplified implementation, optimized cost and the guarantee of the fan variable speed. These kits include the entire element required to the implementation of the fan variable speed during installation. Screwed T; preset dimmer (R404A/ R134a); instruction for easy installation; for ESM technology, dedicated connection kit.

Website: www.tecumseh.com

Shavo Norgen (India) Pvt Ltd bring products

ISO – Roundline Cylinder – SCMI

SCMI Cylinder conforms to ISO-6432 standard specification and is made up of stainless cylinder tubes which resist corrosion and abrasion.
They are double acting cylinders of high strength, double crimped end cap design with butter cushioning.
These cylinders are available with comprehensive selection of mountings for fixed or flexible installation.
Standard Models are Bore dia: 16mm-25mm-stroke: 25mm-900mm.
Special versions like single acting, normally extended / normally returned, male thread / female thread, single rod, double rod, etc are also available on request.

ISO – VDMA profile cylinder – SCQS

SCQS cylinders conform to ISO 15552, VDMA 24562 specification and are available in Double Acting Magnetic with adjustable cushioning.

Standard Models are Bore dia: 32mm to 100mm – Stroke: 25mm to 3000mm.

Special versions like dual rod/adjustable/male thread are also available on request. Reed Switches can be mounted flush with the profile barrel and a comprehensive range of standard mountings are also available.

Website: shavoindia.com

Space Engineering Services Ltd introduces products

Internal Frame

It is the smallest of their plant solution and a cost effective refrigeration unit for the convenience store users with smaller refrigeration requirements. This HFC single or dual temperature plant can be configured with 3 to 10 compressors depending on cooling requirements. The plant is designed for easy installation in a plant or where space dictates a back of house area and is fitted with anti-vibration mounts as standard. As with all of their plant solutions the internal frame is pre-piped, commissioned, strength tested and CE marked, and has been assembled with minimal brazed connections reducing leak potential and manufacturing time. Their internal frame plants benefits from a Temprite oil separator which is 98.5% efficient and Traxoil regulators. The oil separator works by reclaiming oil from the compressors feeding it back into the oil regulators, helping to reduce inefficiencies in the cabinets and associated services costs. The plant's electronic oil regulators stop the compressors from running if the oil levels run low, preventing expensive compressor failures. The control panel has a full PLC backup for overcapacity in high ambient conditions.

Feature

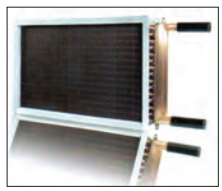
Single or dual temperature configuration, remote 30ltr receiver, supplied with anti-vibration mounts as standard, temprite high pressure coalescing oil separator, traxoil high pressure electronic oil level regulator per compressor, full PLC back up control, integral control panel, designed for easy installations in plant or stock room, suitable for convenience and small supermarket retail applications, can be fitted with any manufacturer or type of primary control or compressor. ●

CO2 plant for convenience

To meet increasing demand for refrigeration plant utilizing natural refrigerant, they have developed their latest CO_2 systems to complement their broad range of packed plant solutions. This environmentally friendly plant is designed CO_2 plant for convenience and small user application. The EC fans have a capped speed for normal operation and a full PLC backup for overcapacity in high ambient conditions; making them an energy efficient alternative. Even though a higher capital investment recent examples have delivered a payback in just 18 months. Copper pipe work is utilized for suction and oil lines to reduce leak potential and manufacturing timescales. For added safety the plant has a high pressure receiver with 60 bar delivery pressure making the plant more resilient and integral gas detection systems with audible alarm. The plant benefits from a Temprite oil separator which is 98.5% efficient and Traxoil regulators. The oil separator works by reclaiming oil from the compressors feeding it back into the oil regulators, helping to reduce inefficiencies in the cabinets and associated service costs. The plants electronic oil regulators stop the compressors from running if the oil levels run low, preventing expensive compressor failures. Single CO_2 refrigerant applied; environmentally friendly; low global warming impact, GWP=1; compact, transcritical design; low noise; EC fan motors; low cost of installation; low maintenance costs; future-proof; copper connections for site pipe work; suitable for convenience and small supermarket retail applications; easy access for services and maintenance; can be fitted with any manufacturer or type of primary control or compressor; integral 80ltr intermediate receiver; available as internal frame option. ●

Website: www.space-engineering.co.uk

Heat Transfer Coil by Waves Aircon pvt ltd



Waves manufactures high quality AHRI certified finned surface coils in 1/2" dia copper tube and aluminum fins for cooling and heating applications. DX coils for various refrigerant & brine application also available. Coils are designed for an optimum balance between pressure drop and heat transfer efficiency so as to get maximum amount of cooling and heating with minimum pressure drop. To provide the optimum cooling / heating solution, their coils are designed & manufactured using their latest coil selection software. The material used, both the copper and aluminum are of the best international standards. Their modern, automatic and highly equipped manufacturing facilities are capable to produce 6-18 FPI with an accuracy of 99%, hair pin join on one side of the coil to reduce friction losses and get better performance etc. They test their coils at pneumatic pressure of 350 psi for two hours to ensure a leakage / defect free product to their customers. ●

Website: www.wavesaircon.in

Products by Optics Technology

Bottle / Chemical Storage Cabinet

These specially designed cabinets provide a wash of sterile filtered, clean air through HEPA Filters having an efficiency of 99.97% down to 0.3 micron particle size. This cabinet protects dust and other particulates on Bottles and chemicals. For use in the Laboratory for chemical storage. Self standing capacity provides down flow clean Air in the cabinet.

Features

Large interior capacity for handling various sizes Bottles / Chemicals. Wire Mesh Trays are provided in the Chamber so that all the air will be fully recirculated. Low made of Stainless Steel & the outer body is made of mild steel duty powdered coated.

Pressure Module

Positive pressure modules are designed to provide a clean area within a small enclosure or cell. These pressure module adopts the same Laminar Air Flow Principle. It generates positive pressure where the Room is totally closed. It provides a source of Fresh Air in the Room.

Features

Wooden / M.S Duly Power Coated / Stainless Steel 304 Body. HEPA Filter, Pre-Filter, Blower (Motor Blower Assembly), U.V. Lamp, Operating Switch. High quality HEPA filter provides protection protection for the product (filtration efficiency of more that 99.97% at 0.3 micron. Ultra-quiet noise level of not more that 65 dBA. Static Pressure Manometer. Air Velocity: 90 ± 20 FPM (Average). Prefilter: 10 microns. Power supply. 220V Single Phase, 50Hz.

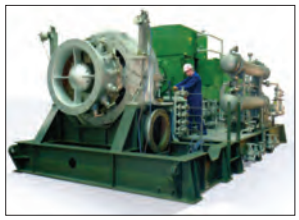
Website: www.opticstechnology.in

Howden offers products

Rotary Twin Screw Compressors (Bare Shaft Screw Compressors)

Howden Compressors ltd made the world's first commercial rotary twin screw compressor in the 1930's and supplies the largest and most versatile range of oil injected and oil free screw compressors. With 35,000 bare shaft units supplied worldwide, they are still at the forefront of screw compressor development. Howden Compressors ltd supplies Oil Injected bare shaft screw compressors through their global network of nominated packagers and distributors. The company offers oil free screw compressors as bespoke designed, complete packaged systems supplied through their specialist packaging business Howden Process Compressors.

Turbo Blowers



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

Efficiency Through Control

Howden Turbo Blowers range in capacity from 4,000 to a maximum 130,000 m^2 / hr with a pressure rise of up to bar, bridging the specification range between fans and compressors. The maximum power rating of the product range is up to 5MW, although the capability exists to exceed this power if required. The exceptional efficiency of their 'SG' blower range is based on the principle of integrating bespoke operational technology into each blower. The 'SG' range operates to a constant speed provided by a horizontally split gearbox that requires minimal maintenance and is encased within a compact package design.

Features

Adaptability: industrial or bespoke; API standards 617, 672 and 614; compact skid design or separate lube oil console; turn down to 45% volume flow.

Efficiency: high efficiency impeller; maintains optimum efficiency in all duty points.

Reliability: ease of maintenance; minimum downtime; designed to suit all environments.

Website: www.howden.com

Portable Air-Conditioner by Shenzhen Icesnow

With the rise of the tourism industry, there is a huge demand for all kinds of cooling products. Due to big in size, heavy in weight and power source restriction of traditional air conditioner coupled with its unmovable shortcomings, which widely limits its application. In order to solve these disadvantages of cooling products for tourism, Shenzhen Icesnow Refrigeration Equipment Co Ltd, has launched WZKT series portable air-conditioner for tourism usage. Icesnow WZKT series portable air-conditioner use low noise compressor, high-quality heat exchanger, which made the whole machine much lighter, smaller and easy to move compared with traditional air-conditioner. It has various model numbers such as, Model: WZKT700; refrigerating capacity (W): 710; Power (W): 413; current (A): 2.43; voltage (V): 220. Model: WZKT600; refrigerating capacity (W): 600; Power (W): 333; current (A): 1.85; voltage (V): 220. Model: WZKT465; refrigerating capacity (W): 465; Power (W): 295; current (A): 1.77; voltage (V): 220.

Application

It is applicable to beach tourism, family outdoor vacation, construction site, shed. ●

Website: www.icesnower.com

Gandhi Automations offers Automatic Industrial Overhead doors

Entrance Automations & Loading Bay Equipment Company, Gandhi Automations Pvt Ltd offers **Automatic Industrial overhead doors – the ideal solution for all industrial needs: Best use of transit openings**; **Weather resistant and Maximum safety**. Their compact size leaves more available space both inside and outside the premises. Gandhi Industrial Overhead Doors ensure a better use of inside space as the side runners vertically move the door along the wall and parallel to the ceiling. The doors are installed above the opening, thus ensuring a better use of the transit opening.

Easy and practical to open and operate - As these doors slide vertically, stopping in the proximity of the ceiling, they blend in with the architectural features of the building. Their compact size ensures more available space both inside and outside of the premises. The doors are also easy and practical to use.

More environmental control – Heat insulation and soundproofing ensured by heat-insulated panels improve working conditions on the premises and ensure energy savings.

Light and aesthetically pleasing environments – The panels can also be manufactured with the addition of practical portholes or full aluminium sections featuring polycarbonate or unbreakable glass panels, wire meshing or air grilles.

They add value to the premises and meet all requirements - the design and different solutions offered ensure the door to be aesthetically pleasing and perfectly suited in any architectural environment – from modern and traditional industrial buildings to fine commercial buildings. The doors can meet any industrial and commercial requirement and add value to the building they are installed on. These doors are built to ensure the highest ease and flexibility of use which, in turn ensures a quick, hassle free and accurate replacement of old doors. Reliability - all products are affixed with a CE mark. ●

Website: www.geapl.co.in

DNV Containers by Crystal TITAN Containers

Engineered for users safety, designed and built for users satisfaction. They operate the full range of dry van and dry special containers including some models not generally available. Available size/types include: All the above types are available for hire or sale as new containers naturally all are supplied with valid & relevant DNV certification. They supply DNV containers worldwide including from Indian locations. They can also supply in alternative sizes and other DNV container products like pipe carriers, skips, accommodation containers and baskets. ●

Website: www.ctcontainers.in

Controller for Heating Functions up to 1000°C by Elreha

The TAR 1159 is especially designed for high temperature heating functions in industrial plants. Heater/oven control, laboratory technologies etc. With its thermocouple inputs and its 16A relay output a heating function can be controlled. With two thermocouple inputs it is possible to use actual temperature values directly or to use average or differential values.

Functions (only parts):
Display of all Actual Values and Setpoints; temperature control; emergency mode while sensor problems; Internal Alarm Buzzer; compact housing for panel-door mounting.

Technical Data
Supply voltage/power consumption: 230V AC (50-60Hz) / 4 VA max.
Output relay: 16A (80A / 20 msec).
Protection class: IP 54 from front.
Air humidity: max. 85% r.H.

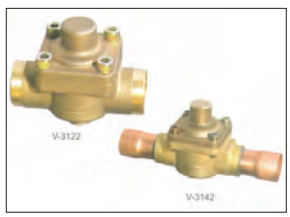
Website: www.elreha.de

National OEM Refrigeration Equipment Co Ltd

F type suction line filter
Introduction By-pass valve will rock while the refrigerant is flowing according to the arrow on the suction filter. If there is too much pressure drop, the by pass valve will open a little to keep the enough current and will make the hermetic compressor motor get the proper cooling. The by-pass valve will not work if make the wrong installation of the suction filter. It will not open even the pressure drop is very high. In this situation, it will need an access valve to check the pressure drop that pass by the core to the compressor suction valve. If the by-pass valve on the suction filter is not working, they can use access valve to check the pressure.

Features
Dual access valves for easy pressure readings.
Solid copper resistant connections.
Corrosion resistant epoxy powder paint finish.
Filtration: 40 microns.
Maximum working pressure: 3.5Mpa.

V Type Plunger check valves



V Type Plunger Check Valves can be used in commercial refrigeration systems, civil and industrial air conditioning equipments. It was designed with piston close and seal, forged brass body, and maximum flow and minimum pressure drop.

Feature
The valve ensures the correct flow direction only.
Prevents back-condensation from warm to cold evaporator.
Built-in damping piston that makes the valves suitable for installations in lines where pulsation can occur, e.g. in the discharge line from the compressor.
Oversize connections provide flexibility in use.
Easy disassembly and assembly design.

Technical Parameter
Refrigerant: CFC, HCFC, HFC.
Maximum.working pressure: 3.0Mpa.
Max.test pressure: 4.2 Mpa.

Website: www.filterdrier.cn

index to advertisers

Hicon Engineering Co Pvt Ltd brings products

Hicon Engineering Co Pvt Ltd is located in Greater Noida with a built up area of 15,000 sq ft. It has state-of-the-art facility, equipped with European machines. Hicon is known in the cold room market and is in collaboration with DAN Doors, Denmark enjoys the 30 years experience in cold room doors.

Flipflop Doors
Ideal for manufacturing premises, food processing facilities, supermarkets, ware houses and in particular with a mixture of walking & driving traffic. Help reducing drought, dust and noise. There are two types of Flip Flap Doors: PC (Polycarbonate) Doors: thickness: 5 mm; Insulated Door: thickness: 40 mm. ●

Website: www.hicon.co.in

Bulk Milk Chiller by Icemake

IC Icemake Refrigeration Pvt Ltd is a leading manufacturer of Industrial and Commercial refrigeration equipments, they also offer bulk milk chiller. The company offers solutions of bacteria free milk storage for dairy, milk collection center. Cooling & Maintaining Milk Quality at 4^{0}C Bulk Milk Center is the essential part of collecting centre of milk. The milk is 37^{0}C after the extraction. Bacterial growth affects the quality of the milk if it remains at room temperature to avoid this it is essential to keep the milk in milk chiller at 4^{0}C in given time. The Bulk Milk Chiller is available in various size, shapes which depending on the amount of milk to be cooled and the system of cooling.

Features
Faster cooling owing to direct expansion; robust design; durable tank made of AISI 304 SS; hermetically sealed compressor; digital temperature controller; it occupies minimum space; it is energy conscious; designed to be user friendly. ●

Website: www.icemakeindia.com

Water Chillers by DK-Kalteanlagen GmbH

DK water chiller consists of a container with a built-in evaporator, i.e. a combination of buffer and evaporator. The DK containers for open water systems (with oxygen supply) are enameled, while closed water systems are equipped with raw storage basins. Cold water containers with a capacity of 180, 280, 400, 700 and 950 l are supplied by DK isolated as steam diffusion proof containers. In the case of bigger containers, there is the risk that a prefabricated isolation might no longer be ensured. Thus, larger containers will be supplied without insulation and must be separated on site following their installation.

Description of the DK-KS-EVAPORATOR:
In the case of the DK water chiller, the KS evaporators are equipped with a very complex fluid distribution unit and interconnected on the suction side. In addition, the precise guidance of the refrigerant is obtained by using bends at the opposite side. The result is an almost 100% even distribution of refrigerants to the single tubes, so that one can assume that the temperatures inside all tubes are the same. This is a prerequisite of a trouble-free operation with evaporation temperatures below zero and water temperatures near the around freezing point. The DK-KS evaporator is also available with additional flange to facilitate the removal of the housing in order to clean the evaporator without any problem. So, nothing stands in the way of the use of the DK water chiller with unclean media. The DK water chiller has gained a good reputation also in the bakery and baking goods trade where enameled containers which are isolated in a steam-tight manner with a capacity of 950 l with double-walled evaporators. The equipment of salad washing plants with DK water chillers follows the same principle, since salad remains fresh for a considerably longer time when washed at below +40C.

Applications
Air conditioning systems with temperatures + 12 / + 6^{0}C; general process cooling plants +8/+4^{0}C or + 15 / + 10^{0}C; asparagus cooling +6/+1^{0}C; indirect cooling using glycol systems, e.g. -8/-4^{0}C; deep freeze systems -32 / -28^{0}C; special plants such as oil cooling -50^{0}C. ●

Website: www.dk-kaelteanlagen.de

Air Curtain by Mitzvah Engg Inc

Air Curtains, blows a controlled stream of air across an opening to create an "air-seal". This air seal prevents flying insects, dust, dirt and cold or warm air from entering the opening. Internal Conditioned air is kept from escaping the building. Traffic can flow freely through the opening and vision is unobstructed. Mitzvah Engg. Inc manufactures both recirculating & non-recirculating air curtains which are easy to install. These units are installed typically above the opening, although they can be vertically mounted in applications where necessary. The air is sucked into the unit which enters the fan housing and is discharged evenly through the nozzles, to meet the floor, thus creating an air seal through opening. The strength of this seal is controlled by both velocity and the nozzle width. The air forms a split when it meets the floor with approximately 80% of the air spilling towards the exterior (or intake side of the Air Curtain) and 20% spilling towards the opposite side. Mitzvah Air Curtains can be very effective when properly sized and installed, and can typically recover its cost in very less time. Industrial, commercial, retail firms and food service setting have been using Air Curtains to maintain a more consistent interior air temperature. Keeping the hot air (outside) from entering the conditioned air (inside) or cold (outside) air from entering the heated (inside) air substantially reduces energy consumption. It also acts as a deterrent to humidity on the premises.

Application for Exterior
The air curtains are not designed for security purposes. They are secondary doors that allow unrestricted access to the outside while conserving energy.

Application for Interior
Air Curtains are even used at interior doorways of industrial and commercial facilities to separate environments and to provide an invisible barrier for protection against drafts, dust, dirt, odour and fume. Mitzvah Air Curtains create an invisible barrier of air, generated by high efficiency, direct driven centrifugal fans that compress the air inside the unit and release the air through a directional nozzles outlet with a pressure powerful enough to stop winds up to 25 miles per hour. ●

Website: www.mitzvah.in

Sunlight with Cooling Factor


Image courtesy of Fraunhofer-Gesellschaft

Refrigerated by sunlight - we could well see an ecostatement like this printed on food packaging in the years ahead.

Using power of the sun for refrigeration is proving to be an original energy concept. In Tunisia and Morocco, Fraunhofer research scientists are using solar energy to keep perishable foodstuffs such as milk, wine and fruits, fresh.

Solar energy is already being used to power airconditioning systems in buildings, but now researchers also want to refrigerate fruit and other perishable foodstuffs using energy from the sun. Scientists from the Fraunhofer Institute for Solar Energy Systems ISE in Freiburg are demonstrating that this is feasible in the Mediterranean region using the examples of a winery in Tunisia and a dairy in Morocco. In the MEDISCO project (MEDiterranean food and agro Industry applications of Solar COoling technologies) solar plants for refrigerating milk and wine have been installed in cooperation with universities, energy agencies and European companies. The project funded by the European Commission is run by the Polytechnic University of Milan.

From Salting to Freezing, Refrigeration Technology has Changed

Refrigeration technology has a history all its own and The Refrigeration School, Inc, teaches courses in its application. Located in Phoenix, Arizona, RSI offers refrigeration classes in the theory and techniques to maintain and repair HVAC/R units. Salting food was a common preservation method before the invention of refrigerators. Bacteria cannot survive in salt, so rubbing dry salt on food or covering it in a salt solution called brine can help keep meat and other foods from spoiling. Some people had the advantage of an icehouse to cool their food to preserve it, which was the earliest form of a refrigerator.

After General Electric produced the first electric refrigerator in 1911, few Americans could afford the luxury of having this new invention in their homes. Other people used an icebox to preserve their food. Even this was a bit expensive since water had to be frozen, then the ice had to be cut, stored, and delivered. It wasn't until the 1930s that Freon was used in refrigerators. Throughout the 1970s, 1980s and into the 1990s, environmental concerns over the use of Freon were debated and studied. Because of its estimated effect on the environment, the government put tight restrictions on the use of Freon in refrigeration equipment. Because of the number of refrigerators used in homes, businesses, and transporting food and supplies, there is a significant need for trained professionals who can repair and maintain this equipment. By completing refrigeration technologies at RSI as a part of their program, capable technicians can work in the growing and highly demanded field of refrigeration.

Newly Launched

Aerosense Air Flow measuring station with Honeycomb flow Straightner

DPT Flow
DPT Flow is a flow meter that provides a new and easy way to measure the flow rate of centrifugal fans

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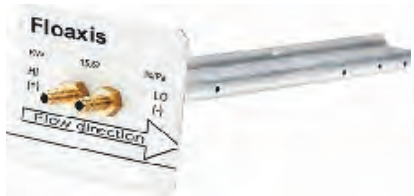

Floaxis - Averaging Flow Sensor

T8031-OEM Duct mount Co_2 Sensors

T8041 - Amphenol Duct mount Co_2 Sensors

Series ISDP - Dwyer Intrinsically Safe Differential Pressure Transmitter

TE - Dwyer - Temperature Sensors

T5100 Amphenol Wall mount Co_2 Sensors

Series HHT - Dwyer Intrinsically Safe Hazardous Area Humidity/ Temperature Transmitter

MODEL PS
Differential Pressure Switches

MS 2 - Dwyer DP Transmitters with Flow measurement capability and optional MODBUS/BACNET

T9002 Vaporstat
Infrared Dew Point Sensor

Series 629
Wet/Wet Differential Pressure Transmitter

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