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Publisher's Letter

Hello and welcome once again to *Cooling India*.

India remains the world's fastest growing large economy with huge middle-class population base. Hot climatic conditions prevailing through most part of the year together with expanding middle-class and increasing per capita income is driving the demand for air conditioners (ACs).

India's room AC market has skyrocketed from two million units in 2006 to approximately 30 million units in 2017 and is expected to cross a billion-unit mark by 2050. This will make the country world's top user of electricity for cooling. Further, increased use of AC also aggravates harmful climate change caused by emissions of carbon dioxide from power generation and the release of refrigerants like hydrofluorocarbons (HFCs) used in AC. This calls for an urgent need to improve cooling efficiency.

On this note, the Indian government has introduced the India Cooling Action Plan (ICAP) that is designed to provide an integrated approach towards cooling and related areas including a reduction in the cooling demand, in order to reduce emissions. This clearly shows India's commitment towards reducing global warming.

Heating, ventilation and air conditioning (HVAC) system is an integral part of any industrial facility because it helps to maintain air quality and humidity. According to latest market research report, the global industrial HVAC market is expected to grow at a CAGR of around 5 per cent during 2018-22 driven by the increasing demand for energy-efficient HVAC systems. This time, we present to you an in-depth analysis on potential opportunities in industrial HVAC.

HVAC cooling tower is used for ejecting the heat generated by a chiller and serve commercial applications like cooling the recirculating water of oil refineries, power plants, and chemical plants as well as cooling buildings such as large office buildings, hospitals, schools, colleges and oil refineries. Here, we discuss the prime features and components of cooling towers and energy conservation opportunities therein. We hope you'll enjoy reading this issue as always!

Please write to me at pravita@charypublications.in.

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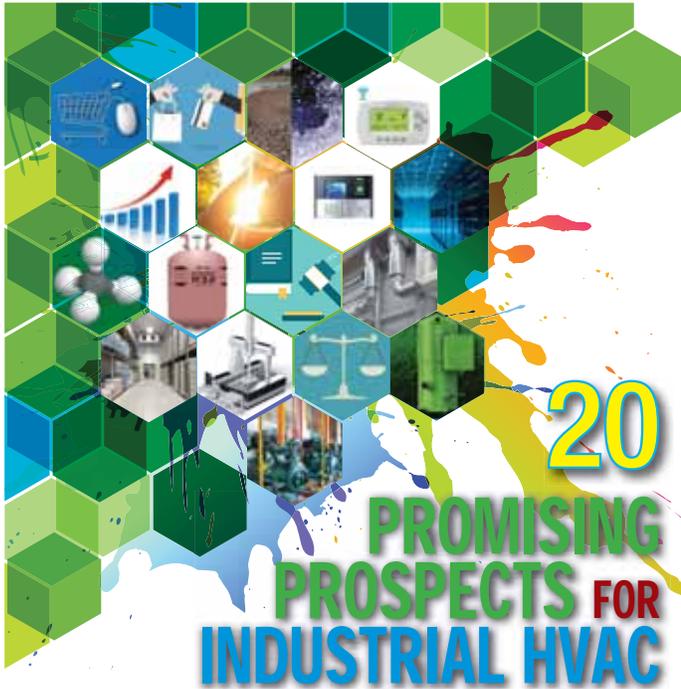


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Mitsubishi Optimises Efficiency through its MSY GR and MSY GR(T) Series of ACs



Mitsubishi Electric has launched its new range of 5-star air conditioners, MSY GR and MSY GR-T Series recently. MSY GR Series are empowered with Inverter Technology and MSY GR(T) Series are catered to Tropical Inverter Cooling. The new range of air conditioner provides features like powerful cooling with high energy efficiency and to bring optimal comfort. The new luxurious and stylish designs are equipped with tropical inverter technology, especially, developed to suit the air conditioning needs of tropical regions. The operational range of MSY GR(T) Series is up to 52 degree Celsius (Outdoor Temperature) with an optimised heat exchanger and the PCBs for improved cooling performance.

The models under these new air conditioner series are equipped with optimised heat exchanger and high cubic feet per minute (CFM) for fast cooling. MSY GR Series will be available with cooling capacity range of 2.8 KW to 7.2 KW and MSY GR(T) Series has capacity range from 3.7 KW to 6.6 KW. Even under harsh tropical conditions, these units will be able to maintain the rated cooling capacity and achieve effective air conditioning. The newly launched air conditioners have 'New Remote Controller' which has a specialty to display the errors code on the remote controller. Both MSY GR and GR(T) Series are loaded with features like long airflow and dual barrier coating which ensure better performance and longer life, are especially suited for living rooms. ■

MicroGroove Penetrates Indian HVACR Market

According to the International Copper Association, smaller diameter copper tubes increasingly are used in air conditioning and refrigeration applications in South Asia. A round tube, plate fin heat exchanger provides superior drainage and is easier to clean than a microchannel heat exchanger with serpentine fins sandwiched between ribbon-like multichannel tubes.

"A MicroGroove heat exchanger is made from smaller-diameter copper tubes," explains Avinash Khemka, Chief Manager at International Copper Association India. "MicroGroove offers numerous advantages. MicroGroove is now emerging as preferred alternative to microchannel. MicroGroove usage continues to grow in India. It is a preferred tube for India because of its corrosion resistance," Khemka continues. "It is true that a decade ago larger-diameter copper tubes began to lose market share to aluminium. Although a low point was reached in 2014, the corrosion resistance of copper prevailed and copper heat exchangers are now recapturing market share. The trend back toward copper has been dramatic in the last four years, as end users of aluminium microchannel experienced many cases of failure and leakage. Now end users have an energy-efficient copper alternative. MicroGroove copper has emerged as an easy-to-

maintain, reliable and durable option, well suited for the tropical climate of India.

"The industry is rapidly switching to MicroGroove as a practical, economical, eco-friendly alternative to MicroChannel," Khemka emphasised.



India is among the largest and fastest growing markets globally for room air conditioners (RACs) with about six million units sold in 2018. Increased infrastructural development, urbanization, higher standards of living and rising disposable income have all contributed to the heightened demand for air-conditioning.

Since the revision of Star Labeling by the Bureau of Energy Efficiency in 2018, AC manufacturers are specifying condensers and evaporators that transfer heat efficiently. Laboratory experiments show that heat transfer coefficients (HTCs) are the highest for smaller diameter inner-grooved copper tubes compared to larger diameter tubes and smooth tubes. Higher HTCs result in more efficient RAC systems. These systems also use less material and less refrigerant. MicroGroove coils made from smaller diameter inner-grooved copper tubes deliver an unprecedented combination of reliability and energy efficiency. ■

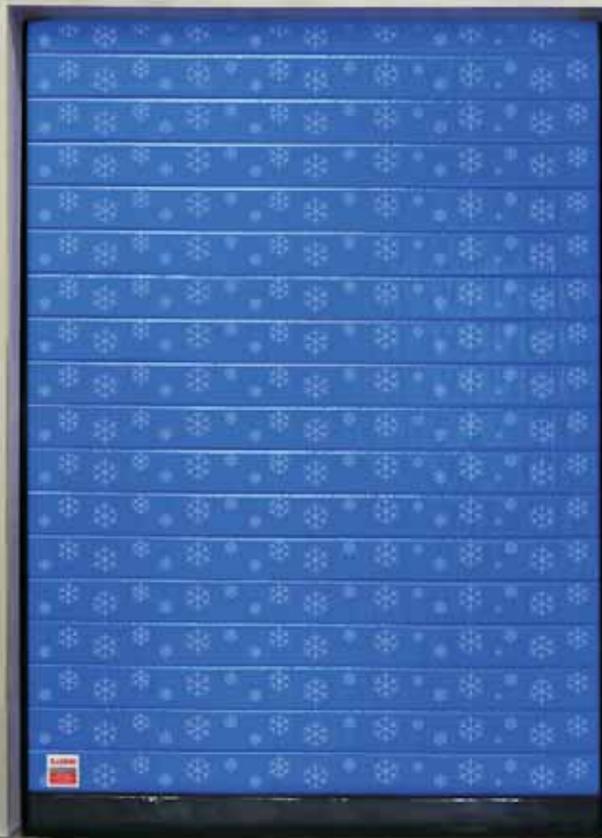
Grundfos India Launches Skid Mounted Systems

Grundfos India launched its 'Pre-fabricated HVAC Pumping System' in India for the first time at the ACREX India 2019. These prefabricated solutions aim to minimise on-site requirements for installation and commissioning shortens project timelines. In addition to the above, Grundfos will also display its range of iSolution products which pioneers a new era of intelligent solutions by utilising intelligent pumps, cloud connectivity and other digital services. These solutions help monitor the pumps real-time, control them remotely, predict faults and optimise the systems to achieve maximum efficiency. ■

Ajit Singh, Vice President- Sales (West), Grundfos India said "Grundfos iSolution is an embodiment of Grundfos' innovative spirit and is leading the way on our digitalisation Initiatives in the market. From Intelligent Vertical Inline Pumps to Efficient End Suction Pumps, from Small intelligent circulators to Big Skid Mounted Systems and from Remote Monitoring & Wireless Transmission to System Optimization, Grundfos has Advanced Pumping Solutions for every customer needs in the HVAC market today." Some of the other Grundfos products that were showcased at ACREX India 2019 are Magna3, TPE3, NB Skid System, CPO and Wireless Transmitters. ■



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Turkey, Germany & Spain Top Countries for LEED Green Building

The US Green Building Council (USGBC), the creators of the LEED green building rating system, announced the annual Top 10 Countries and Regions for LEED outside of the US. The list recognises markets that are using LEED to create healthier spaces for people, as well as use less energy and water, reduce carbon emissions and save money for families and businesses. Europe was well represented by Turkey, Germany and Spain who ranked sixth, seventh and tenth respectively. The three countries have nearly 1,000 certified LEED buildings totaling more than 25 million gross square meters of space.

"For the last 25 years, LEED has played a key role in sustainability efforts around the world," said Mahesh Ramanujam, President and CEO, USGBC and Green Business Certification Inc. (GBCI), the global certifying body for LEED projects. "The Top 10 Countries and Regions represent a global community of dedicated USGBC member companies and green building professionals who are committed to improving our quality of life. A better future requires a universal living standard that leaves no one behind—and that future would simply not be possible without the extraordinary work being done in these countries."

Certifications across the three countries are helping to raise the bar for green building. Projects including Turkey's Teknopark Istanbul Second Phase Buildings is a corporate park supporting the country's technology development and certified Gold under LEED v4. Germany's Airport Garden's office located within Dusseldorf's Airport Area certified Gold using LEED v4 and was designed with flexible floor plans to meet the needs of occupants. In Spain, the Logistik Gavilanes is a food distribution warehouse and the first warehouse to certify Gold under LEED v4. ■

CAREL Expands its Presence in Ukraine

The CAREL group is continuing its international expansion, consolidating its presence in Eastern Europe through the opening of a new sales subsidiary in Kiev, Ukraine.

"Ukraine and Eastern Europe are important regions for Carel," commented Mirco Cauz, Regional Coordinator Eastern Europe, Middle East and Africa. "We have gained significant market share in the area thanks to the support of our local partners, and we believe there is room for further growth, both in refrigeration and air-conditioning. The new Kiev office is intended to consolidate our presence on the Ukrainian market, one we consider very interesting, reinforcing our

commercial partnerships and looking to make direct contact with our final customers."

The new subsidiary will in fact provide faster and more direct assistance and support to customers in the area. Such support will be implemented through additional assistance in systems integration, after-sales services and training. In order to consolidate its position and fully exploit possible synergies in Eastern Europe, Carel's Kiev subsidiary will work closely with Alfacorel, based in Wroclaw, Poland. With an investment of Rs 166 crore (23 Mn USD) in Phase I, the unit has a capacity to produce ■

Schneider Gets Spot on CDP Supplier Engagement Leader Board

Schneider Electric, a global company in digital transformation of energy management and automation, was recognised for its actions and strategies in managing carbon and climate change across its supply chain, earning a ranking on the Supplier Engagement Leader Board by CDP, the non-profit global environmental disclosure platform. Supply Chains create 5.5 times more greenhouse gases than direct operations CDP's 2019 Global Supply Chain Report, prepared by CDP and Carbon Trust and titled Cascading commitments: Driving upstream action through supply chain engagement, revealed that greenhouse gas (GHG) emissions in supply chains are on average 5.5 times greater than those of a company's direct operations.

The growing awareness of the impact of climate change and the need to transition towards a low carbon economy have prompted more and more companies to put strategies in place to understand and manage environmental impacts within the supply chain. Schneider Electric helps customers save 31 million tons of CO₂. "We are extremely proud to be recognised by CDP for our commitment to a low-carbon economy," said Schneider Electric Chairman and CEO Jean-Pascal Tricoire. "Schneider Electric was singled out because of the digital solutions we bring to

our customers, and for the way we use them to improve our environmental performance."

Schneider Electric's engagement is illustrated in the quarterly non-financial Schneider Sustainability Impact (SSI) barometer, which measures the group's sustainable development performance. The latest SSI report shows that initiatives spearheaded by Schneider Electric helped reduce customers' CO₂ emissions by 31 million tons, with a goal of 100 million tons by 2020. The SSI also measures the volume of electricity from renewable sources; the group is striving to hit 80 per cent by 2020, and it is already making rapid progress: between the second and third quarters of 2018, renewable electricity consumption jumped from 6 per cent to 25 per cent. The United Nations recognised Schneider Electric as Global Compact LEAD for sustainable development, i.e., Goal 13: Climate Action.

The company's advisors help customers determine the proper reporting standards to meet organisational goals, implement productivity tools, such as EcoStruxure Resource Advisor, and analyse and verify data. The circular economy is central to the fight against climate change Schneider Electric has made the circular economy a centerpiece of its strategy, and its goals are ambitious. ■



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Panasonic Announces Partnership with Systemair



Air conditioning manufacturer Panasonic has announced the launch of a heat pump chiller series as part of a new strategic partnership announced with Swedish ventilation company Systemair. The alliance with Systemair was announced recently at the Climatización y Refrigeración exhibition in Madrid.

Dubbed the ECOi-W, the chiller is the first product of a collaboration which the two companies say will extend into ventilation and heat recovery for both the commercial and residential sectors. The Systemair-designed ECOi-W is due for launch in the second half of this year. Its spec includes cooling capacities from 20kW to 210kW, with an operating range of -17°C (heating) to 50°C (cooling).

The chillers are being manufactured by Systemair in the former Airwell factories in France and Italy. These new integrated solutions are described as being fully customisable and can be made-to-order to create bespoke solutions for specific projects. These will also utilise the companies' Smart Cloud remote control and maintenance interface.

"We see this as a great synergistic opportunity to develop, deliver and meet the higher level of environmental demands of our customers, in addition to providing long-term business prospects across an evolving European market," said Toshiyuki Takagi, Executive Officer of Panasonic Corporation and President of Panasonic Air Conditioner.

"We are very excited for this partnership and the new opportunity that this will create for new innovative and seamless solutions," added Roland Kasper, CEO of Systemair. ■

First Mega Food Park Opened in Tripura

Union Minister of State for Food Processing Industries Sadhvi Niranjana Jyoti inaugurated Sikaria Mega Food Park Pvt Ltd at Tulakona in Agartala. This is the first Mega Food Park in the state of Tripura. The inauguration took place in the presence of Chief Minister of Tripura Biplab Kumar Deb.

The Mega Food Park has been set up on 50 acres land at the cost of Rs 87.45 crore. The government has accorded approval of a financial assistance of Rs 50 crore to the project. The food park is having facilities of fully operational dry warehouse and material handling of 5000 MT, pineapple canning and pulping line of 2 MT/Hr each, packing unit, ripening chambers of 40 TPD, cold storage of 5000 MT with frozen storage of 1000 MT, quality control, research and development centre etc. It also has fully developed industrial plots for setting up processing units and Standard Design Factory (SDF) sheds to provide ready to move in facility for micro and small enterprises. The park also has a common administrative building for office and other uses by the entrepreneurs and 5 PPCs at Sonamura, Hrisyamukh, Chandipur, Manu and Budhjung Nagar having facilities for primary processing and storage near the farms.

The Mega Food Park will leverage an

additional investment of about Rs 250 crores in 25-30 food processing units in the park and generate a turnover of about Rs 450-500 Crore annually. The park will also provide direct and indirect employment to 5000 people and benefit about 25000 farmers in the CPC and PPC catchment areas.

Speaking on the occasion Sadhvi Niranjana Jyoti said that in 2014 there were only 2 MFP which were inadequate to



meet the demands of the farmers of the country. Farmers in this country have always faced the problem of storage of their produce and its processing. She said that upon taking over in 2014, the government had promised that it would give this country 42 Mega Food Parks. She added that she was happy to announce that the 17th Mega Food Park has been inaugurated in Tripura and expressed confidence that the other Mega Food Parks would also be operationalized and dedicated to the country soon. ■

National Institutes of Food Tech, Management Bill Gets Approval

The Union Cabinet chaired by Prime Minister Narendra Modi has approved the introduction of National Institutes of Food Technology, Entrepreneurship and Management Bill, 2019. The objective of the bill is to confer the status of Institutions of National Importance to National Institute of Food Technology, Entrepreneurship and Management (NIFTEM) at Kundli, Haryana, and the Indian Institute of Food Processing Technology (IIFPT) at Thanjavur, Tamil Nadu.

The legislation would provide for

functional autonomy to the institutes to design and develop courses, undertake research activities and leverage enhanced status in their academic pursuits, so that they become world class institutes.

The institutes would implement the reservation policy of the government and would also undertake special outreach activities for the benefits of concerned stakeholders. It would enable the institutes to provide world class teaching and research experience by adopting innovative practices. ■

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Vincent Named as Commercial Director of Foster

Rebecca Vincent has been named as Foster Refrigerator and Gamko UK's new commercial director, responsible for the UK sales and aftermarket departments.

Rebecca joined Foster in 2007 as regional business manager, progressing to director of export in 2014. She started in the refrigeration trade in 2003 at Hampshire-based contractor Cold



Rebecca Vincent

Control Services.

"I am delighted to be returning to the UK market and heading up the sales, spares and service operations," Rebecca said. "My time as export director has given me a great understanding of the wider Foster and Gamko business and international markets, and I will bring that knowledge with me into my new role." ■

Daikin UK MD Krutz Becomes CEO of AHT

Daikin UK MD Martin Krutz has been selected as CEO of the AHT Group in Austria. He will be replaced by Angela McGinlay, Managing director of Daikin Portugal.

The handover in leadership, that is effective from March 1, follows Daikin's acquisition of the AHT Group in November. Angela McGinlay originally joined Daikin UK in 2010 as midlands branch manager, later becoming corporate affairs manager. After moving to the Daikin Europe HQ in Ostend as department manager of customer service and process improvement, McGinlay became MD of Daikin Portugal in 2016. Martin Krutz's appointment as CEO of the AHT Group builds on 28 years' experience within the Daikin Group. Prior to his three years at Daikin UK, he held roles within the EMEA business reform office at Daikin Europe, as MD of Daikin Central Europe and Daikin Poland.



Martin Krutz

Krutz is taking over the helm at AHT from Frank Elsen, AHT's former chief financial officer, who has been acting CEO since October. McGinlay's place at Daikin Portugal is taken by Jan Logghe, currently section manager distributor sales within Daikin Europe. Mark Dyer, Commercial Director of Daikin UK, says, "On behalf of all Daikin UK employees, I would like to say that it has been an absolute pleasure working with Martin over the last three years, a time during which Daikin UK has grown

from strength to strength. He leaves the business in a very positive position, expanding steadily with a skilled team and strong people-centred culture which, together with continued product innovations, will ensure that we are ready to take on the opportunities and challenges ahead. We look forward to welcoming Angela to take us forward on the next stage of this journey." ■

ANIMA Selects Epta's Nocivelli as its President

Marco Nocivelli, Chairman and CEO of commercial refrigeration equipment manufacturing group Epta has been named President of ANIMA, Italy's Federation of Associations of Mechanical and Engineering.

Marco Nocivelli began his career in Accenture, joining the family business in 2000 as Managing Director of Epta brand Costan. Established in



Marco Nocivelli

1914, ANIMA has 60 associations and product groups within its membership, representing more than 1000 companies. "We want to support the protection and promotion of our sectors," Nocivelli said on his appointment. "We will continue to carry out initiatives to spread the knowledge of what we do and the needs of our sectors, also increasing our presence in Rome and Brussels." ■

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Bitzer Compact Screw Compressor Gets Best Application Compressor Award

Bitzer India won the Best Application Compressor award for its CSVH compact screw compressor series. The award was presented in Hyderabad, India, as part of the Global Logistics Excellence Awards 2019. Harvinder Bhatia, Managing Director BITZER India, is delighted: "Our CSVH series of compact screw compressors truly is an innovation – and we're very happy that an independent jury agrees with this view. But it comes as no surprise: the intelligent, speed-controlled CSVH series has an integrated frequency inverter and is the most efficient compressor in its class today."

The particularly powerful inverter-driven compressors have a displacement of up to 1,156 m³/h (50 Hz) and are optimised for air-cooled liquid chillers and heat pumps. Thanks to an integrated frequency inverter, they simplify to a high degree the installation and safe use of speed-controlled compressors in air conditioning, process cooling and heat pump applications. The series operates with a wide range of control and meets the most stringent requirements in terms of seasonal efficiency.



BITZER CSVH compact screw compressors are optimised for air-cooled liquid chillers and heat pumps



BITZER India won the Best Application Compressor award for the CSVH series

CSVH enables a large choice of refrigerants, including low-GWP HFO and HFO/HFC blends.

Customers around the globe rely on BITZER CSVH compact screw compressors. In India, several well-known process chiller manufacturers and data centres have the CSVH in use. ■

Dr Mark McLinden Wins J & E Hall Gold Medal

Dr Mark McLinden, who spearheaded a globally significant mission to find the next generation of environmentally-conscious refrigerants, has won the prestigious 2019 J & E Hall Gold Medal. The US-based chemical engineer led a team which employed highly-innovative methods to identify the best candidates for the next generation of low-GWP refrigerants.

Dr McLinden was the principal investigator for the groundbreaking five-year project funded by the US Department of Energy. His team applied its combined expertise in chemistry, thermodynamics and refrigeration to the research which has greatly helped the heating, ventilation, air conditioning, refrigeration and chemical industries to comply with international regulations.

"I am very honoured and somewhat surprised to receive this award," said Dr McLinden, who is based at the National Institute of Standards and Technology (NIST) in Boulder, Colorado. Dr McLinden has been actively engaged in researching new refrigerants for virtually his entire career. He was one of the original developers – with Graham Morrison – of the NIST



REFPROP database which has become the standard for refrigerant properties in the industry and which is widely used in the design of refrigeration equipment.

He was heavily involved in the phase out of the ozone-depleting CFC and HCFC refrigerants in the 1990s and the setting of standards for the thermodynamic properties of the then-new HFCs. ■

Refrigerants Market worth USD 31 bn by 2023

Factors such as rapid urbanisation, increasing spending income, and rising standard of living are expected to drive the demand for split ACs during the forecast period.

According to MarketsandMarkets report, the refrigerants market is projected to reach USD 31 billion by 2023 at a CAGR of 6.2 per cent from USD 22.9 billion in 2018. Split ACs is the largest application segment in the refrigerants market. APAC was the largest market for refrigerants in split ACs application in 2018, in terms of both volume and value. Factors such as rapid urbanisation, increasing spending income, and rising standard of living are expected to drive the demand for split ACs during the forecast period.

Ammonia was the largest type segment in the refrigerants market in 2018

Ammonia, an inorganic refrigerant, is mostly used in applications such as supermarket or hypermarket, industrial refrigeration, and chillers. It offers advantages such as low-cost refrigeration system, high efficiency that results in low power consumption, and a zero OPD and GWP rating, thus improving the overall ratings of HCFCs and HFCs. Ammonia refrigerants are gaining popularity in the APAC market mainly due to lower carbon dioxide emissions. The emergence of China as the global leader in the grocery market and the emergence of India and Indonesia as the fastest-growing grocery markets are driving the demand for ammonia refrigerants in the region.

The split ACs segment is estimated to dominate the refrigerants market during the forecast period

Splits ACs was estimated to be the largest application in 2018 and is projected to continue its dominance throughout the

forecast period. Factors such as increasing demand for ACs with better performance and durability are driving the split ACs segment. With an increase in disposable income, the standard of living in APAC is increasing drastically. Thus, the demand for luxury products is increasing rapidly.

APAC to account for the largest share of the refrigerants market and the trend is expected to continue throughout the forecast period

APAC is the largest market for refrigerants due to the presence of the largest and fastest-growing economies such as China and India, respectively, in the region. The rapid industrialisation coupled with the growing manufacturing industry is also driving the market in the region.

The rising disposable income of consumers along with the changing lifestyle plays a significant role in boosting the refrigerants market. Factors such as advancements in civil construction and high demand for efficient refrigerants drive the market. In addition, the rising demand from Thailand, Indonesia, Malaysia, Japan, and South Korea is estimated to boost the market for refrigerants.

The key market players profiled in the report include Arkema S.A. (France), Dongyue Group (China), Honeywell International (US), The Chemours Company (US), The Linde Group (Ireland), Air Liquide (France) (US), Sinochem Lantian (China), Daikin Industries (Japan), Mexichem (Mexico), and Asahi Glass Corporation (Japan).



PROMISING PROSPECTS FOR INDUSTRIAL HVAC

Rapid industrialisation and the growth of the service sector hold the promise of growth of Industrial HVAC, particularly, in manufacturing plants, warehouses, pharmaceutical industry, IT and ITES companies.

– Supriya A Oundhakar, Associate Editor

The World Bank expects India's GDP (Gross Domestic Product) to witness a growth of 7.3 per cent in the fiscal year 2018-19 and 7.5 per cent in the next two years on account of a surge in consumption and investments. For the next two years, India will continue to be the fastest growing major economy in the world. The rapid consumption of a burgeoning population is fueling the need for development of retail, hospitality, manufacturing plants, commercial properties, Information Technology (IT) and Information Technology enabled Services (ITES) industry, e-commerce sector, etc.

TechSci Research Report estimates that the Indian HVAC market will surpass USD 7.7 billion by 2022, on account of rising need for energy efficient HVAC systems, increasing construction activities, surging infrastructure-based developments and growing replacement demand for HVAC systems. Moreover, rising industrialisation, improving standard of living and surging purchasing power of people are some of the other major reasons expected to boost demand for HVAC systems in India during the forecast period.

Rapid industrialisation and the growth of the service sector hold the promise of further rapid growth of heating, ventilation and air conditioning (HVAC) systems in manufacturing plants, warehouses, pharmaceutical industry, IT and ITES companies.

"The government investment in infrastructure development, smart cities development, mass education and healthcare, tourism and transportation segments, has generated opportunities for HVAC market in India. Rapid climate change also attracts more demand for HVAC as Asia has hot and humid climatic conditions along with a growing urban population," states Manish Dhamija, CEO, VTS India.

Industries prefer to have its HVAC equipment connected to building management system or standalone

Using natural refrigerants – especially hydrocarbons – is the ideal solution for the future of refrigeration by sustainably aligning economic and environmental needs.

Guilherme Almeida

Marketing and Strategic Planning Director,
Embraco



automation system which eases the operation and maintenance process of the equipment. The new trends are more focused on energy saving, improved air quality, thereby categorising HVAC as a technically advanced industry, he further adds.

Trends

The major trend that the global industrial HVAC industry is experiencing is the growing adoption of R32 refrigerant in air conditioners. It seems that the global industrial HVAC market is moving towards the adoption of newer, advanced refrigerants that have better efficiency and are more environment-friendly than traditional refrigerants.

"Using natural refrigerants – especially hydrocarbons – is the ideal solution for the future of refrigeration by sustainably aligning economic and environmental needs. Moving to natural refrigerants not only helps with compliance of future standards, but it also makes it easier to service equipment and be more energy

efficient and environmentally friendly," believes Guilherme Almeida, Marketing and Strategic Planning Director, Embraco.

The need for energy-efficient equipment for different industrial processes has increased as end-user industries have been increasing their production volume to cater to the growing demand.

New refrigerants, the use of intelligent electronics in system components, increasing energy efficiency requirements for air-conditioning and refrigeration systems, stricter regulations, new system concepts and client-specific solutions are all challenges facing the HVAC industry. It is crucial to have the right refrigerant for each application and environment, informs Harvinder Bhatia, Managing Director, Bitzer India.

Need of HVAC for Industrial Segments

E-commerce boom has led to the development of warehouses of fulfilment centres where products are stored by the

It is crucial to have the right refrigerant for each application and environment.

Harvinder Bhatia

Managing Director, Bitzer India





We foresee an aggressive growth in new, upcoming industries and in turn increase in demand of the HVAC systems. Quality being the prime focus for all the customers, HVAC industry will see a continuously rising graph contributing to the industrial sector.

Manish Dhamija
CEO, VTS India

manufacturers and then distributed to the consumers. It is very important to maintain the ambient air temperature or humidity to the desired levels for staff to work effectively and to maintain the Indoor Air Quality (IAQ) of the space to the acceptable standards. Further in cold chain warehouses, perishable products can be damaged due to lack of necessary temperature maintenance.

“ASHRAE 62.1 2010 lays down the acceptable ventilation rates for warehouses. It is typically 10 cfm/person but will depend on other factors as well such as outside air quality, type of work etc. The temperature that is typically maintained in warehouses is around 28-degree C with a variance of 1 – 2 degrees. While no humidity standards are defined for warehouses specifically, the design aims for a humidity range of 55 – 65 per cent,” informs Aneesh Kadyan, Executive Director – Operations, CBRE South Asia Pvt Ltd.

Programmable thermostats can be applied in warehouses with time clocks, setbacks and demand control ventilation

depending upon the needs of stored products. It helps to reduce energy requirements of HVAC system.

Ammonia refrigeration for air conditioning in large, non-refrigerated warehouses can provide efficient cooling to large spaces and create a comfortable working environment for its employees.

The boom in IT industry has led to the development of data centres that require more cooling. Many servers run round the clock in data centres generating heat. The slightest dip or rise in temperature may lead to the malfunctioning of servers thus impacting its effectiveness. Further, dust particles can also wreak havoc for servers. Hence, it is very important to keep a tab on air quality inside data centres. Thus, maintain ideal temperature is crucial for proper performance of servers.

According to ASHRAE, the recommended temperature and humidity guidelines for multiple classes are shown in below:

**ASHRAE Class A1 to A4
Recommended Temperature and
Relative Humidity Range**



With the requirement of warehouses set to increase exponentially, the need for more advanced ventilation systems will arise and further help in making the supply chain more effective.

Aneesh Kadyan
Executive Director – Operations,
CBRE South Asia Pvt Ltd

Property	Recommended Value
Lower limit temperature	64.4°F [18°C]
Upper limit temperature	80.6°F [27°C]
Lower limit humidity	40% relative humidity and 41.9°F (5.5°C) dew point
Upper limit humidity	60% relative humidity and 59°F (15°C) dew point

ASHRAE has defined four classes of data center equipment; A1, A2, A3 and A4. Below are the essential points:

- A1 equipment operates from 15 to 32-degree C at 20 per cent to 80 per cent relative humidity
- A2 equipment operates from 10 to 35-degree C at 20 per cent to 80 per cent relative humidity
- A3 equipment operates from 5 to 40-degree C at 8 per cent to 85 per cent relative humidity
- A4 equipment operates from 5 to 45-degree C at 8 per cent to 90 per cent relative humidity

IT companies can monitor its HVAC bills by adopting alternative forms of practical, ambient cooling i.e. air-side or water-side economisers.

HVAC plays an integral part in manufacturing plants for ensuring the premium quality of the product. It also provides ambient working conditions for its employees thus, boosting the overall productivity. While designing an HVAC system for a manufacturing facility, the following requirements need to be considered:

- High and low temperature
- High and low humidity requirements depending on the product
- High volume of air
- Large quantities of outdoor air requirements.

The pharmaceutical industry, food industry, petrochemical plants need such requirements. Temperature, relative humidity and ventilation drive the quality of pharmaceutical products during its manufacture and storage. Further, microbial contamination can take a toll on the products.

Products for Industrial HVAC

As a driver of innovation in the air-conditioning and refrigeration industry, Bitzer has been offering climate-friendly, energy-efficient solutions for a whole host of applications for decades. These are ideal for a populous country like India, where the transition to sustainable, intelligent technologies is a high priority due to the significant environmental impact. It is going to take brand-new system concepts and further development of existing ones to phase out high-GWP refrigerants, which have always been the ones most commonly used.

Bitzer offers an extensive portfolio of energy-efficient and environmentally friendly HVAC solutions for industrial segments. Bitzer Orbit + and ORBIT FIT series take compressor performance to a new level, enabling users to meet the strictest energy efficiency standards. Orbit+ with line start permanent magnet motor boosts scroll chiller and heat pump system efficiency. The economiser operation of ORBIT FIT (Flexible Injection Technology) enlarges the application envelope and increases capacity as well as efficiency. All ORBIT series can be used with Bitzer Advanced Header Technology (BAHT) in more than 700 tandem and trio combinations which can also be uneven, meaning they combine different compressor types. The technology

guarantees proper compressor lubrication and reduces costs, increasing overall system economy. All series are suitable for A1 refrigerants like R410A as well as for the low-GWP A2L refrigerants R454B, R452B and R32.

Apart from products using low-GWP refrigerants, another great possibility to reduce energy costs is to use frequency inverter driven solutions, with which users can smoothly adjust a compressor's capacity to meet the actual requirements and save energy. According to Bhatia, if the motor is controlled by a frequency inverter, the frequency of the starting current and thus the speed of the motor can be adapted to the required refrigerating capacity.

If less energy is required at certain points in the process, the frequency inverter can adjust the electrical frequency and slow the motor down. This ensures that the motor consumes only the energy the process needs right now.

Embraco drives its strategy for the future in its drives - energy efficiency, natural refrigerants, low noise, sustainability, competitiveness and quality in food preservation. Another one is the environmental consciousness which it has driven more energy-efficient systems and regulations.

Based on the worldwide need to reduce energy consumption, Embraco developed

variable speed solutions, called Fullmotion technology. With the launch of FMX last year, we brought to the market the most optimised and competitive solution with advantages for new refrigerator designs, mainly those with limited internal space, informs Guilherme Almeida.

Outlook

The government's congenial policies have been beneficial in giving an uplift to all major industries equipment players setting up their manufacturing facilities and R&D centers in India. Thus, momentum in industrialisation is anticipated to drive growth in HVAC industry. As result, India as an emerging market has witnessed inventions, technological advancements and applications.

"We foresee an aggressive growth in new, upcoming industries and in turn increase in demand of the HVAC systems. Quality being the prime focus for all the customers, HVAC industry will see a continuously rising graph contributing to the industrial sector," claims Manish Dhamija from VTS India.

"With the requirement of warehouses set to increase exponentially, the need for more advanced ventilation systems will arise and further help in making the supply chain more effective," asserts Aneesh Kadyan. ■

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Embraco has been a pioneer in variable speed compressors achieving energy efficiency. The differentiation for Indian market is to offer a portfolio that can work with any voltage fluctuation and achieve high level of power consumption reduction, informs **Guilherme Almeida, Marketing & Strategic Planning Director, Embraco**, in an interaction with **Supriya Oundhakar**.

Embraco Expects 15-20% Growth for Indian HVACR market

India is an emerging economy. So, what kind of potential do you envisage for your products and services in India?

India is one of the fastest growing in the world with high GDP of about 7 per cent. Further, it has a huge population which is not using refrigeration at home or stores. So, considering this fact, there is a huge potential to increase the refrigeration market in this country. By having people with more disposable income and more power for consumption, we believe that India is going to be a huge market for Embraco solutions.

Which products have you launched at ACREX India?

ACREX is a very important trade show for us and is one of the largest in Asia Pacific. During the event, we have presented new solutions focused on energy efficiency and better food preservation, focusing on food retail, food service, aftermarket and merchandisers to connect with the value that we're providing to the end user.

First, we have the solutions for food retail segment, such as supermarkets and convenience stores. Second, Embraco has portfolio for food service applications, as professional kitchens for hotels and restaurants. The third one is for aftermarket where we have condensing units as well as replacement parts. We've also presented the merchandisers portfolio which can be applied in bottle coolers, for example. In ACREX, we have introduced NJX series compressors and this technology is equipped with motors up to two horse

powers that are ideal for professional kitchens and cold rooms applications.

Our solutions for India have wide voltage features, if you have any fluctuations in voltage and power is off, the compressor will keep working. For household refrigerators, we have showcased FMX compressors co-branded with Whirlpool, which has longer life span approved by VDE Institute (with 25-year lifetime) and is a bugless solution, a very relevant feature in India. These compressors can help the manufacturers in India to achieve the energy efficiency regulations which are stringent. India also has energy regulations that are very similar to Europe.

These solutions have high energy efficiency and can support OEMs to reach their energy efficiency goal. Further, we have also introduced FMFD compressors for food retail, such as supermarket islands and reach-ins. These are the most efficient compressors in the world for this range, with low energy consumption. In addition to the new launches, Embraco is still one of the leaders of R134a market, delivering a reliable and robust solution focused in India.

Do you think that ACREX India is the right platform for launching of the products? What kind of response did you expect for your products?

ACREX India is one of the best platforms to launch products in the Asia-Pacific, especially in India, and we've participated for the second year. Our goal at ACREX was to position Embraco as one of the biggest players in the refrigeration segment and as a global company that promotes quality of life through innovative cooling solutions. To be present in a large trade show like ACREX has been important to introduce Embraco's innovations in the Indian market and make ourselves known as a trusted and reliable brand.



Embraco's FMF compressor range

How do you differentiate Indian markets from European markets for your products?

We are selling almost the same products that we sell in Europe. India also has stringent regulations for achieving the goal of energy efficiency, such as Europe. So, the products are similar. The only differentiation for the Indian market is to offer a compressor that can work with any voltage fluctuation and this is something that Embraco has been doing for almost 20 years around the world through Fullmotion (variable speed) solutions. We have powerful products that will work even if the power goes off.

How unique are your products? Do you have any competitors for your products in India?

Embraco is a global refrigeration company that, throughout its 48-year journey and its local team, has invested in developing innovative solutions with the aim of providing a better quality of





Embraco is a global refrigeration company that, throughout its 48-year journey and its local team, has invested in developing innovative solutions with the aim of providing a better quality of life for society. We are a pioneer in variable speed compressors that help to achieve energy efficiency and reduction of power consumption as well as divide voltage.

life for society. We are a pioneer in variable speed compressors that help to achieve energy efficiency and reduction of power consumption as well as divide voltage. As India has problems with voltage fluctuations, it can work efficiently in India and bring higher energy efficiency. Embraco is also working with this technology for over 20 years, that is differentiated by natural refrigerants as well. It is in our portfolio if the customers want to have any new product, then he has the option with natural refrigerant or alternatives. Moreover, we push our customers trying to engage them to go for the natural refrigerant to achieve energy efficiency. We call it future proof solution as if a customer adopts natural refrigerant product or service, it will not affect the ozone layer and our next generation can live much better than us. India is also concerned about emission of greenhouse gases impacting the ozone layer.



Embraco's FMX Model Compressor

We do have competitors for our products in India. So, it is very important for us in ACREX to increase our brand awareness with differentiation that we have in terms of portfolio and services in terms of distribution. Today, we are serving India in every region. Then, these kinds of events help us a lot to get to know the market and also the market to get to know about Embraco.

Do you have any expansion plans in India? Do you have R&D centre in India?

Right now, I cannot speculate about expansion plans in India as we are under the acquisition process. What I can say that is we have a right set up with local and very experienced team. We have Indian workforce already working for Embraco in India, which work closely to our distributors to offer Embraco products in the whole territory.

Embraco's R&D Centre also has the support of its own 47 labs, located at its various plants. These labs are equipped with cutting-edge technology for research, measurement and diagnosis, as well as software for simulation and experiments. In India also, we have a team that has very strong technical expertise.

What is your outlook for HVACR industry in India?

I would say it is going to go very close to the GDP of India or even higher. I expect HVAC industry would witness 15-20 percent of growth every year and is going to grow more in the next five to ten years. ■

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Prime Freezer



High Speed Doors for Cold Storages from Gandhi Automations

Consultative selling has always been the basics of high-end technical products, Gandhi Automations a 22 years old company and dominating 70 per cent of the automated door market in India still believes in basics. Gandhi Automations is one company which doesn't get solutions from other parts of the world and just use Ctrl C-Ctrl V for the Indian markets.

While talking about cold chain, the geographical dynamics and operational conditions are very different in India as compared to other countries. The only one who has built solutions from scratch can address the Indian market. That's where Gandhi Automation fares sky above the others. 23 branches of Gandhi Automation across India are the data engines that generate humungous data on day to day challenges of a cold storage but good news is customers always walk out of these branch offices with a solution that is specially designed and customised for them, surely "Early Doors to Success" for cold storage owners.

'Envelop' a concept for Cold Chain Distribution Centre (DC) means a DC has to be perfect at walls to floors to entry-exit doors so that energy loss is low. DCs cannot afford to have solid panel doors and simultaneously the cooling wastage needs to be curtailed, even Door and Access System Manufacturer's Association (DASMA) confirms roll up design has lesser energy losses. Prime Freeze Duo is the solution from Gandhi Automations with a high-speed dual curtain technology with blower aid, roll up door. This product is suitable from +5 Degree Celsius to -35 Degree Celsius in case of a forklift impact the Prime Freeze Duo resets itself back into position. Hence it is a self-repairing product, innovative indeed. It has high level of insulation and is extremely safe and ideal solution to avoid any cooling loss. Further, products like High Speed Doors are apt for food storing cold storages with lesser cooling loss and ensuring reduced bacterial activity

promising higher standards.

Gandhi Automations' solutions cater to wide variety of customers ranging from large beverage manufacturing corporates to cold storages operating in retail markets, and every requirement is unique. But we want to highlight the ability of this company where it offers tailored solution to every client who decides to opt for 'Early Doors' to success.

The fact that Gandhi Automations believes in detailed research of its customers so it can offer a unique solution for better ROI creates impact in the business and plans future scalability. This process of owning customers and working as business partner ensures Gandhi Automations a sublime customer satisfaction, a must for a leader in Industry 4.0. ■



Prime Freeze Duo



Prime Freeze Duo

R170

Pure Hydrocarbon based Refrigerants

R600a

R290

R600

Hydrocarbon-based refrigerants can be used as an alternative to fluorocarbon refrigerants in some refrigeration and air conditioning applications.

The realisation of the importance of Earth's Ozone layer and the severity of Atmospheric Ozone Depletion due to Halocarbon atoms, particularly Chlorine in mid-1980s prompted the search for Environmentally-friendly Refrigerants. Particularly, we were looking for Refrigerants with least ODP and GWP. One of the products found suitable for refrigeration and air-conditioning applications was the family of Pure Hydrocarbons.

These were already being used in industry as clean fuel sources being petroleum products from fossils. However, it took a while for this fuel to be used for domestic applications as cooking fuel at homes. Storage in larger quantities presented potential risks. At homes, we have ladies, children and old people staying. So, Liquefied Petroleum Gas (LPG) consisting of Propane and Butane was introduced at homes as a cooking fuel

as an alternative for coal, kerosene and wood only after appropriate safety features

were incorporated in the gas as well as the storage and pipeline systems. Now we

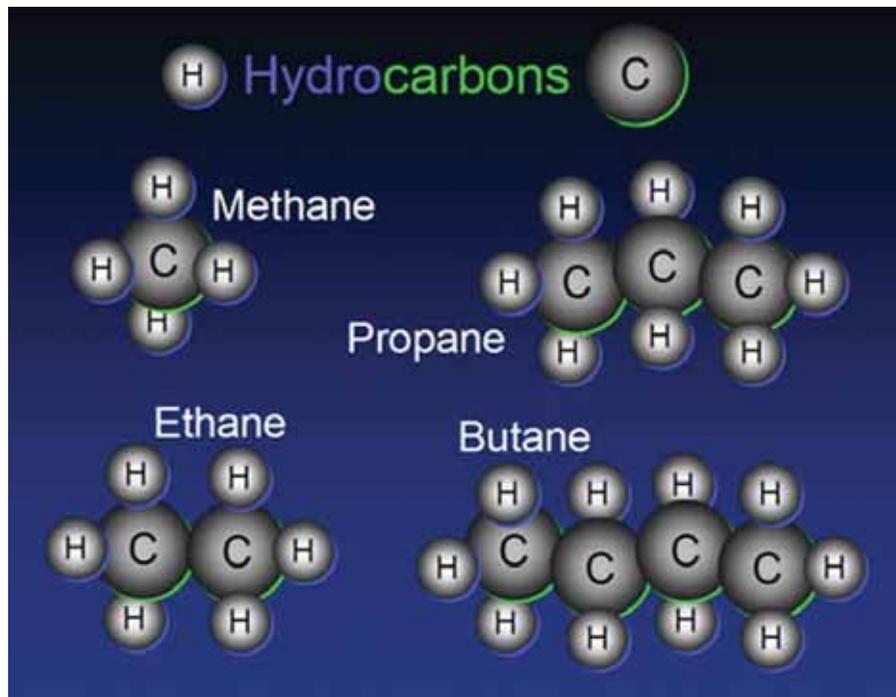


Table 1: Flammability Characteristics of Pure Hydrocarbon Refrigerants

Refrigerant	R600a	R290
Lower flammability limit (LFL)	1.5% by vol. (38g/m ³)	2.1% by vol. (39 g/m ³)
Upper flammability limit (UFL)	8.5% by vol. (203 g/m ³)	9.5% by vol. (177 g/m ³)
Ignition temperature	460°C	470°C

cannot imagine life without LPG. It was a quantum leap. There was no looking back. This slowly got evolved into LPG gas supply to homes through pipelines. Many cities have adopted this system with in-built safety features incorporated to make it harmless.

The search for alternative refrigerants led to pure hydrocarbons to be used as refrigerants.

What are Hydrocarbon-based Refrigerants?

Hydrocarbon-based refrigerants can be used as an alternative to fluorocarbon refrigerants in some refrigeration and air conditioning applications.

The term 'Hydrocarbon' encompasses following:

- Ethane (R170)
- Propane(R290)
- Butane (R600)
- Isobutane (R600a)
- Propylene (R1270).

Properties

- Hydrocarbons are highly flammable.
- They have low toxicity.
- R600a and R290 are heavier than air and the concentration will always be highest near the floor.
- R600a must only be stored and transported in approved containers and must be handled according to existing guidelines.
- Hydrocarbon refrigerants are fully

compatible with nearly all lubricants commonly used in refrigeration and air conditioning systems, except for those lubricants which contain silicone and silicates.

Flammability of Hydrocarbon Refrigerants

Flammability is a property of a mixture during which a flame is capable of self-propagating for a certain distance. Flammability is defined as its ability of a substance to burn or ignite, causing fire or combustion. The degree of difficulty required to cause the combustion of a substance is quantified through fire testing and is dependent on a number of parameters mentioned here.

Whether a substance is flammable depends upon the higher and lower flammability limits and also the supplied energy for ignition. The consequences of the flammability event depend upon the burning rate, heat discharged and by-products of combustion.

Mixtures of refrigerant and air can burn given that the fuel concentration lies inside well-defined lower and limits determined by experimentation stated as flammability limits.

Lower flammability limit (LFL, per cent by volume or g/m³): minimum concentration of the refrigerant that is capable of propagating a flame through a

homogeneous mixture of the refrigerant and air under the required test conditions of 23-degree C and 101.3 kPa. At a concentration in air, lower than the LFL, gas mixtures are too weak to burn. Methane gas has LFL of 4.4 per cent. In an atmosphere having less than 4.4 per cent methane, combustion cannot occur even if a source of ignition is present.

Upper flammability limit (UFL) is the highest concentration of a gas or a vapour in air capable of producing a flash of fire in presence of an ignition source (arc, flame, heat). Concentrations more than UFL are considered to be "too rich" to burn.

Burning velocity is the velocity relative to the unburnt gas (normally in cm/s), at which a laminar flame propagates in a direction normal to the flame front, at the concentration of refrigerant with air giving the maximum velocity.

Heat of combustion is defined as the heat evolved from a specified reaction of a substance with Oxygen.

Standards and classification

Standards offer limitations and suggested practices on the way to properly handle various refrigerants, including flammable ones.

ASHRAE standard 34 "Designation and Safety Classification of Refrigerants" categorises refrigerants based on their flammability and toxicity characteristics. It recognises several flammability classes from non-flammable A1 to highly flammable A3, depending on refrigerant's LFL value, heat of combustion and maximum burning velocity.

Standard ISO 817 "Refrigerants –



Figure 1: Safety Signs of Pure Hydrocarbons

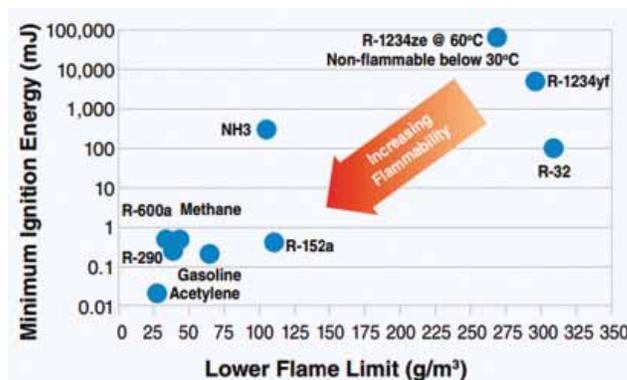


Figure 2: Minimum ignition energy and lower flame limit for selected refrigerants

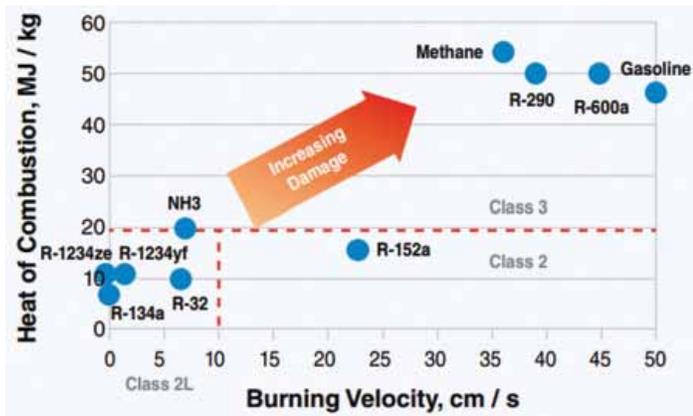


Figure 3: Heat of combustion and burning velocity for selected refrigerants

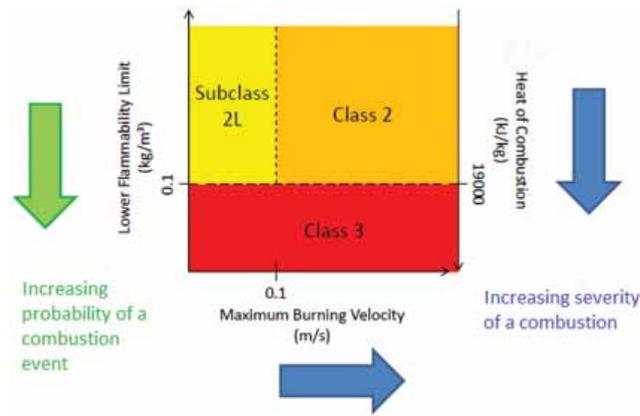


Figure 4: Flammability classes of flammable refrigerants according to ASHRAE standard 34

Table 2: Behaviour of flames of different refrigerants

Classification	A3	A2	A2L	B2L
Substance	Propane	HFC-152a	HFC-32	Ammonia
Burning velocity	39 cm/sec	23 cm/sec	6.7 cm/sec	7.2 cm/sec
Heat of combustion	46 MJ/kg	16 MJ/kg	9 MJ/kg	19 MJ/kg

Designation and safety classification” provides a clear and an unambiguous system for assigning designations to refrigerants and its flammability.

European Standard EN 378 “Safety and Environmental Requirements for Refrigeration Systems and Heat Pumps” aims to mitigate hazards to persons, property and the environment, caused by refrigerating systems and refrigerants. It thus regulates the use of flammable refrigerants in systems based on system location, occupancy level, system type and refrigerant used. A Current edition of EN378 standard was published in 2008 and does not directly recognise the A2L flammability refrigerants.

It is expected that the standards will be updated in the new edition.

In different countries the safety level of refrigerants is regulated by ASHRAE Standard 15 “Safety Code for Mechanical Refrigeration” (US) and ISO 5149 “Refrigerating systems and Heat pumps - Safety and environmental requirements” (internationally). On the equipment level, safety is regulated by European standards EN 60335-2-34 and EN 60335-2-40 etc.

Lower flammability refrigerants

To be deemed mildly flammable, any substance must burn at a velocity no greater than 10 cm/s. Hydrocarbons burn many times faster compared to Usain Bolt’s world record 100-meter time of 1043 cm/s.

It was felt that a more precise flammability index was required. Same

was proposed in ISO 817 revision working group (WG) in 1999. This proposal was to extend the relaxed anti-explosion requirements for ammonia, which was already well known as difficult to ignite substance, to all similar or lower flammability refrigerants. The WG concluded using burning rate as an extra category in 2002 with the upper boundary of 10 cm/s. This category was named 2L to differentiate from conventional flammable class 2. ASHRAE34 adopted this concept in 2010, while ISO 817 finally adopted in 2014.

In order to confirm safe use of refrigerants with this flammability category and to open up a path for lower GWP refrigerants within the category, specialists on the problem have conducted analysis and development for about ten years. Several risk assessments were conducted. They indicated that 2L refrigerants’ flammability is appropriate for air conditioners and heat pumps when these systems comply with standards for

Table 3: Refrigerant Charge Limits in Applications

Hospitals, prisons, theatres, supermarkets, schools, hotels, restaurants, dwellings	<ul style="list-style-type: none"> Refrigerant charge must not exceed 1.5 kg per sealed system Refrigerant charge must not exceed 5.0 kg in special machinery rooms for indirect systems
Offices, small shops, small restaurants, places for general manufacturing and where people work	<ul style="list-style-type: none"> Refrigerant charge must not exceed 2.5 kg per sealed system Refrigerant charge must not exceed 10.0 kg in special machinery rooms for indirect systems
Industrial, cold stores, dairies, abattoirs, non-public areas of supermarkets	<ul style="list-style-type: none"> Refrigerant charge must not exceed 10.0 kg in humanly occupied spaces Refrigerant charge must not exceed 25.0 kg for systems with high-pressure side in special machinery rooms No restrictions are placed on the charge size if all parts of the system containing refrigerant are in a special machinery room or in open air

equipment safety like EN 378.

It may be seen, that flame of mildly flammable refrigerants R-32 and ammonia does not propagate horizontally, thanks to their low burning velocities. In addition, the range of impact of the combustion of 2L refrigerants is limited, thanks to their low heat of combustion (that is specifically visible for refrigerant R-32).

Hydrocarbons and Environment

HCs are not connected to ozone layer depletion, and therefore the majority of HC refrigerants have a GWP rating (Global Warming Potential) of 3, compared to R404A chemical refrigerant which has a GWP rating of 3260!

The role of HC refrigerant systems in reducing harmful greenhouse gases is twofold: firstly, direct GHG emissions are considerably slashed because of the low GWP rating of HCs. Taking a typical grocery store, for instance, where about 5 to 10 per cent of total refrigerants are vented into the atmosphere, the employment of HCs as a replacement refrigerant cuts annual gas emission by several tonnes. Secondly, a typical HC system with a lower condensing point, positive thermodynamic properties and a superior COP (Coefficient of Performance) act together to optimise energy-efficient operation. Typically, the employment of propane gas (R290) as an air-conditioning replacement for HFC-134a system would result in a minimum GHG saving of 80 per cent.

Comparison with HCFCs

- It has been found that the performance of hydrocarbon refrigerants R290, R600a and R1270 compared to R22 is as good or better.
- It has been found that hydrocarbon refrigerants like R600a and R290 when blended with HFC R134a when used as a replacement to CFC R12 in domestic refrigerators can reduce energy consumption by 4-11 per cent.
- Hydrocarbon refrigerants have been found to be compatible with the materials in HCFC R22 and can use similar lubricants, but with appropriate safety measures.

- No one refrigerant has been known as an appropriate alternative for many applications, the blends may be HFC/HFC or HFC/HC.
- Hydrocarbons could be appropriate in some applications, but not for others, so usage should be based on individual merit.

Safety Issues

- Hydrocarbon refrigerants are flammable and restrictions are placed on their use to ensure safety.
- All electrical contacts should be sealed or non-sparking.
- The refrigerant charge in underground applications should not exceed 1.0 kg.
- Sealed systems up to 0.25 kgs weight refrigerant charge may be located anywhere.
- Systems with refrigerant charges over 0.25 kgs weight should not be located in places where an abrupt loss of refrigerant can raise the concentration of the space beyond 0.008 kg/m³.
- Piping for systems with more than 1.5 kgs refrigerant charge should be restricted to the space containing the refrigerant.
- It is not permitted to convert systems from refrigerants R12 or R134a to R600a, and from refrigerants R22, R502, or R134a to R290 due to intrinsic flammability safety issues as electrical safety has not been tested to existing standards. Compressors using flammable refrigerants like R600a and R290 are equipped with a yellow warning label.

Corporate Acceptance

- In Europe, several models of domestic refrigerators are factory-charged with hydrocarbon refrigerant. There are almost 100,000,000 home refrigerators in use around the world containing hydrocarbon refrigerants.
- Hydrocarbons have been employed in smaller air-con systems and cold-water dispensers.
- Hydrocarbon refrigerants also are employed in large process refrigeration systems within oil and gas industry.

Propane (HC-290) Based Home Refrigerators (EON) and Room Air Conditioners by Godrej & Boyce

Godrej developed R290 RACs with the collaboration of GIZ and India's Ministry of Environmental and Forests' Gas Cell. Since R290 is flammable, Godrej upgraded their producing facility to include further safety alarms and procedures for managing flammable refrigerants. Currently, Godrej has an annual production capability of 180,000 units for R290 RACs at its facility close to Pune.

Using Flammable Refrigerants Safely

R-290 could be a flammable substance, however, application of this refrigerant in residential and industrial refrigeration is safe if it meets European and international safety standards for 1- to 1.5-tonne capacity to be used in small rooms. The Godrej R290 AC unit, developed together with German development agency GIZ, and India's Ministry of Environment and Forests' Ozone Cell, addressed flammability of R-290 in four ways:

- Designing the appliance and manufacturing facility to minimise risks.
- Limiting the quantity of refrigerant charge within the AC in keeping with international safety standards.
- Installation of the A/C by factory-trained technicians.
- Safety procedures and training of service personnel.

The R-290 AC uses blast-proof components and system design to ensure that the amount of R-290 charged in an AC is so small that it never causes a flammability hazard in the event of refrigerant leakage.

Hydrocarbons are already widespread in domestic refrigerators with at least a 55 per cent market penetration in industrialised countries. Additionally, LPG producers and refineries are often able to supply the refrigerant.

Case study: Grenfell Tower fire

The Grenfell Tower fire occurred on 14 June 2017 at the 24-storey Grenfell Tower block of public housing flats in North Kensington, Royal Borough of Kensington



Figure 5: Grenfell Tower Fire

and Chelsea, West London. It caused about 80 deaths and over 70 injuries.

Police and fire department believe the fire started accidentally in a fridge-freezer

on the fourth floor. The rapid growth of the fire is assumed to have been accelerated by the building's exterior cladding that is of a standard type in widespread use. A

review of building regulations and fire safety by an independent body has been launched.

Emergency services received the primary report of the fire at 00:54. It burned for almost sixty hours until it was finally extinguished. About 250 firefighters and 70 fire engines from all over London were involved in efforts to control the fire.

Over one hundred London Ambulance Service crew on at least twenty ambulances attended, joined by the specialist Hazardous Area Response Team. London's Air Ambulance sent groups of HEMS doctors and paramedics by road in support. Firefighters rescued 65 people.

It was plausible that the building's structure may contain a fire within one flat, however in this case the fire was spreading speedily via the building's exterior.

It is to be noted that the fridge where the fire started was using R 600 (n-Butane) as refrigerant. However, it is not confirmed if leaking refrigerant was the reason behind the fire. ■

Mega Food Park Project to be Set Up in UP

Union Minister for Food Processing Industries Harsimrat Kaur Badal laid foundation stone for M/s Nandvan Mega Food Park Private Limited located in Mathura in Uttar Pradesh. Hema Malini, Member of Parliament from Mathura, Uttar Pradesh, Lakshmi Narayan Chaudhari, Minister of Dairy Development, Government of Uttar Pradesh and Krish Iyer, President and CEO of Walmart India also attended the inauguration ceremony.

The Mega Food Park is being set up on 57.41 acre of land at a cost of Rs 120.77 crore. Government of India has approved a financial assistance of Rs 50 crore to the project. The facilities being created by M/s Nandvan Mega Food Park Private Limited at Central Processing Centre (CPC) of this Mega Food Park include Multi-purpose Cold Storage - 2000 MT, Individually Quick Frozen (IQF) with Frozen Storage - 2 MT/Hr and 4000 MT, Dry Warehouse - 10000 MT, Raw milk packaging Line - 2 LLPD, Pulses and Grain packaging line - 2 MT and Food testing lab. In addition, the lead promoter will also setup an Anchor Unit with an investment of approximately Rs 24.13 crore for dairy processing with plant capacity of 500 TPD. The park also has a common administrative building for office and other uses by



areas."

The minister said that the modern infrastructure for food processing created at park will benefit the farmers, growers, processors and consumers of Uttar Pradesh and adjoining areas immensely and prove to be a big boost to the growth of the food processing sector in Uttar Pradesh.

Badal also said that the present government is fully committed to providing an environment that is smooth, transparent and easy for investors wanting to start an enterprise in India and in a bid to make India a resilient food economy and the Food Factory of the World, the government has made Food Processing a major thrust area of 'Make in India'. ■

Copper's Role in \$140 billion HVACR Market

Copper has played a key role in market drivers like climate change mitigation, product efficiency and design improvements that have expanded the HVACR market and present an opportunity for continued growth.

Copper's high conductivity, durability and workability gives it a dominant role in the fast-growing and rapidly changing Heating, Ventilation, Air Conditioning and Refrigeration (HVACR) market. Design change is a key feature of this industry, as the use of more environmental-friendly refrigerants and more efficient products are required, at a reasonable cost.

The HVACR market comprises a variety of product types used in both residential and commercial applications, from room air conditioners and large commercial systems to commercial and industrial refrigeration. Altogether, these systems make up a \$140 billion market that has grown by 55.5 per cent over the last 12 years, according to a study conducted by International Copper Association. Room air conditioners make up the majority of the units sold, and they also form the largest sector for copper. The market for room air conditioners requires annually about 1.04 million tonnes of copper, compared with 430,000 tonnes for refrigeration products and 220,000 tonnes in chillers.

Copper has played a key role in market drivers like climate change mitigation, product efficiency and design improvements that have expanded the HVACR market and present an opportunity for continued growth. Meanwhile, emerging markets present further opportunities for market expansion.

Countries like India, Indonesia and the Philippines have high populations as well as a high number of cooling degree days, which measure potential demand for air conditioning. These countries also have the lowest density of room air conditioners in place. These market factors represent a significant demand opportunity for additional air conditioning units. The market demand for copper is forecast to reach three million tonnes by 2022.

While emerging markets are forecast to drive HVACR demand,

copper's unique properties have allowed the metal to help improve the efficiency and design of HVACR products without a significant increase in costs.

Growing climate change concerns and an increase in minimum efficiency performance standards (MEPS) and labelling of room air conditioners worldwide have created a greater demand for product efficiency. Copper's inherent properties are helping to meet this demand through improved designs. For example, smaller diameter, thinner copper tubes and the inner grooving of copper tubes have been used to optimise product designs and increase efficiency in heat exchangers. These modern MicroGroove heat exchangers have dropped to 5 millimetres in diameter down from 9.52 mm over the past 20 years. They are more efficient, use less refrigerant and can work with high-pressure refrigerants. Similarly, motor-driven systems have been improved to deliver better and more efficient design. High-efficiency motors are more likely to use copper stator windings. In this way, copper's efficiency and its ability to be worked into smaller and more complex designs help to deliver better, more eco-friendly products for the same cost. The HVACR market will continue to adapt to climate change mitigation and efficiency demands. At the same time, growing populations in emerging markets will likely demand more air conditioning units. These trends are expected to have a significant impact on the market and, copper will continue to have a big role to play. ■



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Top 10 States for LEED Green Building in 2018

USGBC announces its annual list of top 10 states for LEED.

The US Green Building Council (USGBC) released its annual list of Top 10 States for LEED (Leadership in Energy and Environmental Design), the world's most widely used green building rating system. Illinois topped the list, which ranks states based on the number of LEED certified square feet per person. The Top 10 states for LEED are home to 128 million Americans and together include more than 468 million gross square feet of LEED-certified space. Buildings that are LEED-certified create healthier spaces for people, as well as use less energy and water, reduce carbon emissions and save money for families, businesses and taxpayers.

"Over the past 25 years, the US Green Building Council, its member companies and the green building community have come together to make our planet stronger, greener and more sustainable through

LEED," said Mahesh Ramanujam, President and CEO, USGBC. "These Top 10 states are examples of how we can create lasting, measurable change and improve the quality of life for everyone in

our communities. A better future requires a universal living standard that leaves no one behind—and that future would simply not be possible without the extraordinary work being done in these states."

2018 Top 10 States for LEED

Rank	State	Certified Gross Square Footage (GSF)	GSF Per Capita	Number of Projects Certified
1	Illinois*	68,133,942	5.31	172
2	Massachusetts*	34,718,212	5.30	122
3	Washington*	28,555,753	4.25	137
4	New York	72,881,287	3.76	214
5	Texas*	88,404,993	3.52	277
6	Colorado*	17,042,295	3.39	114
7	Hawaii*	4,504,287	3.31	20
8	Virginia*	25,348,631	3.17	136
9	California*	112,388,968	3.02	521
10	Maryland*	16,869,680	2.92	113
**	Washington, D.C.	37,147,538	61.74	145

*Included in 2017 Top 10 States for LEED list

**Washington, D.C. is not ranked as it is a federal district, not a state



Albany Damien Center Residences

As the number one state for LEED certification in 2018, Illinois certified 172 green building projects representing 5.31 square feet of LEED-certified space per resident. This is the first time Illinois has taken the top spot since 2015. Washington and Texas also made triumphant returns to the Top 10 securing the highest rankings in each states' history. In addition, Colorado

made notable strides in its LEED activity moving from number 10 in 2017 to number six on this year's list. The Top 10 list is based on 2010 US Census data and includes commercial and institutional green building projects certified throughout 2018. The full rankings is shown in Table 1.

USGBC calculates the list using per capita figures to allow for a fair comparison

of the level of green building taking place among states with significant differences in population and number of overall buildings. Notable projects that certified in each state in 2018 include:

- **Illinois:** Northwestern Medicine Lake Forest Hospital is LEED Silver and part of a redeveloped campus that opened in March 2018 with over 700



physicians providing primary, specialty and emergency care;

- **Massachusetts:** Dr Martin Luther King, Jr School, LEED Platinum served as a prototype for the Cambridge Green Schools Initiative and changed the way the District thinks about building energy while also using its design as a teaching tool for students;
- **Washington:** The LEED Platinum Seattle Fire Station 22 was designed to support the wellbeing of its firefighters while finding ways to reuse and conserve non-potable water to meet the station's needs;
- **New York:** Albany Damien Center Residences is a LEED Gold housing project that has provided over 400 chronically homeless people living with HIV and AIDS with long-term housing stability;
- **Texas:** The LEED Silver Austin Animal Kennel expanded its facility to meet the city's growing "No Kill" community and provides an additional 44 kennel

spaces, as well as play yards and adoption rooms;

- **Colorado:** Jones Hall at the Colorado School for the Deaf and Blind is a historic building that achieved LEED Gold and provides a place for visiting families to stay as well as a repository of resources for students across the state;
- **Hawaii:** Hawaii Convention Center achieved LEED Gold and is focused on measuring environmental performance to improve visitor experience and uses Arc to track its sustainability efforts;
- **Virginia:** Operation Smile's Global Headquarters used LEED to reflect its own commitment to make the world a better place during the construction of its new LEED Gold office in Virginia Beach;
- **California:** The Jet Propulsion Laboratory (JPL) achieved LEED Gold for Building 301 using LEED v4.1; LEED is used across JPL's campus to compare progress and continuously

improve building performance while also meeting federal guiding principles for sustainable buildings as a contractor to NASA; and

- **Maryland:** The Merriweather Post Pavilion Stagehouse is a LEED Silver home-away-from-home for touring artists playing at the iconic venue and reflects many of the artists environmental values.

While the Top 10 recognises progress at the building level, LEED is also now used to measure sustainability performance at the city and community levels. This year, nine of the Top 10 states are also home to LEED-certified cities and communities, including Chicago, Seattle, Austin, San Diego County and more. There are currently more than 137 registered and certified LEED cities and communities around the world, representing more than 50 million people.

Despite Washington DC not appearing in the official Top 10 list because of its status as a federal territory, it has



Dr Martin Luther King, Jr School, LEED



The LEED Platinum Seattle Fire Station



consistently led the nation and in 2018 certified 61.74 square feet of space per resident across 145 green building projects. The nation's capital has a strong legacy of sustainability leadership and in 2017 was the first city in the world to be LEED-certified.

Research shows green building will continue growing through 2021. Client demand remains the top reason to build green in the US and occupant health and well-being emerged as the top social factor. Through LEED, USGBC pushes the market toward higher performing buildings that also improve quality of life. Recently, USGBC introduced LEED v4.1, the latest update to the rating system, and opened registration for existing buildings (LEED v4.1 O+M), new construction (LEED v4.1 BD+C) and interiors (LEED v4.1 ID+C). LEED v4.1 emphasises human health and integrates performance metrics using Arc to encourage

ongoing tracking. There are currently more than 96,275 registered and certified LEED projects in 167 countries and regions.

The impact of buildings, cities and communities on people continues to be a priority for USGBC and across industries. In an effort to expand USGBC's global green building efforts and ensure that LEED is not only the de facto leadership standard, but also the pre-eminent living standard, USGBC launched the Living Standard campaign at 2018's Greenbuild in Chicago. Focused on the belief that storytelling can lead to a more sustainable world, the campaign aims to highlight stories – big and small – that capture how USGBC, LEED and other sustainability programs are raising the quality of life for people around the world. By visiting livingstandard.org, individuals and companies can join the campaign and submit stories. ■

Cooling Tower finds applications for heat rejection process. The article gives a glimpse of design methodology of a small cooling tower.

Cooling towers (CT) are widely used for variety of heat rejection applications like HVAC industry. A comprehensive design methodology is not available. Hence, design of a small water cooling tower is described in this article.

Cooling tower is generally designed for the average hourly wet bulb temperature (WBT) during summer at the place, where it is going to be used. Induced draught counter flow CT with splash fill is chosen after considering the relevant merits of various types. The CT characteristic and height are computed from empirical relationships. The fill structure is chosen from the commonly used fill configuration. The detailed design of CT system is described below.

- i. Selection of WBT & DBT: For example, the average of hourly wet bulb temperature in a site during summer (April to July) is 20.3 deg celcius and dry bulb temperature is 25.4 °C.
- ii. Selection of type of tower: The

natural draught cooling towers (ND CT) tend to be quite large, built in hyperbolic contour and initial investment is very high. It is difficult to have strict control on the temperature of cold water out from the CT and the approach to WBT will be high. The operation and maintenance cost is relatively less. Hence, only for very large installations, ND CT is preferred. On the other hand, mechanical draught cooling towers (MD CT) can be of very small capacity, less expensive, larger cooling range and close approach to WBT can be obtained. Forced MD CT causes more recirculation of hot humid air exit from CT as suction to the blower. Cross flow MD CT is thermally less efficient, has more recirculation, needs more maintenance and needs more tower volume for a particular capacity of cooling. Considering all the above factors, induced draught counter flow MD CT is selected.

Design Methodology of Small Cooling Tower

iii. **Design parameters:** The cooling tower is proposed to be designed with the following data:

- Design WBT is 20.3 °C
- Design DBT is 25.4 °C
- Atmospheric pressure is 92.0 kPa
- Water temperature inlet to CT is 35 °C
- Water temperature out from CT is 30 °C
- Water flow rate, m is 1,200 kg/h or l/h

iv. **L/G ratio:** The MD CTs are generally designed with water to air flow (L/G) ratio of 0.75 to 1.5. L/G ratio of 1.2 is chosen for the CT.

v. **Computation of tower characteristic:**

From psychrometric chart, enthalpy of inlet air, $h_i = 62.42$ kJ/kg

Enthalpy of outlet air, $h_o = h_i + \left(\frac{L}{G}\right) C_w \Delta T$

$$h_o = 62.42 + 1.2 \times 4.186 \times (35-30) = 87.54 \text{ kJ/kg}$$

$$\frac{KaV}{L} = \int_{T_o}^{T_i} \frac{C_w dT}{h_w - h_a} \cong C_w \frac{(T_i - T_o)}{4} \left(\frac{1}{\Delta h_1} + \frac{1}{\Delta h_2} + \frac{1}{\Delta h_3} + \frac{1}{\Delta h_4} \right)$$

Location in the CT	Water temp., °C	Water Enthalpy (h_w), kJ/kg	Air Enthalpy (h_a), kJ/kg	$\Delta h = (h_w - h_a)$	$\frac{1}{\Delta h}$
CT top	$T_i = 35$	$35 \times 4.18 = 146.2$	$h_o = 87.5$	58.7	
Level # 1	$T_i - 0.1 \times (35-30) = 34.5$	$34.5 \times 4.18 = 144.1$	$h_o - 0.1 \times 1.2 \times 4.186 \times 5 = 84.9$	59.1	0.0169
Level # 2	$T_i - 0.4 \times (35-30) = 33.0$	$33 \times 4.18 = 137.9$	$h_o - 0.4 \times 1.2 \times 4.186 \times 5 = 77.5$	60.4	0.0166
Level # 3	$T_o + 0.4 \times (35-30) = 32$	$32 \times 4.18 = 133.7$	$h_i + 0.4 \times 1.2 \times 4.186 \times 5 = 72.4$	61.2	0.0163
Level # 4	$T_o + 0.1 \times (35-30) = 30.5$	$30.5 \times 4.18 = 127.4$	$h_i + 0.1 \times 1.2 \times 4.186 \times 5 = 64.9$	62.4	0.016
CT bot-tom	$T_o = 30$	$30 \times 4.18 = 125.3$	$h_i = 62.42$	62.9	

$$\sum \frac{1}{\Delta h} = 0.0658$$

Tower characteristic

$$\frac{KaV}{L} = 4.186 \times \frac{(35-30)}{4} \times 0.0658 = 0.344$$

vi. **Cooling tower capacity:** The capacity of the cooling tower is calculated as given below.

$$\text{CT capacity} = m C_w \Delta T$$

$$= \frac{1200}{3600} \times 4.186 \times 5 = 6.97 \text{ kWt} (\cong 2 \text{ TR})$$

(Because, 1 TR = 3.52 kW)

vii. **Cross section of the tower:** From the nomograph, given in Perry's hand book, for the above design parameters, the tower area is computed as given below.

- Water concentration of the CT is 4,898 l/h m².
- The water flow to the CT is 1,200 l/h.

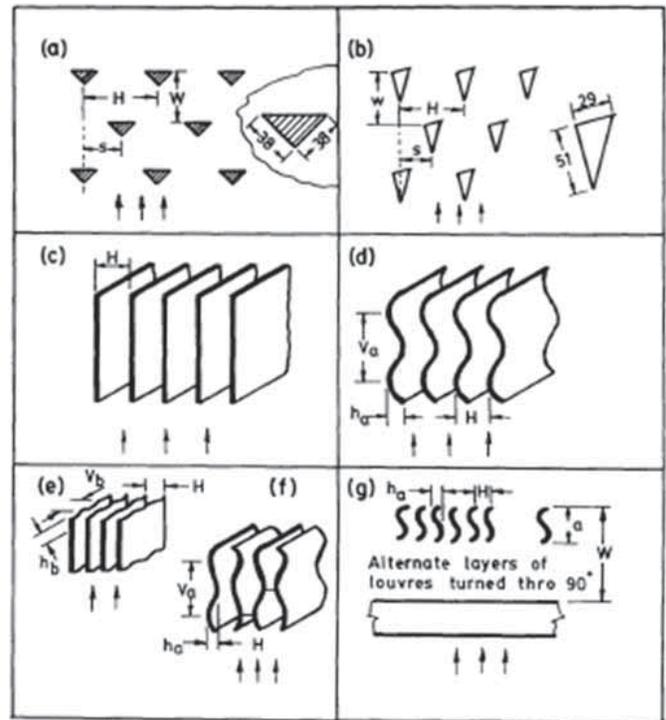


Figure 1: Schematic of commonly used fill in CTs. Note: (a) & (b) are splash fills and others are film type fill.

- From this, the area of the CT is calculated as 0.245 m².
- Hence, CT with cross section of 0.5 m x 0.5 m is chosen.

viii. **Fill type:** The water to be cooled in a CT is sprayed over the fill which provides large area of contact between water and air stream. The extent of heat transfer that can occur depends on the surface area of the fill. In induced draught CT, the air is induced along the fills through the fan. Two basic types of fills are utilised in modern CTs: Splash type and film type. The factors influencing the choice of fill are its heat transfer performance, maintenance, pressure drop, cost and durability. The film type fill gets chocked very fast, causes more pressure drop and needs more maintenance, although the thermal performance of film type is superior. Splash type fill does not get chocked because of the gap in between the bars, causes less pressure drop and needs less maintenance. Hence, splash type fill is chosen. The commonly used fill geometries are shown in Figure 1. Triangular splash bar (geometry a) is chosen for the project. Since this is a small CT, half the dimension of the common geometry is chosen.

ix. **Height of the tower:** The height of the tower is calculated directly using the volume transfer coefficient (Ka/L) represented in equation form as given below.

$$\frac{Ka}{L} = \lambda \left(\frac{L}{G}\right)^{-n}$$

For the type of fill chosen, $\lambda = 0.295$, $n=0.5$

$$\frac{Ka}{L} = 0.295 \times 1.2^{-0.5} = 0.269$$

From equation, $\frac{KaV}{L} = 0.344$

Tower volume, $V = \frac{\frac{KaV}{L}}{\frac{Ka}{L}} = \frac{0.344}{0.269} = 1.2 \text{ m}^3/\text{m}^2$

Hence, tower height = 1.2 m

- x. **Fill structure:** The overall dimension of the fill matrix is chosen just smaller than the tower dimension so that it can be kept inside the tower. Hence, the fill matrix dimension is 0.49 x 0.49 x 1.2 m height.
- xi. **Cold water sump:** The function of the sump is to collect the water from the fill without spillage. Hence, the area of sump has to be larger than the fill area. The area of the fill is 0.5 m x 0.5 m and the area of the sump is chosen as 0.6 m x 0.6 m. Minimum quantity of water is to be stored in the sump to attain the steady temperature fast during the operation of the cooling tower. Hence, the sump height is chosen as 0.25 m, whereby upto 90 litres of water can be held in the sump for circulation.
- xii. **Design of water distribution system:** The function of the distribution system is to spray the hot water from the geysers evenly over the fill matrix. To ensure the evenly spray of hot water over the fill, it is proposed to have five small pipes at equidistant on either side of the main distribution pipe. In each small pipe, five small holes are put at equidistant, below which a conical plate is fixed to splash the water from each hole. The detailed design procedure is described below.

The design water flow rate to the tower is 1,200 l/h (= 1.2 m³/h).

The optimum water velocity inside a cooling water discharge line is 1-3 m/s. Hence, a 19 mm pipe is chosen for both suction & discharge side.

Water velocity = $\frac{\text{Flow}}{\text{Area}}$

Velocity, $v = \frac{1.2}{\frac{\pi}{4} \times 0.019^2} = 1.18 \text{ m/s}$

Kinematic viscosity, ν of water at 32.5 deg celcius(average of cold & hot water) = $0.788 \text{ e}^{-6} \text{ m}^2/\text{s}$

Reynolds number, $\frac{vD}{\nu} = \frac{1.18 \times 0.019}{0.788 \text{ e}^{-6}} = 28,452$

For Re 4,000 to 10⁶, coefficient of friction, $f = \frac{0.0791}{\text{Re}^{0.25}} = 6.09 \text{ e}^{-3}$

Loss of head in pipe due to friction, $H_f = \frac{4fv^2}{2Dg}$

- a) **Suction side head:** The pump will be mounted by the side of the cold water sump, so that the suction pipe is at the bottom of the sump. Suction pipe diameter is 19 mm. Pump suction will have a non-return valve (NRV) and no foot valve.

i. Entrance loss = $\frac{0.5v^2}{2g} = \frac{0.5 \times 1.18^2}{2 \times 9.81} = 0.035 \text{ m}$

ii. Loss across NRV = $\frac{\rho_w \zeta v^2}{2g}$
 $H_f = \frac{4 \times 6.09 \text{ e}^{-3} \times 0.3 \times 1.18^2}{2 \times 0.019 \times 9.81} = 0.027 \text{ m}$

where ζ is Coefficient of resistance across 19 mm NRV = 1.9

= $\frac{1000 \times 1.9 \times 1.18^2}{2 \times 9.81} = 134.8 \text{ mmWc} = 0.135 \text{ mWc}$

- iii. Pump suction pipe length = 0.3 m

Loss of head in suction pipe due to friction, $H_f = \frac{4fv^2}{2Dg}$

- iv. Water level above centre of suction pipe in sump = 0.2 m

v. **Net positive suction head = 0.2 - (0.035 + 0.135 + 0.027) = 0.003 m**

- b) **Discharge side head:** The fill height is 1.2 m. Additional 0.4 m is taken up to main header. The discharge line (length is 1.6 m) will supply water to the heat source.

- i. Static head of the system = 1.6 m

- ii. Loss of head in discharge pipe due to friction,

$H_f = \frac{4 \times 6.09 \text{ e}^{-3} \times 1.6 \times 1.18^2}{2 \times 0.019 \times 9.81} = 0.146 \text{ m}$

- iii. Head loss in heat source = 3.5 m (typical value)

iv. Discharge head = 1.6 + 0.146 + 3.5 = 5.319 m

- c) **Distribution system:** The size of main distribution header is 19 mm. To ensure evenly spray of hot water over the fill, it is proposed to have five small pipes at equidistant on either side of the main distribution pipe. In each small pipe, five small holes are put at equidistant. Since the piping is small and short length, it is taken that water flow is equal through each small pipe and also through each small hole.

Water flow in each small pipe = $\frac{1.2}{10} = 0.12 \text{ m}^3/\text{h}$

It is taken that the same water velocity (1.18 m/s, as that of main pipe) is maintained in each small pipe. Hence, diameter of small pipe

= $\sqrt{\frac{0.12}{\frac{\pi}{4} \times 1.18}} = 5.99 \text{ e}^{-3} \text{ m} = 6 \text{ mm}$

It is taken that the velocity of water through each hole is 2.0 m/s so that water is splashed adequately. Water flow through each hole = $\frac{0.12}{5} = 0.024 \text{ m}^3/\text{h}$.

Diameter of each hole = $\sqrt{\frac{0.024}{\frac{\pi}{4} \times 2.0}} = 2.06 \text{ e}^{-3} \text{ m} \cong 2 \text{ mm}$

- i. Length of main distribution line = 0.6 m

Head loss in main line due to friction, $H_f = \frac{4 \times 6.09 \text{ e}^{-3} \times 0.6 \times 1.18^2}{2 \times 0.019 \times 9.81} = 0.055 \text{ m}$

- ii. Length of small side pipe = 0.24 m

Reynolds number, $\text{Re} = \frac{1.18 \times 0.006}{0.788 \text{ e}^{-6}} = 8985$

$f = \frac{0.0791}{8985^{0.25}} = 8.12 \text{ e}^{-3}$

Head loss in small side pipe, $H_f = \frac{4 \times 8.12 \text{ e}^{-3} \times 0.24 \times 1.18^2}{2 \times 0.006 \times 9.81} = 0.092 \text{ m}$

- iii. Loss of head at exit through the 2 mm hole = $\frac{v^2}{2g} = \frac{2.0^2}{2 \times 9.81} = 0.204 \text{ m}$

Total head of distribution system (THDS) = 0.055 + 0.092 + 0.204 = 0.351 m

Total pumping head required = (5.319 + 0.351) - 0.003 = 5.667 m

xiii. Pump rating: Pump rated for 5.7 m total head and 1.2 m³/h is required.

Power required by the motor and pump = $\frac{\rho_w g H q}{\eta}$
 η - Efficiency of motor + pump (Considering low capacity, it is taken as 25 per cent)

$$\text{Power} = \frac{1000 \times 9.81 \times 5.7 \times \frac{1.2}{3600}}{0.25} = 74.6 \text{ watts.}$$

A commercially available motor + pump rated with following specification are selected.

Suction & discharge line internal size: 19 mm, Speed = 2700 rpm, 230 V, AC, single phase, 50 Hz, 92 watts, 600-1600 lph & 3-15 m head.

On the discharge line of the pump, a re-circulation pipe with valve will be mounted for flow control, if any, needed.

xiv. **Drift eliminator:** Drift eliminator basically refers to the baffles placed at outlet of fills to restore the water particles carried, if any, along with the moist air. The drift eliminator should provide minimum resistance to air flow and minimum drift loss. The drift eliminator is proposed to be made with sheet of 490 mm long and 50 mm width (90° bend at 25 mm to form 'V' shape). No. of such units are to be arranged with a spacer in between to form the matrix and to be mounted just above the fill matrix.

xv. **Induced draught fan:** The L/G ratio of the tower is 1.2 and hence, the air flow through the tower is $\frac{1200}{1.2} = 1000 \text{ kg/h}$. A fan rated for 1500 m³/h (with suction side damper for flow control), 1.5 kW is selected for the purpose. The schematic diagram of a small cooling tower is shown in Figure 2.

Conclusion

A simple methodology is described for designing of small cooling tower. ■

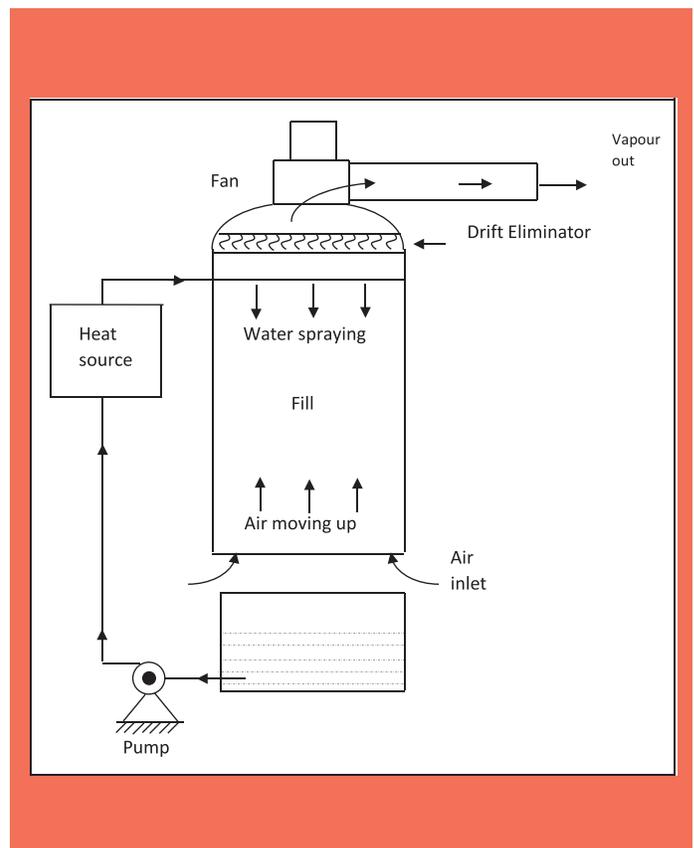


Figure 2: Schematic of a simple cooling tower.

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 Joint Director, Central Power Research Institute
 Bangalore



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Danfoss : Revolutionising India's Climate & Energy Outlook



Danfoss India serves a wide range of industries that rely on Danfoss solutions for heavy industries, refrigeration, air conditioning, HVAC, district cooling and heating applications. **Anuraaga Chandra, Director – Cooling, Danfoss India** takes **Cooling India** through journey of Danfoss in India, its products and services, evolution of technology and many more in an interaction.

How has been the journey in India so far?

Danfoss began its journey in India as a Denmark-based sales organisation way back in 1960s and it was two decades ago that we incorporated Danfoss Industries as our 100 per cent subsidiary in India and commenced manufacturing from our facility in Chennai.

Since then, Danfoss India has been working towards re-writing India's growth story by revolutionising its climate and energy outlook in a sustainable manner. By entering a new market that was rife with opportunities, our goal was clear - we wanted to innovate, be disruptive, while being a great company of repute that also focussed on giving back to the society. Today, Danfoss has a leading position in India in all our four segments – Danfoss Heating, Danfoss Cooling, Danfoss Drives and Danfoss Power Solutions wherein we have grown 10-fold in sales and our people.

What are the products and services offered by the company?

Danfoss meets the growing need for infrastructure, food supply, energy efficiency and climate-friendly solutions through our products that find applications in areas such as refrigeration, air conditioning, heating, motor control, heavy industry, industrial automation and mobile hydraulics.

Danfoss AC Drives can be found in use across industries and sectors. Some of them include: HVAC, refrigeration, food & beverages industry, marine technology, water and wastewater management, lifts and escalators, mining and minerals, chemicals, cranes and hoists, etc.

Our expertise in HVAC business started from 1933, providing energy efficient technologies that make modern life easier and to this day, we continue to break new ground in our core business areas. Every day, more than 2,50,000 items are produced at our more than 70 factories spread across 25 countries. Danfoss Industrial Automation business primarily focuses on the development and production of fluid controls, pressure and temperature controls.

Mobile & Hydraulic equipment manufacturers around the world rely on Danfoss Power Solutions for innovative solutions such as propel, control and steering solutions. We design and manufacture a complete range of engineered hydraulic and electronic components including hydrostatic transmissions, mobile electronics, orbital motors, steering components and PVG spool valve among others.

As the original inventor of both the radiator thermostat and the automatic differential pressure controller, Danfoss has been instrumental in serving the needs of the heating industry for over

80 years and has emerged as a market leader in automatic heating control technology. We have also been pushing the boundaries of climate and energy technologies by being at the forefront of a new wave of district energy solutions across the globe, including the pilot projects in India. With regards to the same, we are working with national and local governments to engineer district heating and cooling systems that help create a sustainable future.

We also hold a strong position in the air conditioning and refrigeration space with a wide range of products such as compressors, valves, pressure switches, thermostats, filter drives and heat exchangers that cater to a comprehensive range of diverse applications such as cold chain, commercial refrigeration, food processing and retail and industrial refrigeration.

In short, the scope of our technology and products is ever-growing to meet the requirements of an ever-changing world and our customers.

How technology for air conditioning and refrigeration market has evolved over the last decade?

Over the years, the lack of awareness, implementation and monitoring of proper standards and protocols in the HVACR industry has contributed to the low performance of standard cooling systems.

However, with the advent of the latest digital technologies, several 'easy to understand and use' solutions and affordable pricing has helped the market to evolve, to become better equipped to understand and address these challenges, while increasing commitment to global sustainability.

Considering this, Danfoss has always been committed to creating sustainable technology which is energy efficient in nature, thereby, reducing the carbon footprint of industries as well as individuals.

What are the growth drivers of your business? Which sector does generate the maximum demand?

Agriculture and horticulture will emerge as the sunrise sectors for India in the near future, with cooling and refrigeration as the high growth factors. Currently, the Indian Cold Chain industry is expected as per estimates to log a Compounded Annual Growth Rate (CAGR) of 13-15 per cent in the coming five fiscals through 2022 compared to the average CAGR of 11-13 per cent in the previous five fiscals. This will potentially expand the market from Rs. 24,800 crore in 2017 to Rs. 47,200 crore in 2022.

There are huge opportunities for efficient cold chain industry, wherever there is a distance between the production centre and consumption centre. In this regard, India has a long way to go and therefore, Danfoss has huge potential to maximize its growth in this sector.

How technically are superior your products as compared to your peers? Do you have R&D hub in India?

Since the beginning of our manufacturing operations in 1999 in India, we have transformed from being a sales focused organisation selling international products to an organisation that is focused on creating and customising its technology to suit to the requirements of diverse industries and the local market. It has been a pleasure to witness our steady growth and evolution into being a full-fledged facility that is facilitated by a strong R&D team with a manufacturing unit which develops products not only for India but also exports products to other countries.

Earlier, Danfoss India was importing 100 per cent of its products from manufacturing sites in other countries. However, now a major per cent of all our products and solutions for India come from within India. We have created a strong eco-system of supply base which will contribute to increasing sourcing within India by five times as compared to the previous year, over the next three years. While the general market trend is to import products from China, we can proudly say that Danfoss India is exporting to China.

R&D is an important aspect of Danfoss' growth and profitability. At a global level, Danfoss invests over 4.2 per cent of its returns



on R&D and this has contributed to new ideas and innovations being created today for the problems that may be faced by the industry tomorrow.

We also organise various hackathons and innovation challenges among employees from the various global facilities to ideate and create new technologies. At Danfoss, we go by the belief that even if we are not able to succeed in converting some of these ideas into innovations, it is better to fail fast rather than leave such an idea untested.

Our company has also set up four laboratories that are committed to co-creating energy efficient technologies in partnership with OEM equipment manufacturers where we have created an opportunity to test the effectiveness of the products in different conditions. We are also greatly committed to increasing the speed of innovation which has also led us to acquire or partner with new-age companies which have already developed such technologies required to increase competency.

Additionally, we follow a 'One product one location strategy' across Danfoss and revel in our Global Supply chain footprint and strong local sourcing expertise. Scale is also an important driver for growth. Our success has been in adopting and being a pioneer in 'mass customisation strategy'.



With emerging and advanced technologies like Internet of Things, 3-D printing, big data and analytics, we are now empowered to design, modify and create products and solutions that customers are looking for. This helps companies to explore new revenue opportunities.

How IoT has helped to bring efficiency in operations?

Digitisation across industries has given rise to the phenomenon of smart manufacturing, paving the way to Industry 4.0, where there are flexible business models. This can contribute to reducing wastage of resources and the consumption of energy apart from increased efficiency, faster turnaround, better quality, faster time-to-market, integrated supply chain and better security. In simple terms, one achieves operation excellence with smart manufacturing by addressing the ease of use of a product.

With emerging and advanced technologies like Internet of Things, 3-D Printing, Big Data and analytics, we are now empowered to design, modify and create products and solutions that customers are looking for. This helps companies to explore new revenue opportunities.

Through these technologies, companies are now able to produce customer-centric solutions which should ideally be the main architecture of our design principles. Industries should also look at incorporating design thinking in their products to ensure that we build

them in such a manner that helps our customers connect to various devices and gain maximum value from the products and solutions. However, it is important to keep in mind that digitisation can be disruptive. It is fundamental that companies ensure that the golden triangle of change is ready to make the transition i.e. people (who are at the crux), processes (which require human intervention) and technologies (that help perform processes).

What is your take on cold chain industry in India?

In terms of total farm output, India is the second largest in the world with high rankings in the production of fruits, vegetables, milk and pulses. The agri-sector also employs a total of 600 million people in the country. However, the sector's contribution to the national GDP continues to be lower than other industries. This is because, the penetration of refrigeration across industries continues to be stagnant between 5-6 per cent and over 40 per cent of India's agricultural produce gets wasted due to the lack of functional cold storage systems.

Of the existing cold chain systems, three fourth of the capacity is restricted to the storage of potatoes and onions which further highlights the pressing need to build newer and organised cold storages. As the first step, the government and the industry

players should work towards setting up packhouses closer to the farmlands where the produce could be brought, cleaned, graded and stored in cold rooms to retain its quality. This could reinvent the way in which fresh and healthy food is served from farm-to-fork.

With the right mix of technology and practice, India has the potential to emerge

as the 'food capital of the world'. It is not long before the food processing industry emerges as the next IT industry.

What are the solutions offered by the company for the cold chain industry?

The safety and longevity of perishable farm produce and processed food is critical for India's trade and commerce. Therefore, Danfoss seeks to provide the enabling technology that sustains the farm-to-fork process, ensuring food safety, freshness and hygiene all along the way.

Danfoss India provides solutions that help in sustaining the farm-to-fork process, ensuring freshness all along the way with cold chain machinery installations and automation systems that are reliable, cost and energy efficient. From dairy and fishery products to farm produce such as vegetables and fruits, or processed foods such as bakery items, Danfoss' technology for cold storage provides a haven for all food items. Danfoss innovative solutions—such as hot gas defrosts systems with two-stage solenoid valves,

variable frequency drives, valve stations and system controllers, among others—reduce downtime, lower maintenance costs and operational expenditure, and save as much as 15–20% in energy costs when compared to conventional cold stores.

What is your Outlook for HVACR industry for 2018-19?

While the Indian HVAC industry is seen outperforming the rest of the world by 2019, the penetration of air conditioning and refrigeration in the country stands only at four per cent today. Estimated to grow at 9.16 per cent CAGR versus the global market that is estimated to grow at 5.6 per cent CAGR, India is still an untapped market when it comes to the HVAC industry.

With the rising avenues of sociological development and economic growth, India's urban population is expected to soon reach close to half a billion. This accounts for more than 70 per cent of India's GDP, which in turn requires a steady boom in the infrastructure sector. Currently, Commercial Buildings account for approximately one-third of global energy use and is expected to contribute 45

per cent of efficiency-related CO2 emissions savings by 2040. At Danfoss, we believe that two-third of India is yet to be built. Understanding that infrastructure is a primary tool for progress, it is necessary that individuals and industries become aware of the limited availability of our natural resources and therefore shift towards adopting energy efficient interventions which have the potential to save up to 30 per cent in energy consumption.

In the current scenario, the most cost-efficient and smart way to decarbonise the economy is the usage of energy efficient technology which presses the need for individuals and industries to make responsible decisions while they invest in their HVAC systems – across both residential and commercial buildings.

With a firm commitment towards transforming cities to become greener, healthier and more energy efficient, Danfoss' technologies aim to meet the growing need for modern infrastructure in the country with its extensive range of products and solutions that contributes to its global expertise as an industry leader in climate friendly and energy efficient solutions. ■

Monitor and manage your facility from anywhere

Easy facilities monitoring and control, with predictive proactive automation

75F Facilisight is an intelligent building management system (IBMS), with web & mobile apps, that uses machine learning of real-time sensor and weather data to predictively and proactively manage indoor environment for optimal occupant experience and operational efficiencies. It also helps building owners and operators manage smarter, with remote monitoring and control of smart HVAC, lighting and energy management systems across all sites.

View your entire portfolio

Get a portfolio-wide, colour-coded snapshot and dashboard across all buildings, with the ability to drill down to individual building, floor, zone and equipment levels in a few easy clicks to check status and monitor real time data, with 650 data points synched to the cloud every minute. Access quick summaries of

each of your buildings on one screen, in real time.

Compare energy data across sites

Gain multi-site visibility and insights on lighting and HVAC gas and electric energy consumption, intensity and costs with 75F Portfolio Energy Manager, part of the 75F Facilisight intelligent building management system. Facilisight helps compare sites and benchmark energy consumption, identify peak energy use spikes, and gain energy sub-metering insights to reduce utility bill.

Unlike traditional Energy Management Systems (EMS), 75F building intelligence solutions can predictively and proactively reduce HVAC and Lighting energy by 30-50 per cent, while delivering optimal indoor environment comfort and air quality through smart sensing, controls and remote management.

Schedule with a single click

The global policy editor functionality allows one to set system, HVAC and lighting zone parameters, create named groups and push complex schedules to hundreds of locations with a single click in the IBMS. ■



Future Trends in HVAC Retrofit Engineering

Retrofitting an existing commercial HVAC system can be challenging, but the results are well worth the effort.

More than one-third of energy is consumed in buildings worldwide, accounting for about 15 per cent of global greenhouse gas emissions. In cities, buildings can account for up to 80 per cent of CO2 emissions. The built environment is, therefore, a critical part of the climate change problem and solution. Most existing buildings were not designed for energy efficiency, but by retrofitting with up-to-date products, technologies and systems, a typical building can realise significant energy savings. Improving the energy efficiency of buildings is a priority for reducing both greenhouse gas emissions and energy costs.

HVAC systems are major retrofit targets for reducing energy use in commercial buildings. Heating, cooling and ventilating taken together account for 45 to 70 per cent of the building's energy use. In comparison, lighting ranges from

10 to 30 per cent of energy use in a commercial building. While energy use in buildings is affected by climate, building type, and building usage, optimising the HVAC system can yield significant energy savings.

While most LEED advisor and energy consultants often addresses the buildings envelope (windows, skylights, roofs), lighting (interior, exterior), and controls, the heating or cooling, ventilation, air conditioning (HVAC) and refrigeration is often overlooked. This being the largest energy consumer in any business, they accept the so called EER/SEER rating. These ratings are a guideline and more often do not match the regional location. The rating is a one size fit all. The tailored solution should be driven by a comprehensive understanding of the existing HVAC and if any, refrigerant equipment now in place, utility power

consumption or expense, and characteristics associated with the building.

HVAC, Building Automation & Retrofit

With energy costs soaring and energy efficiency being a paramount concern, it's probably time to assess building's HVAC (heating, ventilation and air conditioning) system. Retrofitting an existing commercial HVAC system can be challenging, but the results are well worth the effort.

Why Retrofit Existing System

Modern systems can dramatically improve the bottom line costs and energy efficiency of a building's HVAC system. Utilising state-of-the-art mechanical systems, an expert specialises in enhancing comfort, minimising HVAC



repair and improving indoor air quality. These benefits, coupled with the amortised energy and repair cost savings make retrofitting a system both sensible and responsible.

Benefits of Retrofitting

Conserving energy and improving cost efficiency are the primary reasons to retrofit existing HVAC system. Modern systems, mentioned above, can dramatically improve energy efficiency and building automation. In addition, one can reap the benefits of reduced maintenance, improved indoor air comfort and the efficiency that comes from 'going green.'

The bottom line is here to help maintain a business environment that is energy efficient and cost-effective, as well as comfortable.

Did anyone know that a 30 per cent reduction in energy consumption can also lower the operating costs up to lakhs of rupees per year for every 50,000 square feet of space? Reducing energy consumption, every marginally, can add up to significant savings in operating costs.

When to Consider an HVAC Upgrade or Replacement

There are many situations that may prompt a decision to replace or upgrade an existing HVAC system:

Poor Performance: The purpose of the HVAC system is to provide space conditioning and good indoor air quality (IAQ). To accomplish this, the system must be designed to provide heating, cooling, and ventilation while providing for control of temperature, humidity, filtration, ventilation, distribution, and noise. The system must also be durable and operate cost-effectively to provide value to the home owner.

A general HVAC system assessment is

Average Lifespan of HVAC Equipment and Components

A/C Windows Unit	10	Heat Exchangers, shell and tube	24
Single or Split package unit	15	Reciprocating compressors	20
Air-to-Air Heat Pump	15	Air-cooled condensers	20
Electric Boilers	15	Evaporative Condensers	20
Burners	21	Insulation, Molded	20
Furnace, gas or oil-fired	18	Insulation, blanket	24
Unit Heater, gas or electric	13	Pumps, Sump and well	10
Electrical Radiant Heaters	10	Pumps, Condensate	15
Hot Water Radiant Heaters	25	Electric motors	18
Diffusers, grilles and registers	27	Motor Starters	17
Ductwork	30	Electric Transformers	30
Dampers	20	Controls, Pneumatic	20
Fans, Centrifugal	25	Controls, Electronics	16
Fans, Axial	20	Controls, Electric	15
Fans, Propeller	20	Valve actuators, Hydraulic	15
Coils, DX, Water or Steam	20	Valve actuators, Pneumatic	20
Coils, Electric	15	Valve Actuators, Self-contained	10

Source: ashrae.org

NOTE: The life expectancy depends on environment and input air and water qualities.

recommended if one notes any of the following issues:

- Poor comfort control due to fluctuating temperatures, uneven temperatures, or inability to reach or maintain temperature set points.
- Poor comfort control due to drafts
- Staleness or slow moisture and odour removal due to lack of ventilation
- Excessive illness – coughs, colds, bronchitis, asthma, headaches, sore throat, dizziness poor humidity control – too dry or too moist
- Excessive system noise
- High energy bills or sudden increases in energy use and run-time not due to weather but can be due to poor system efficiency.

End-of-Life: Furnaces, air conditioners, boilers, and heat pumps have finite useful lifespan like all mechanical equipment. When a piece of HVAC equipment breaks down, it needs to be repaired or replaced. Even if the equipment is still operating, it is likely to need adjustment to operate efficiently as it ages. Signs of an HVAC system nearing the end of its useful life include reduced comfort, increased energy use, or both. In some cases, newer equipment options may be available that are so much more efficient that it may make sense to replace existing equipment

even if it is still functional. Generally, residential HVAC equipment more than 15 years old can be assumed to be near the end of its useful life. If performance falls off or if the equipment breaks down after this period, only minor, low-cost repairs are financially justifiable. Table 1 lists average lifespan for HVAC equipment and components.

Addition and expansion: When a structural addition is planned for a building, new equipment may be needed to meet the increased heating and cooling loads. If the expansion can't be accommodated by, or coordinated with the existing system, there are two options:

- 1) Replace the old system with a new, possibly different, type of system that can meet the load of the entire building including the new spaces; or
- 2) Install a dedicated system to independently heat and cool the new addition.

Building Energy Upgrade: Some renovations improve the performance of windows, walls, and roofs, which decrease the building's annual energy use as well as its peak loads. Existing equipment may then be oversized and may run inefficiently at these new lower heating and cooling loads, resulting in poor comfort control and energy performance. Newer equipment

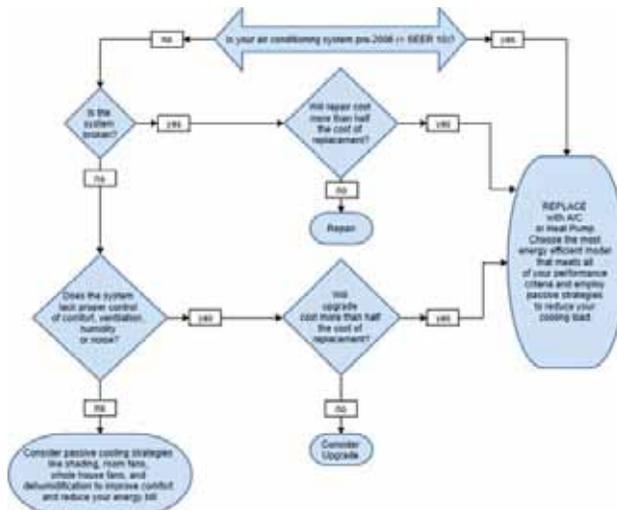


Figure 1: Should one replace existing cooling system?

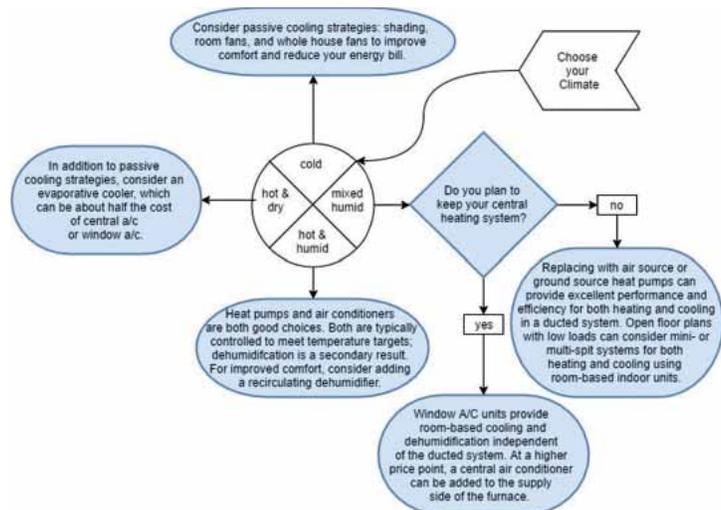


Figure 2: Should one add cooling to existing heating system?

is available in higher efficiencies and smaller capacities, and with the capability for part-load performance, which can help with right-sizing to better match the reduced loads. Another consequence of energy-efficiency improvements that can have significant impacts on HVAC equipment is tightening of the building envelope, which can reduce natural ventilation (previously occurring through air leaks). This could result in poor air quality and moisture problems, and might even cause combustion safety issues if naturally vented combustion appliances are located within the building envelope of the home. Correcting these issues may require adding venting and ventilation.

HVAC Options: Retain, Upgrade, or Replace

Often an owner is already primed for complete replacement. For an HVAC system, that is clearly underperforming with respect to comfort and energy efficiency, it may not be necessary to conduct a detailed investigation of the



existing equipment and distribution conditions to confirm that replacement is the right choice. In other cases, the choice is not as clear. Figures 1&2 below are decision trees to help guide you through the thought processes for replacing or refurbishing heating and cooling systems.

HVAC System Replacement Options

Replacing with the Same Type of System

The easiest approach is to replace the system 'in-kind' with a more modern version of the same type of equipment. Sometimes the distribution system – typically air ducts and registers and grilles – can be re-used as is, or modified to accommodate the new equipment's capacity and airflow. When a major component in either the outdoor or indoor unit of a traditional heat pump system or air conditioner fails, both units should be replaced because newer equipment is carefully matched for optimal efficiency and operating pressures. Ideally, the line-set should also be replaced to avoid contamination of a new refrigerant with traces of incompatible fluids.

Replacing with a Different Type of System

Another approach is to change to a different type of system entirely, which could offer an improved or expanded range of

performance capabilities. Note that changing to a completely different system is expensive, since it requires not only new equipment, but often a different distribution system, as well.

The following may be compelling reasons to make this choice, even if energy savings do not cover the entire cost of the change:

- Switch from electricity to site fossil fuels for resiliency or cost reasons.
- Switch from site fossil fuels to electricity to take advantage of a solar photovoltaic system. Improve comfort and coverage, and reduce noise.
- Eliminate room-based terminal devices for aesthetic reasons. Change from an air-based system to a radiant system.
- Add integrated cooling capability. Add integrated ventilation capability.
- Take advantage of a major renovation combined with the current system's end-of-life.
- Switch from central forced air to mini-split heat pump system for zoned control of heating and cooling and greater efficiency. Switch to smaller or variable-capacity systems to better meet reduced load due to insulation and air sealing improvements.

If a complete HVAC system change is considered, be sure to choose the highest efficiency option that meets user's needs and budget. Generally, a new HVAC system should always be equipped with a new, programmable thermostat.

Value Proposition for Existing HVAC System Analysis

- Diagnostic analysis of existing systems provides detailed performance report with cost benefit analysis for modifications.
- Road-map preparation and design evaluation for energy efficient HVAC system based on latest technologies and guidelines with optimised life cycle cost assessment.
- Evaluation of new or existing HVAC systems and perform pre-commissioning and post commissioning analysis.

Modern systems can dramatically improve the bottom line costs and energy efficiency of a building's HVAC system. Utilising advanced analysis tools, experts work on enhancing comfort and improving indoor air quality. These benefits, coupled with the amortised energy and repair cost savings, make HVAC system retrofitting both sensible and responsible. The study provides all necessary inputs to make intelligent business decisions concerning HVAC equipment and facilities.

Brief Summary Towards Diagnostic

Study of HVAC System Assessment or Audit Studies

Engineering Heat Load and Comfort

Study: This analysis provides an HVAC load calculation to determine tonnage necessary for a job comparing actual load to existing design. This also includes a general review of the drawings and any comments on equipment selection, air distribution, pressurisation, adequacy of air duct delivery and return systems to meet the demand of the building.

Air Balance and Confirmation of As-Built Mechanical Drawings:

If the building's air pressure is off, ductwork disconnected, or diffusers in less than optimal areas, the specialist can review as-built mechanical drawings and redesign ductwork and diffuser conditions to make sure building is balanced, pressurised correctly and air flow is optimised for a comfortable experience.

Energy Benchmarking Report and Energy

Audits: Reduce user's carbon footprint and achieve energy efficiency. Simulate and analyse the energy costs per square foot, energy usage index and the carbon footprint. Actual site conditions are evaluated examining temperature, relative

humidity, carbon dioxide levels, noise and lighting levels. Develop a road-map and energy strategy to identify unique opportunities to reduce operating and energy expenses.

HVAC Unit Replacement Assessment or

Audit: This assessment or audit is designed to provide critical information needed for retrofitting. Based on the HVAC equipment and site survey the following assessments are performed:

- Evaluate costs of operating and maintaining older systems or equipment;
- Determine impact of inconsistent equipment performance on validated status;
- Plan to replace under-performing equipment to maintain operation;
- Update operational and validated status of systems or equipment to be replaced, retired or salvaged. ■

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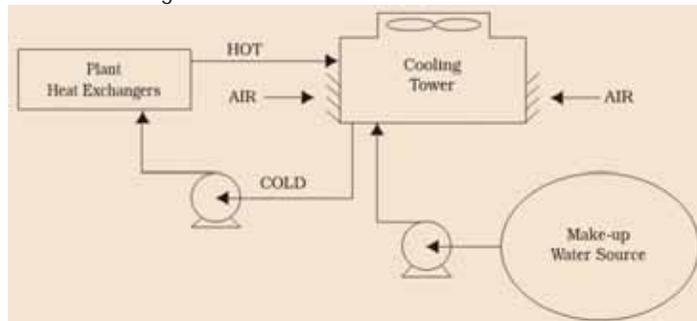
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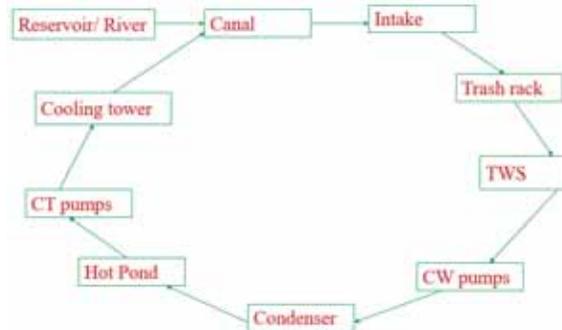
HVAC Cooling Towers and Energy Conservation

This article discusses the prime features and components of cooling towers and energy conservation opportunities therein.

Cooling towers are important part of many chemicals and power stations. The primary task of cooling tower is to reject heat into the atmosphere. They are generally modest and trustworthy methods for expelling poor quality heat from cooling tower. The make-up water source is utilised to renew water lost to vanishing. Boiling water from warmth exchangers is sent to the cooling tower. The water exists the cooling water and is sent back to the exchangers for further cooling. Typical closed loop systems is shown in figure below.



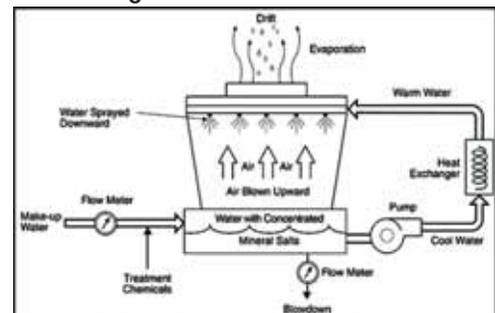
General block diagram of Typical Closed loop systems of cooling towers.



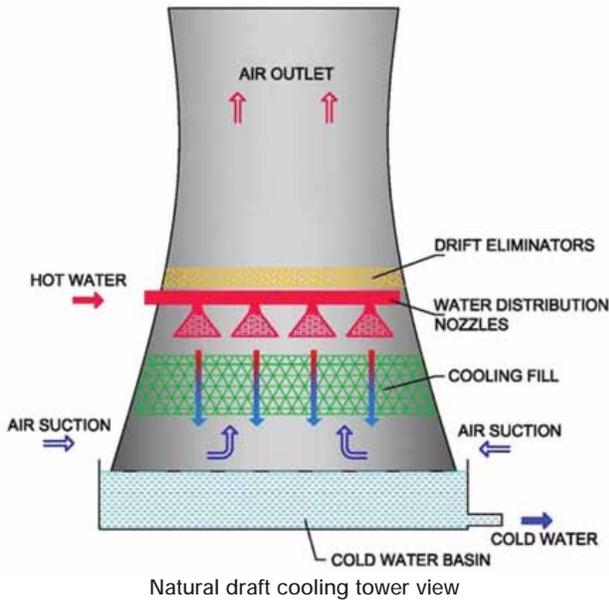
Typical Circulating water Systems with cooling tower

Main Features and components of Cooling Towers:

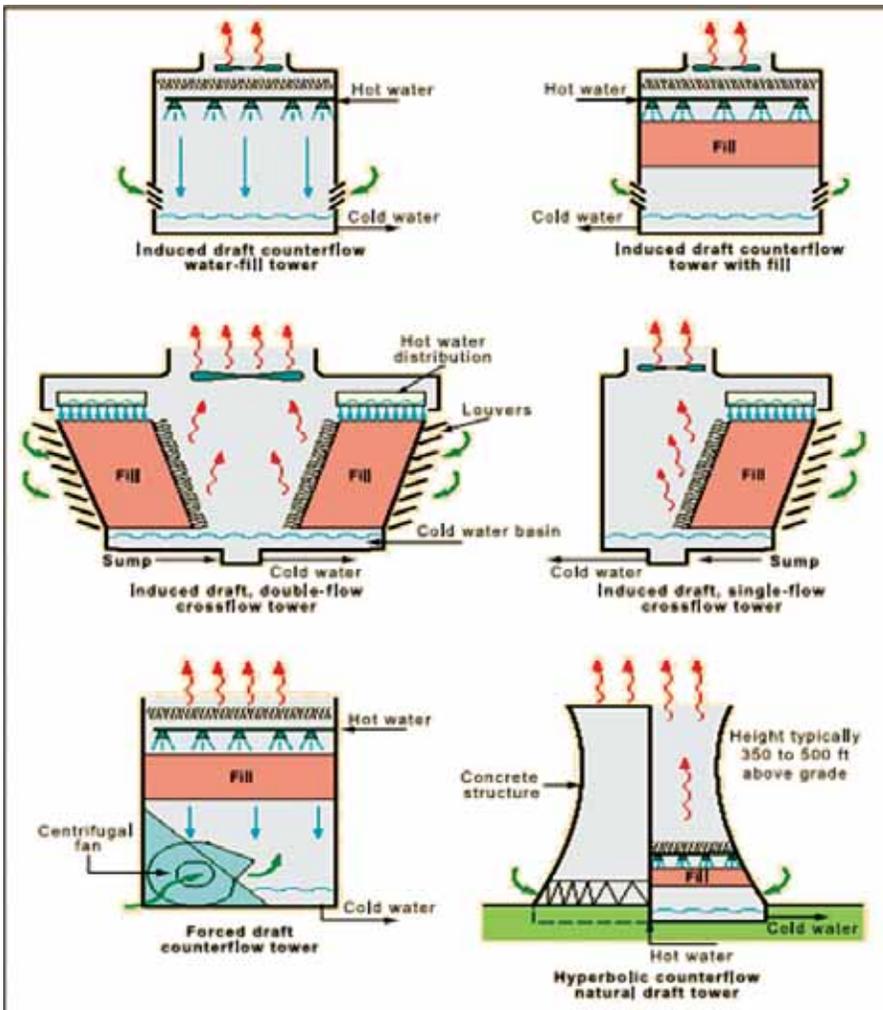
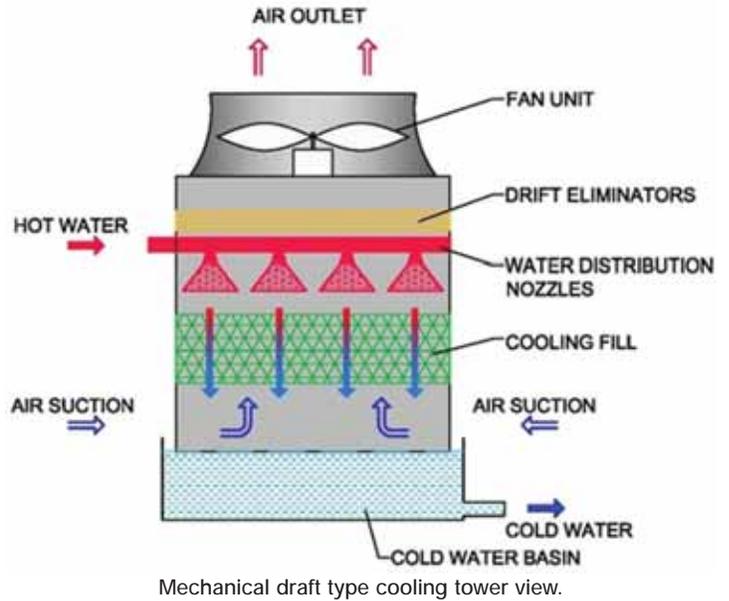
- Frame and casing: support exterior enclosures
- Fill: facilitate heat transfer by maximising water / air contact
 - Splash fill
 - Film fill
- Cold water basin: receives water at bottom of tower.
 - Drift eliminators:



WET COOLING TOWER
NATURAL DRAFT



WET COOLING TOWER
FORCED DRAFT



Cooling tower types

capture droplets in air stream

- Air inlet: entry point of air
- Louvers: equalise air flow into the fill and retain water within tower
- Nozzles: spray water to wet the fill
- Fans: deliver air flow in the tower.

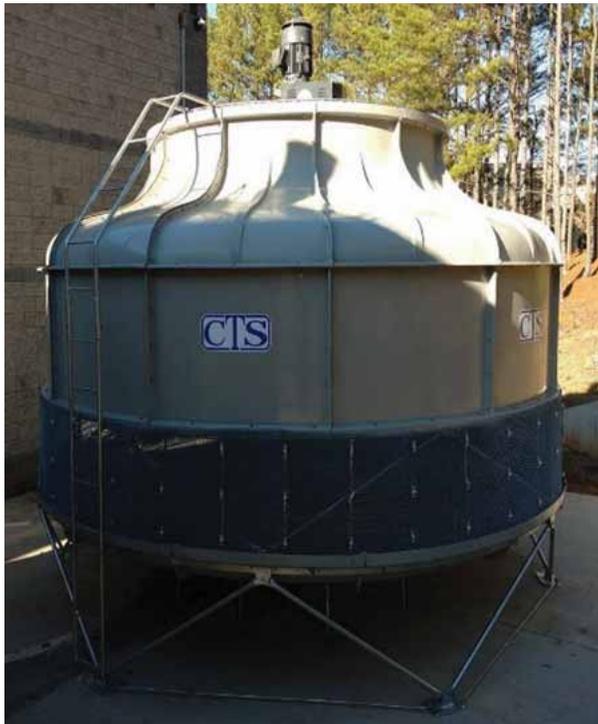
Cooling towers are basically two types: Natural draft and Mechanical draft.

Natural draft use very large concrete chimneys to introduce air through media. Because of the expansive size of these towers, they are commonly utilised for water flow rates over 45,000 c.m./hr. These types of towers are only used by utility power stations such as Thermal power plant or nuclear station.

Mechanical draft type towers utilise large fans to force or suck air through circulated water. The water falls downward over fill surfaces, which help to increase the contact time between the water and air. This augments heat exchange between the two. Cooling rates of mechanical draft towers relies on their fan distance across and speed of activity. Mechanical draft cooling towers are much more widely used; the cooling applications.

HVAC Cooling Towers

HVAC cooling towers are typically smaller than industrial cooling towers, and



Typical HVAC Cooling Tower – Cooling Tower Systems-1



Typical HVAC Cooling Tower – Cooling Tower Systems-2

serve more commercial applications such as cooling the recirculating water of oil refineries, power plants, and chemical plants as well as cooling buildings such as large office buildings, hospitals, schools, colleges and oil refineries.

Typical HVAC Cooling Tower – Cooling Tower Systems-1

Through these applications and more HVAC cooling towers can serve enterprises including petrochemical, mash and paper, Business, development, correspondences, water/wastewater and electric.

A HVAC chilled-water system comprises of a water-cooled chiller and its parts, including an evaporator, compressor, an air-or water-cooled condenser, and development gadget, just as a cooling tower that fills in as a helper cooling gadget. The water-cooled chiller is cooled by the water-cooled condenser in a different water circle. This circular water is associated with the airside by an open air HVAC cooling tower that expels heat from the cooling water stream.

Typical HVAC Cooling Tower – Cooling Tower Systems-2

As a mechanical draft kind of cooling tower, HVAC cooling towers use a power-driven fan motor to either constrain or

compel outside air to course through the tower fill, a medium that is utilised to extend the measure of surface region between the air and water streams.

Tower fills come in two unique sorts: Film fill and Splash fill. In a film fill a flimsy layer of water is spread more than a few layers of firmly dispersed plastic surface.

In a splash fill water drops over different layers of flat splash components and structure beads that spread an expansive surface territory. The water is moved by the power-driven fan to dive through the fill while being cooled through direct contact with an air stream passing overhead. After the water is cooled it is collected in a cold water basin that is below the fill, from which it is pumped back to repeat the water loop.

The heated air stream leaving the fill is released into the atmosphere far enough way to discourage it from being pulled back into the cooling tower.

Application of VFD for cooling towers fan (CT) can also save energy and used in typical schematic of CT Fan control with VFD and closed loop feedback through PID controller is also used. An RTD sensor, installed at CT outlet generates can current signal as the feedback to integrated PID

controller in the drive. The set point for cooled water temperature is entered in the drive controller.

Energy conservation & saving opportunities in cooling towers:

- Control cooling tower fans based on leaving water temperatures.
- Control to the ideal water temperature as decided from cooling tower and chiller execution information.
- Utilise two-speed or variable-speed drives for cooling tower fan control if the fans are few. Stage the cooling tower fans with on-off control if there are many.
- Turn off unnecessary cooling tower fans when loads are diminished.
- Cover hot water basins (to minimise algae growth that contributes to fouling).
- Balance flow to cooling tower hot water basins.
- Periodically clean plugged cooling tower water distribution nozzles.
- Install new nozzles to obtain a more-uniform water pattern.
- Replace splash bars with self-extinguishing PVC cellular-film fill
- On old counter flow cooling towers,

- replace old spray-type nozzles with new square-spray ABS practically-non-clogging nozzles.
- Supplant slat-type drift eliminators with high-productivity, low-weight drop, self-stifling, PVC cell units.
 - On the off chance that conceivable, chase after producer's suggested clearances cooling towers and migrate or alter structures, signs, wall, dumpsters, so that interfere with air intake or exhaust.
 - Upgrade cooling tower fan cutting edge on an occasional and additionally load premise.
 - Right extreme or potentially uneven fan blade tip leeway and poor fan balance.
 - Use a velocity pressure recovery fan ring.
 - Divert clean air-conditioned building exhaust to the cooling tower during hot weather.
 - Re-line leaking cooling tower cold water basins.
 - Check water overflow pipes for proper operating level.
 - Optimise chemical use.
 - Consider side stream water treatment.
 - Restrict flows through large loads to design values.
 - Shut off loads that are not in service.
 - Take blowdown water from the return water header.
 - Optimise blowdown flow rate.
 - Automate blowdown to minimise it.
 - Install interlocks to prevent fan operation when there is no water flow.
 - Establish a cooling tower efficiency-maintenance program. Start with an energy audit and follow-up, then make a cooling tower efficiency-maintenance program a part of your continuous energy management program. ■

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Belimo's New Generation Butterfly Valves

The latest actuator and valve technologies increase reliability and flexibility, simplify installation and thereby, reduce energy consumption by up to 80 per cent.

The new generation of Butterfly Valves for high flows is compelling because of its simple installation, maximum application flexibility, and excellent longevity. The new PR actuators cannot only be used with Belimo Valves but are also compatible with over 2500 types of third-party valve suppliers globally.

Clever Design

Thanks to lower overall height and reduced weight, the new PR actuators are quick and easy to install. With 80 per cent lower power consumption this valve-actuator combination allows for substantial energy savings. The visual position



indicator shows the position of the Butterfly Valve from distance.

NFC and SuperCap

Near Field Communication (NFC) allows wireless parameterization via smartphone, even if the actuator is not connected to the power supply. This set of technologies can also run a quick and thorough functional check for diagnosis during commissioning and in the operating phase. That increases operational safety.

The Butterfly Valves are also available with the patented SuperCap technology, which allows moving to the desired safety position during a power failure – an application utilised for example in data centers. ■

For more information, write to info.india@belimo.ch

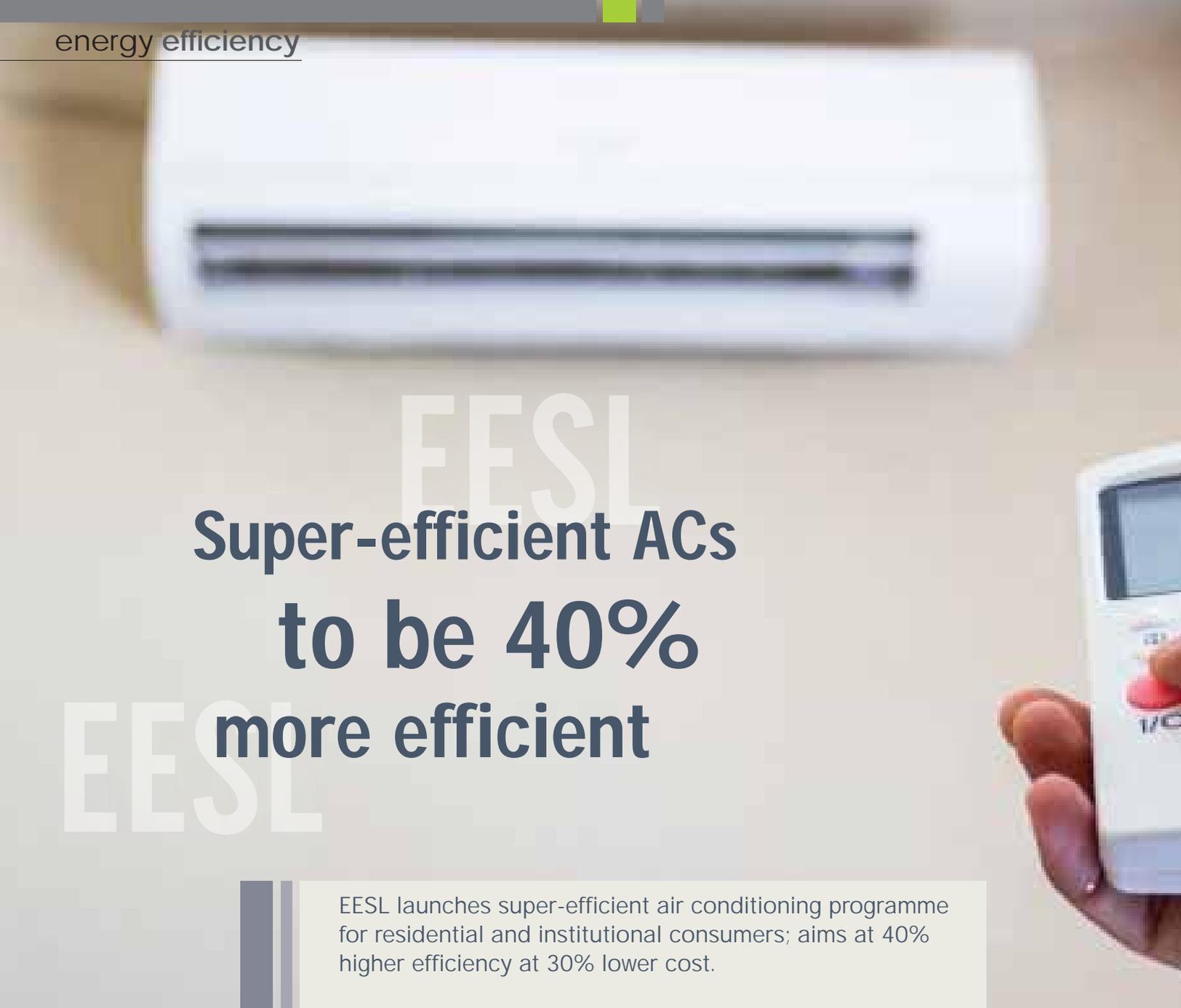
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EESL

Super-efficient ACs to be 40% more efficient

EESL

EESL launches super-efficient air conditioning programme for residential and institutional consumers; aims at 40% higher efficiency at 30% lower cost.

Energy Efficiency Services Limited (EESL), a joint venture of four National Public Sector Enterprises under Power Ministry, recently launched its Super-Efficient Air Conditioning Programme for residential and institutional consumers in the BSES area. These ACs are 40 per cent more efficient than, but priced comparably with, the 3-Star ACs

currently available in the market (ISEER 3.8), EESL said in a statement. EESL is working towards making this programme and its benefits available to all consumers across the nation with the other DISCOMs likely to partner with EESL in future.

Besides promoting energy efficiency, the Super-Efficient AC programme will also help to reduce the peak power demand in South and West



Delhi by 22MW, enabling the two organisations to harness synergies to promote energy security and sustainability. "The programme directly addresses the prospect of the nearly four-fold increase in energy consumption from buildings and cooling appliances in India by 2032, while also addressing goals of India's Cooling Action Plan and Hydrochlorofluoro carbons Phase Out Management Plan, enabling achievement of India's targets

under the Kigali and Paris Agreements," EESL statement said.

EESL and BSES have joined hands to implement a 12-month pilot of the programme by exchanging an agreement through which BSES Rajdhani Power Limited (BRPL) would assist in aggregating demand and providing local marketing and outreach support to promote energy efficient technologies in the areas it currently services, thereby covering over 25 lakh residential and institutional consumers in South and West Delhi.

EESL will conduct all activities related to source, supply, complaint management and redressal, and fulfilment of warranty obligations for the products. Applying its proven business model of demand aggregation, EESL will mobilize the capital of Rs 150 crores for the programme while redeeming its investment through upfront payments for the super-efficient ACs from customers.

EESL has initiated the procurement process of super-efficient ACs, thereby capitalising on opportunities for leveraging economies of scale through demand aggregation, and so reducing the cost of this superior green technology to consumers. Based on its past experiences with bulk procurement for other technologies and programmes, EESL expects to discover prices that are 20-30 percent less than the retail costs of similar technologies currently available in the market.

Addressing the launch event, Saurabh Kumar, Managing Director, EESL said, "Our UJALA programme gave us the confidence that the Indian consumer is receptive to awareness and demand cultivation efforts for energy efficiency. Through the Super-Efficient AC programme, we are endeavouring to not only redefine standards for efficiency and widen the gamut of energy efficient appliances available to Indian consumers, but to also significantly improve upon our previous efforts to make these technologies universally

and conveniently accessible."

During the event, EESL also launched its e-Commerce website, EESLmart.in, through which customers of BRPL, and of other DISCOMs that partner with EESL in future, can purchase the super-efficient air conditioners. With a focus on increasing consumer adoption of, and access to, energy efficient technologies, the website will also allow customers to purchase other appliances distributed by EESL, including induction cookstoves and products sold under the UJALA programme - 9-Watt LED bulbs, LED luminaries, and BEE 5-star rated energy efficient fans.

The website will also feature a catalogue of products, a payment gateway, product specifications and images, stock status and order completion and shipment information, as well as 24x7 customer service, query address and post-shipping support. Once the website is opened to the public in March 2019, customers can create a profile and register on the website free-of-charge after submitting requisite documents, such as electricity bill number and/or government-issued identification documents, and place orders for doorstep delivery of eligible products.

EESL's investment in the programme is partially supported by a grant from the Global Environment Facility (GEF), an independent financing mechanism that was established on the eve of the 1992 Rio Earth Summit to address global environmental issues. The GEF is an international partnership of 183 countries, international institutions, civil society organizations and the private sector. Further, Asian Development Bank (ADB) is providing necessary grant support and loan while United Nations Environment (UNEP) is providing technical assistance support to the Super-Efficient AC programme. ■



New Universal IAQ Instrument Testo 400



The measurement technology expert Testo once again rings in the new generation of IAQ measurement technology: The new testo 400 is the universal measuring instrument for all air flow and IAQ applications, and impresses with smart technology, fast readiness and convenient application.

With the testo 400, Testo has cleverly extended its range of measurement technology for all volume flow and comfort measurements. The universal testo 400 is not just smarter, faster and better – it is also seamlessly integrated into Testo's comprehensive IAQ range. The range of probes for the new measuring instrument is among the broadest in the market. In addition to this, the Testo Smart Probes can also be connected to the universal measuring instrument. The testo 400 itself offers innovative functions which make the user's job easier in every way, and allow reliable, norm-compliant measurement including documentation.

Fast on

The new testo 400 allows all probes to be quickly and easily exchanged during the measurement. This eliminates the need for a bothersome instrument re-start, and the waiting times involved for booting and shutting down.



Measurement assistant

The testo 400 features clearly structured and unambiguously guided measurement menus which guide the user safely and easily through the whole application. A traffic-light system evaluates the measurement results objectively and unambiguously – for norm-compliant and error-free measurement results in all volume flow and comfort measurements.

Universally applicable

Thanks to the broad selection of probes, all IAQ, ventilation and comfort parameters can be precisely and reliably measured. The IAQ portfolio covers digital Bluetooth probes, digital cable probes, the Testo Smart Probes as well as NTC and TC temperature probes (Type K). Five digital PT100 temperature probes are new in the range.

Always ready to go

If probes need to be calibrated, this is possible independently of the measuring instrument. The testo 400 can continue to be used with other probes while the affected probe heads are in service for calibration.

Saving time

Instead of having to go back to the office after the measurement, the documentation of the measurement job can be finished directly on site with the customer. The measurement reports incl. measurement values and customer data can be conveniently sent by e-mail and are also stored in the instrument. ■

website www.testo.com



Importance of Cleaning Kitchen Extract Ventilation Systems



In order to maintain a healthy working environment, lower the risk of fires and avoid getting into trouble with the law, it is important to clean kitchen extract system on a regular basis.

Around 70 per cent of all commercial kitchen fires originate from faulty ventilation and ducting due to a build up of fat and grease. Due to this, it is so important to clean kitchen extract system on a regular basis. Often chefs and kitchen managers believe that if the canopy and filters look clean, the job is done. However, the problem is that if the ductwork behind the kitchen extract system isn't clean, then one can put his staff and even customers at risk. It is crucial that extract systems are regularly cleaned. Their purpose is to remove cooking odours, steam and greasy vapours from cooking appliances, which can then act as an ignition source.

Flammable vapours constantly give off during the cooking process. These cooking oils can reach temperatures of up to 300 degree centigrade and it only takes one spark to ignite raging flames within the ductwork. Grease extract ductwork systems usually spread through the entire breadth of a building which means that in the event of a spontaneous fire, flames will spread throughout the entire premises, putting every occupant of the building at serious risk.

One can imagine years' of grease gathered inside catering facilities ductwork. Everyone within that building including employees and customers, are like sitting ducks. Grease-laden deposits in extract ventilation systems are the biggest fire risk

in a premise with operating kitchens and catering facilities. Grease deposits will inevitably seep through filters located in canopies which then give the grease particles time to not only cool but settle on the internal surfaces of the kitchen ductwork. This collection of grease will also reduce ventilation efficiency which can lead to excessive humidity, overheating, unwanted odours and an inability to successfully remove potentially toxic fumes found in gas-burning appliances. Regular cleaning kitchen extract system is essential to maintaining a healthy working environment for staff.

The kitchen extract system presents particular hazards due to the potential for the accumulation of grease. Accumulated grease within an extract system forms a hidden combustion load. Under certain circumstances flame or very high temperature within the duct can ignite the grease causing fire to spread rapidly through the duct. Flame and heat within the duct can ignite surrounding materials at various points along the ductwork path and transfer fire in ways that are difficult to predict and control by designers, installers and ultimately fire fighters.

Kitchen extract ventilation systems components:-

A kitchen extract system would typically comprise of the following components:

- **Canopy:** This would most likely include a vertical canopy skirt running around the perimeter of the canopy. A channel on the bottom edge of the skirt; a canopy roof sitting horizontally on the top of and joining the skirts; a grease filter housing assembly (with grease filters and traps) hanging within the boundary of the skirts.
- **Canopy/Extract plenum:** This is typically the area immediately behind the grease filter housing and below where the ducting commences.
- **Ducting:** Beyond the canopy/extract plenum, extraction ductwork would be connected. This may involve short transition ducts connected directly to the suction side of an extract fan or could include many linear metres of horizontal or vertical ductwork. Contained within the ducting, there may be attenuators, flow control dampers, fire dampers, air turning vanes and sensors.
- **Extract Fan:** To create extraction from the canopy an extract fan would be connected to the ductwork, some extract fans (roof mounted) discharge directly to atmosphere via a cowl.
- **Discharge Duct :** On the exhaust side of the fan, a discharge duct would direct extract air out of the building via an outlet. This outlet point may include weather louvers and mesh to prevent the ingress of weather and vermin.

Other systems such as ventilated ceilings and directly ducted extraction are also used. It is important that the person responsible for implementing cleaning regimes clearly understands the breakdown of the system so that any cleaning regime is compliant with the terms of buildings insurance relevant to the kitchen extract maintenance.

Table 1 includes components, such as fire dampers and attenuators, which are not normally recommended to be installed, but are often found in practice.

Table 2 sets out guideline maximum levels of grease deposit and actions recommended. The actual recommended action timing will depend on the rate of accumulation, the risk vulnerability of the system and site and any particular warranties imposed by the building insurers.

Cleaning Methods

- As there are many existing methods that can be applied in tandem, and emergent new technologies.
- The actual method or methods must be capable of achieving the required results, i.e. Post-Clean Verification, not only on the internal surfaces of the extract duct but also on system components.
- When choosing the cleaning method, consideration should be given to operative safety and also to effects on the surrounding environment, particularly where using wet cleaning methods, since grease or moisture can leak from the ductwork components and damage the surrounding fabric.
- Steam cleaning and high pressure water washing are not recommended for ductwork that is situated above false ceilings or in sensitive areas, due to possible leakage of contaminants from the duct, unless specifically designed for wet cleaning.
- After applying wet cleaning methods care should be taken to ensure that any condensed vapours and cleaning fluids are removed from all parts of the system.

Table 1: Location of Access Panels for Cleaning and Inspection Purposes

Volume Control Dampers	Both sides
Fire Dampers	Both sides
Attenuators	Both sides
Changes in Direction	Both sides
Filter Sections	Both sides
Horizontal Ducts	Generally every 3 metres
Risers	Top and bottom as a minimum
Extract Fans	Both sides
Discharge grille/mesh	One side

Table 2: Surface Grease Deposit Limits

Wet Film Thickness Test Measurement	Recommended Action
200 μ m as a mean across the system	Complete cleaning required
Any single measurement above 500 μ m	Urgent local cleaning required

Benefits of cleaning ventilation system

Create a healthy working environment

Cleaning kitchen extract system is essential to maintaining a healthy working environment. Extractor fans require regular cleaning and servicing in order to maintain maximum air flow in kitchen. If they are blocked up with dirt and grease, they are not going to be able to remove heat, cooking odours and most importantly carbon monoxide as efficiently. Carbon Monoxide is well known for being a deadly toxin that is produced by cooking ranges. Block ducts only contribute to problems associated with CO.

Eliminate fire risks

Whilst canopy kitchen extract systems contain filters that act as a first line of defence against grease, unfortunately it is inevitable that smaller particles will pass through the filters into ductwork. Whilst kitchen extract system will be easy to access, the ductwork behind it can be much trickier. However, this doesn't mean that one can get away without cleaning it.

Ignorance to clean kitchen extract system's ductwork can potentially cause a fire. Due to the size and complexity of kitchen extract systems, most companies tend to hire in professionals like duct busters to clean ducting.

Access doors are another legal requirement, so if one does not has them installed, he or she is at risk from being

prosecuted in the event of a fire. Cleaning is routine maintenance for all equipment in the kitchen including kitchen exhaust ductwork. In fact, due to the increasing complexity of ventilation systems, it's more crucial than ever to ensure a professional cleaning that covers all corners of the system.

Conclusion

If one wants to maintain a healthy working environment, lower the risk of fires and avoid getting into trouble with the law, the easy answer is to clean kitchen extract system on a regular basis. The frequency of kitchen extract ductwork cleaning depends heavily on the number of hours per day the kitchen is in use. Low use would be considered as 2-6 hours per day in which case, yearly clean should be sufficient. Moderate use spans between 6-12 hours per day and this requires a professional cleaning service every six months. If the kitchen is deemed 'heavy use', this means that it is operational from 12-16 hours per day and is in need of an expert cleaning procedure every three months. These are minimum guidelines and the requirements of individual kitchen ductworks may vary. ■

Ritesh Mistry
M.E. CRYO.
QAE Pty. Ltd. Australia



ACREX

brings innovation to the fore



Inauguration

The 20th edition of South Asia's largest HVAC&R event held in Mumbai showcased the latest innovations and developments from across the globe.

Driven by evolving needs and lifestyle of the Indian consumers, India's HVAC&R market is expected to surpass US\$ 7.0 billion in 2019. While the international market in HVAC&R has been growing at approximately 7 per cent, the market demand in India has always been higher than the global demands by almost 30-40 per cent and that's what makes India a great destination for various manufacturers to spread their base in India. HVAC&R industry has established its significance as it is widely utilised in the major economy driving industries whether it is IT, agriculture, retail or real estate sector. By leveraging commercial HVAC services, developers can see major operational improvements as it contributes towards profitability, energy savings and

consumer satisfaction.

"India's aggregate cooling demand is poised to grow 8 times over the next 20 years. This is happening because of growing urbanisation, increased aspirations, need for better thermal comfort conditions, worsening ambient air conditions, increased industrialisation and a fast-growing economy. All this will add to our energy bills as HVAC consumes the largest chunk of electricity in buildings," said Vishal Kapur, National Past President, ISHRAE.

C. Subramaniam, National President, ISHRAE said, "As the demand for air conditioning solutions is rising, we see a bright future for HVAC&R industry in India."

As the industry is noticing a rapid growth, ACREX India is also becoming grander than before by offering opportunity

to all participants to reach relevant stakeholders and decision makers. The show has grown remarkably over the years and has emerged as a unique launch pad for potential business-enabling collaborations in the HVAC&R sector, guiding the integrated building solutions.

ACREX India 2019, the 20th edition of South Asia's largest show for HVAC&R industry, brought together intelligent innovations from across the globe. The three-day exhibition held between 28th Feb and 2nd March in Mumbai witnessed participation of over 500 companies from 25 countries with a footfall of more than 50,000 visitors. The next edition of ACREX is going to be held in Greater Noida on 27 - 29 February 2020. Here we feature some of the key highlights of the 2019 edition.



Tecumseh launches new range of compressors

CEO of Tecumseh Products Company, LLC, said, "India is a crucial market for our company and we are committed to strengthening our relationship with our customers in the region. The state-of-the-art Global Technology Centre near Delhi that is near completion will further help to bolster the market."

In India, Tecumseh India has two plants in Hyderabad (Telangana) and Ballabgarh (near Delhi) for air-conditioning and refrigeration with strategic partnership with global brands and a wide range of compressors and condensing units for applications in deep freezers, beverage dispensers, visi coolers, cold rooms across hospitality industry, dairy and foods, pharmaceutical, to name a few.

Tecumseh Products India Pvt Ltd, a subsidiary of the 85-year old Tecumseh Products Company LLC, unveiled a new range of compressors with hydrocarbon refrigerants for light commercial applications.

Speaking on the launch, Doug Murdock, President and

LG presents best of its HVAC products

At ACREX 2019, LG Electronics India displayed its flagship HVAC products which have been developed using the finest technologies and breakthrough innovations. The products on display were VRF systems, hydro kit for hot water generation, chillers like magnetic bearing centrifugal chiller, light commercial systems including inverted ducted, inverter cassette and inverter floor standing, inverter split air conditioners and control systems.

The range of LG Multi V VRF systems is suitable for most applications. These systems are available in air-cooled (top and side discharge) and water-cooled outdoor unit options with a very wide variety of indoor units. These systems boast of high energy efficiency with all 100 per cent inverter compressors and the highest corrosion resistance, with 2 coatings on the fins of the outdoor units, claims Sunil Khatwani, Business Head - System Air conditioning Division, LG Electronics India.

Hydro Kit can provide simultaneous heating, cooling and hot water supply when used in conjunction with LG VRF systems. Hot water temperature can be as high as 80-degree C. This system can perform in a wide operating range i.e. (-) 20 to 53-degree C and is suitable for a wide variety of applications that range from hotels, resorts, hospitals,



commercial buildings, educational institutes and more.

The Magnetic Bearing Centrifugal Chillers from LG are oil-free chillers that have eliminated oil-related parts and piping. Each chiller is equipped with a UL rated UPS for protection. These chillers are available in capacities from 260 TR to 2200 TR.

Another product under Light Commercial systems was the Inverter Cassette unit. This is a ceiling mounted air conditioner that boasts of a low height design and blends in perfectly with the surrounding décor. It promises clean air with a high level of cooling performance. This is available in 1.5 TR, 2.0 TR, 3.0 TR and 4.0 TR capacities.



Trane launches High Speed Magnetic Centrifugal Chillers

Trane, a brand of Ingersoll Rand, launched its High Speed Magnetic Centrifugal chillers (HSWA) at ACREX India 2019.

Sanjeev Seth, Country Leader, HVAC & Transport, India & SAARC Markets, Ingersoll Rand, said, "The High Speed Magnetic Centrifugal chillers (HSWA) exceed the AHRAE 90.1-2016 IPLV standard by 40 per cent. Equipped with advanced Oil-Free Magnetic bearing compressor and CHIL next-generation heat exchanger, this product brings down the operating cost exceptionally."

Trane has also expanded its commercial unitary portfolio by introducing Genyue5+, the advanced 5th Generation Full DC Inverter Variable Refrigerant Flow (VRF) systems.

Seth adds, "Given the pressing need for sustainable HVAC solutions that help tackle climate change challenges, our specifically designed - EcoWise portfolio of products will help lower environmental impact with the use of next-generation, low global warming potential (GWP) refrigerants and high-efficiency operation."

Grundfos wins the 'Energy Efficiency' award

Grundfos India won the ACREX Awards of Excellence under the 'Energy Efficiency' category for its highly efficient and intelligent pump solution 'MAGNA3'. Grundfos was also the only pump company to be awarded under any of the three categories - 'Energy Efficiency', 'Indoor air quality' and 'Innovation'.

MAGNA3 circulator is the most efficient circulator pump range for commercial buildings on the market today. Its Smart "Control Modes" and "FLOWLIMIT



feature" use built-in intelligence to gather information about operation data, conditions and resets operating parameters automatically if required.

"MAGNA3 is not only energy-efficient but is combined with the renowned Grundfos reliability, this makes this pump a very attractive proposition for anyone interested in quick return on investment and low Life Cycle Costs", said Gaurav Mathur, Head – Business Development (Building Services), Grundfos India.

ACREX Hall of Fame 2019



ITC Grand Chola, Chennai has been recognised as the newest inductee to the ACREX Hall of Fame 2019 for their commitment to energy efficient and sustainable infrastructure. ACREX Hall of Fame, is a coveted recognition jointly instituted by ISHRAE and Danfoss India in 2015 seeking to recognise best practices and to encourage innovation in technology, design and systems to promote the highest standards of energy efficient HVAC systems in Commercial Buildings.

This year, the initiative sought to promote the incorporation of sustainable technologies in the healthcare and hospitality sector which have set a benchmark among infrastructure projects in the country. The other top finalists for ACREX Hall of Fame 2019 were ITC Maurya, Delhi; Radisson Blue, Bangalore; Awasa, Hyderabad and HN Reliance Hospital, Mumbai. With over 1.6 million sq. ft. space, the ITC Grand Chola, Chennai is the largest hotel of the ITC

Limited and the world's largest LEED Platinum rated building while being the first to be rated 5-Star by TERI GRIHA. The hotel is also a pioneer in the usage of heat pumps in the hospitality industry.

Speaking on the recognition, N. Ramamoorthy, Chief Engineer, ITC Grand Chola said, "With the current challenges of global warming and water scarcity, we have made an active effort to source over 71 per cent of our electrical energy from renewable sources while ensuring that 100 per cent of the waste water is recycled by the in-house sewage treatment plant. The specific energy footprint for our building is the lowest when compared to other buildings of the same stature and grandeur."

The previous inductees into the ACREX Hall of Fame include Chatrapati Shivaji International Airport, Terminal 2, Mumbai (2016), Infosys EC-53 Building, Bengaluru (2017) and the Reliance Corporate IT Park, Navi Mumbai (2018). ■

Declaration FORM IV

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Navi Mumbai
15th March, 2019

Sd/-
Pravita Iyer
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IGM Clamp Meter with Datalogging

The FLIR CM275 clamp meter combines thermal imaging with electrical measurement into powerful inspection, troubleshooting, and diagnostic tools. Through Infrared Guided Measurement (IGM), the CM275 provides a reliable way to identify hot spots and overloaded circuits from a safe distance. The findings can be confirmed with the clamp meter's wide range of functions plus temperature readings:



- Quickly identify issues with IGM, without contact with panels, cabinets, or cluttered wires and cables that may present safety hazards.
- Get accurate amperage and voltage measurements and centre-point temperature readings. Also features a large display for data and image viewing.
- Upload and organise electrical measurements and thermal images, share information with your team, and file reports while in the field. ■

For more information, contact at flirindia@flir.com.hk

Forthcoming Events At A Glance**AICCS 2019**

Venue: Kunjamal N Convention Centre (KNCC), Agra

Date: 12th to 14th July 2019

Website: www.aiccs.in

Foodpro 2019

Venue: Chennai Trade Centre, Chennai

Date: 23rd to 25th August 2019

Website: www.ciifoodpro.in

Dairy Tech India 2019

Venue: Bangalore International Exhibition Centre, Bangalore

Date: 30th August to 1st September 2019

Website: www.dairytech.in

ISK-SODEX Istanbul

Venue: TÜYAP Fair Convention and Congress Centre

Date: 2nd to 5th October 2019

Website: www.sodex.com.tr/en

Schiphol's Data Center Achieves Sustainability

Mitsubishi Electric Hydraulics & IT Cooling Systems has supplied the IT cooling system for a data center at Schiphol Airport. The data center operator acquired the data center in April 2016 with the intent to bring it up to date and to enlarge the available floor space. From 1,000 square meters of space, they increased the total area to more than 4,500 square meters.

The data center operator additionally wanted to revise and re-install the entire cooling system with the aim of achieving a low



PUE (Power Usage Effectiveness) for both existing and new customers and thus, significantly reducing energy costs in terms of cooling. At the same time, they wanted to increase the power density per square meter to between 1.6 and 1.8 kW for greater efficiency. For this reason, the IT cooling system is based on RC 6 GLIDER EVO free-cooling chillers and 40 NEXT EVO water chilled close control units was chosen. NEXT EVO units were supplied with the air intake from the

top and air delivery from the bottom of the unit. ■

BEE & CPWD MoU for Energy Efficiency

Bureau of Energy Efficiency (BEE) and Central Public Works Department (CPWD) signed an MoU for energy efficiency in CPWD managed buildings and to promote designs and construction of new buildings under Energy Conservation Building Code (ECBC). Ajay Kumar Bhalla, Secretary of Power, Government of India, Abhay Bakre, Director General, BEE, Prabhakar Singh, Director General, CPWD and other senior officials from Ministry of Power, BEE and CPWD witnessed the event in New Delhi in January.

In the first stage approximately 150 buildings will be taken under star rating scheme and to promote energy efficiency in CPWD managed buildings. It is anticipated that this initiative will result in energy saving of more than 260



million units in the first stage with operational savings of about Rs 100 crore. ■

Willis Tower Receives LEED Certification

Willis Tower, owned and managed by EQ Office, the portfolio company wholly owned by Blackstone's real estate funds, is proud to announce that it has earned the Leadership in Energy and Environmental Design (LEED) Gold from the US Green Building Council. Willis Tower achieved an initial LEED v2009 certification as well as the recertification tasks using the latest update to the rating system, LEED v4.1, which emphasizes performance and tracks progress through the Arc platform.

Willis Tower is currently undergoing a more than half a billion-dollar renovation, the biggest restorative transformation in the building's 43-year history, adding 300,000 square feet of new



retail, dining and entertainment space, including Catalog, a five-story immersive neighborhood experience, as well as 125,000 square feet of tenant exclusive amenities and a 30,000 square-foot outdoor deck and garden to the building.

"Willis Tower is a major destination in the heart of Chicago, and for more than 15,000 people, it's also their workplace," said David Moore, Senior Vice President and Portfolio Director, EQ Office. "As we redevelop this iconic Tower, we're making a conscious effort to find ways to improve energy efficiency and reduce our environmental footprint. Earning the LEED Gold certification is a credit to our entire team for their hard work." ■

LOUVER TYPE MIST COOLING SYSTEM

For

CHILLERS

A Superior Alternative to Cooling Tower



▲ *Louver Type MCS*

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

Other Superior Features of LTMCS

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

**Over 300
installations**

Typical case study data of a 1200 TR Chiller

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



Mist Resonance Engineering Pvt. Ltd.

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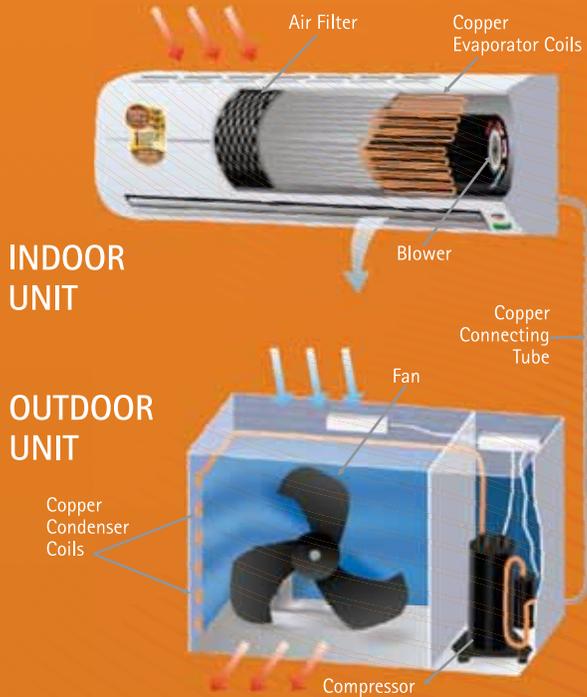
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