Issue no.1, March 2009
(for private circulation only)

IC^2 –Towards Greener Pastures

News letter of ISHRAE Chennai Chapter

Milestone in the History of Chennai Chapter …. Standing tall …The brand new Chapter Premises declared open by Dr. Prem C Jain, Chairman IGBC on 26th March 2009.

From the President's desk……

Mr. Mansoor

The first issue of "IC^2" is before you. This will satisfy the basic objective of ISHRAE namely the 'Dissemination of information on the Arts and Science of Refrigeration and Air Conditioning..' Energy Efficiency is the by-word in today's context of HVAC & R. Today the choice is 'Be Efficient or Perish…' There is another aspect of Green which we have not touched in today's context. This deals with the real Green of our Rural Farms. The refrigeration for storage and transportation of Vegetables and Fruits is the need of the hour.

We look forward to articles from members of ISHRAE to keep this newsletter Vibrant and Informative. Kudos to Dr. R. Saravanan who voluntarily came forward with this great idea.

Number of Equipment and plants in service Worldwide (www.unep.fr)

Commercial refrigeration – 477 000 units

Industrial refrigeration: 350 million m^3

Air-conditioning (air-cooled systems) – 340 million units

Air conditioning (water chillers) – 1.1 million units

Mobile air conditioning – 450 million

Worldwide refrigerator market (Ref: JARN, Nov 2008)

Country	Demand in 2006		Demand in 2010		Growth
	1000 units	%	1000 units	%	%
India	**4.57**	**5.8**	**6000**	**6.7**	**31.3**
Brazil	3.79	4.8	4.52	5	19
United states	11.07	14	12.34	13.7	11.4
China	12.18	15.4	14.73	16.3	9.4
Japan	4.25	5.4	4.35	4.7	0

Technical News

Green buildings not so expensive

A study sponsored by the investment firm Good Energies on 150 green building projects around the world shows that, on average, they cost only around 2% more than traditional buildings and yielded 33% savings on energy use. For about half the buildings in the study, energy and water savings yielded a five-year payback on the extra costs of going green. The study fits in with comments from people interviewed by Green tech Media over the past two years, which peg the cost of integrating various some green strategies at 2 percent to 6 percent.

Source: http://www.greentechmedia.com

ASHRAE Position Document Outlines Commitment to Natural Refrigerants

ASHRAE outlines its support for research into and expansion of the use of natural refrigerants in refrigeration systems and other technologies in a new position document. Natural refrigerants include ammonia, CO_2, hydrocarbons, air and water. Because of their low global-warming potential, natural refrigerants offer the potential to improve the environmental performance of refrigeration systems. The carbon dioxide used as a refrigerant is generally of industrial or scientific grade, and is typically recovered from the waste streams of industrial processes. The embedded energy required to reclaim, clean, liquefy and transport carbon dioxide is estimated to have a carbon equivalent of 1 kg CO_2eq per kg. In contrast the ammonia production process has a carbon equivalent of 2 kg CO_2eq per kg and for fluorocarbons this is typically about 9 kg CO_2eq per kg.

Source; http://www.ashrae.org

Importance of water in the Energy Equation

Relationship between water and energy takes on new urgency with mounting pressure on limited freshwater resources, underlines new World Economic Forum report. Water is increasingly moving from an operational issue to one of strategic significance for the energy sector as risks continue to rise. Energy companies will increasingly be called upon to be partners in managing the world's water resources, along with agriculture and other large users.

Source : http://www.weforum.org

DEVELOPMENTS IN AIRCONDITIONING

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Air conditioning (AC) is a rapidly growing sector. Demand is increasing thanks to technology advancement, industrial growth, rising affordability of common man and expanding call for essential services. However, it is an energy guzzler. While the mandates of Montreal protocol concerning ozone depletion are nearly met, those of Kyoto protocol concerning global warming are yet to be addressed. The least our fraternity can do to mitigate this problem is to enhance energy efficiency of AC systems across the board.

Indoor air quality (IAQ) is very poor to mediocre in many air conditioned buildings. We need a paradigm shift[1] and one should serve the air "cool and dry" and where it is consumed. Lower humidity and temperature enhance the perceived air quality we inhale and people prefer rather dry and cool air. One should provide indoor air that is perceived as fresh, pleasant, comfortable and stimulating, and with no negative effects on health. In achieving this aim, due consideration must be given to energy efficiency and sustainability. In the conventional system with 10 l/s/person ventilation air, just about 1 % of it is inhaled, that too not even clean as fresh air. Personalized air concept wherein small amounts of fresh, clean, dry and cool air supplied directly and gently to a person's breathing zone thus has the potential to significantly bring down the required quantum of fresh air.

Displacement ventilation, earlier developed and used for industrial buildings, has now become a proven technology for air conditioning. The slightly cooler supply air introduced to the space at or near the floor level at a low velocity displaces the warmer room air upwards. Advantages are better IAQ / ventilation efficiency, quieter and improved energy efficiency. Demand ventilation concept and enthalpy recovery wheels also have the potential to save the energy without sacrificing IAQ.

Desiccant technology, either solid or liquid based, includes a wide range of systems providing dehumidification, cooling and ventilation in order to maintain IAQ in the indoor environment of both commercial and industrial segments of air conditioning[2]. Heat is the primary motive energy for such systems. However, there are many technical, material and manufacturing issues like corrosion, size optimization, heat and mass transfer enhancement, and so on still to be addressed to make this technology viable and competitive with the conventional electric energy driven systems.

Close to one third of the power consumption will be at the air handling unit (AHU) in large central AC installations. Well designed systems operate at part load conditions for most of the time. But the conventional systems supply "constant air volume" and the AHUs continue to draw the same power. True variable air volume systems (VAV) modulate the supply air quantity in line with the load and thus have the potential to save energy apart from catering to many zones. The old direct expansion (DX) systems have now resurfaced as variable refrigerant volume / flow (VRV/F) systems thanks to advancement in electronic control systems. They offer simultaneous space heating and cooling capabilities (though not required at Chennai), soft start means and higher energy efficiency and diversity factor, etc.

In contemporary data centers the limit is dictated by the ability to supply and return the air for cooling. Hence the cooling units are placed directly in the data centers with under deck air supply arrangements. Computation fluid dynamics is widely used to simulate air flow patterns avoiding mixing of air. Humidification is not required for data centers in cities like Chennai, and therefore one should not recommend such a provision in the cooling units.

[1] Fanger, P.O., Human requirements in future air-conditioned environments, International Journal of Refrigeration, Vol. 24, pp. 148-153, 2001.

[2] Refrigeration drives sustainable development, State of the art report card, IIR, Paris, 2007

WATER –COOLED CHILLERS: ISSUES AND CHALLENGES

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Background

Most of the young engineers, who have joined the field in the last fifteen years, may not be aware that, what they are seeing now as - a fully assembled packaged chiller was not available in the present form fifteen years back. We used to get compressor, condenser chiller separately assemble at site and then do the refrigerant piping with thermostatic expansion valve etc. Fixing a control box, with all control, doing field control piping and wiring itself was a major job. The issues those days were mostly connected to the chiller package itself. With the availability of fully factory assembled and factory run/ tested chillers there is no great challenge for the field engineer on any mechanical electrical or control components of chiller package. The issues and challenges are (1) Selection of chiller, (2) Location and Installation of chiller (3) Water management and (4) Cooling tower location - maintenance.

Selection of Chiller

It is important to select and compare the power consumption of various chillers for the actual operating condition rather than for ARI conditions, ARI condition is suited mostly for US or European application. For our conditions in Chennai condenser water entering temp. will be around 90°F and never goes below 85°F. We should also consider fouling factors, 0.001 (British units) for condenser and 0.0005 for chiller. with the type of water quality available in Chennai and not ARI fouling. The table below gives power consumption of three brands of screw chiller of similar capacity at 90/89/88°F condenser water entering condition and at 100%, 75% and 50% loads. with our std. fouling. The table also gives power consumption at ARI condition.

Power consumption (IKW / TR)														
Water entering	90˚F				89˚F				88˚F				ARI	
Brand	**A**	**B**	**C**		**A**	**B**	**C**		**A**	**B**	**C**		**A**	**B**	**C**
100% LOAD	0.69	0.8	0.66		0.68	0.79	0.65		0.68	0.77	0.63		0.60	0.63	0.564
75% LOAD	0.67	0.77	0.62		0.66	0.75	0.62		0.65	0.74	0.61		0.51	0.52	0.453
50% LOAD	0.72	0.78	0.70		0.71	0.77	0.69		0.7	0.76	0.68		0.44	0.45	0.448
IPLV													0.48	0.49	0.472
	STD Fouling cond .0.001, chiller 0.0005 British units												ARI Fouling		

Most of our chiller plants are designed with multiple chillers mostly with either three or four. This helps flexibility of operation in part load as also redundancy in case of break downs. It was also observed that based on the load pattern 1,2 or 3 chillers are run at any part of time for overall power saving. We have also found that the cooling water entering temperature to the condenser will be mostly between 88 to 90°F .With these in the back of our mind it is better to compare the power

consumption on a customized part load. My suggestion is that it is reasonable to assume that chillers will work on 50% time at 100% load, 35% time at 75% load and 15% time at 50% load. It is also good to assume water temp. of 90°F for 100% load, 89°F for 75% load and 88*F for 50% load. If you work out the customized integrated part load IKW for all the tree brands as per the suggestion given and compare the owning cost you find a different brand becomes cost effective compared to similar exercise with ARI - IPLV. You will find the IPLV as per ARI conditions are almost same for all brands while for our operating conditions brand C seems to be more beneficial. It is therefore essential to study the expected conditions at site and decide on the most cost effective solution. The operation of screw chiller below 40% load particularly when condenser water temperature also tends to be low normally creates some operational problems. It is necessary therefore to calculate the lowest operating load requirement and check whether the screw compressor can operate at these loads on a sustainable basis.

Location and Installation of Chillers

Normally water cooled chillers are located at basement levels. Nowadays, it is a common sight to have these units at terrace level also. For basement installation ,if chillers are allowed to rest on solid foundation or even in case of floating foundation- the solid foundation below floating foundation , **should not** be allowed to touch the column cap as any such resting may transmit vibration to column and it will become permanent nuisance. In case of roof top installation, ensure the load of chiller is transmitted to beams or columns and not to slab. Ensure that properly designed vibration isolators, preferably spring isolators are provided below the chiller package. Ensure piping connection, both on condenser and chiller side is through rubber bellows to avoid transmission of vibration from chillers to piping. It is always preferable to locate the chiller at least 6 to 8 ft below the cooling tower sump. Sometime this is over looked and ends up with lot of problems and modification during commissioning time.

Water management

Water management is the most neglected area in all our jobs. Water being supplied by customer most of the contractors , even though advise the customer of the quality of water required do not put their foot down to stop the plant when unacceptable water is supplied for cooling tower / expansion tank make up. The latest state of the art chillers use special high efficiency copper tubes for both condenser and chiller and are designed for very clean, soft, low TDS water circulation. The following may be taken as guide line for minimum acceptable standard for makeup water.

Test items	**Make up water Quality**	**Test items**	**Make up water Quality**
pH	6.0 - 8.0	Total Ion (Fe) ppm	Less than 0.3
Total Hardness ($CACO_3$) ppm	Less.50	Silica (SiO_3) ppm	Less than 30
Total Alkanity ($CACO_3$) ppm	Less than 80	Ammonium Ion ppm	Less than 0.2
Chloride Ion (ppm)	Less than 50	TDS ppm	Max. 250

With most of the large building complex go in for Zero Discharge, the periodic checking /recording the makeup water quality of water is very essential. Few large sized centrifugal plant still working immaculately for more than 20 years – (Chillers at IGCAR) compared to chillers which have failed with in 6/7 years (many in Chennai – not wish to name them) The only major differentiator between these two types of installation is the superior water quality management. There are two aspects in

cooling tower water. 1. Make up water, 2. Re-circulated water. We normally tend to be concerned only about make up water The concentration of the impurities increase in the re circulated water of the cooling tower. It is desirable to check all the parameters listed for the makeup water or at least, total hardness and TDS. The desirable upper limit for re-circulated water - total hardness 500ppm and TDS - 750 ppm. It is better to have a automatic bleeding system in the cooling tower- monitoring above parameters.

De-scaling of condenser is done very frequently in our plants as the quality of water used is poor It is desirable to limit the de-scaling with chemical once in 3 years or so particularly for large sized centrifugal plants.. May be once a year "end shield" be removed and physically brushed. This type of maintenance will enhance the life of the plant to more than 20 years. We frequently come across tube failure within 5 years of operation – the major reason for this is due to frequent chemical de-scaling. The de-scaling should be done under expert supervision, with the right chemicals of the right concentration. Most of the contractors, to get quick results use concentrated de-scaling agent which normally eats into parent tube material and consequently drastically reduces the life of the plant. For chilled water -- it is important to fill up with similar water specified for cooling tower initially after cleaning the piping system. Being a closed loop system the water quality remains constant - however it is important to monitor the dissolved oxygen level. Use of good monitoring and dosing system will avoid rusting, pitting, pin hole leak of chilled water system and enhance the life of the plant.. Most of our chilled water piping system is not cleaned initially before commissioning. This is long drawn process: may even take 2/3 weeks for large system. Initially water with mild acid is circulated through the entire system.. Then to pacify mild alkaline solution is circulated. Finally normal water solution is circulated and the water in circulation is tested to find the condition of piping system. Only after the approval of this test, plant can be commissioned. To enable continuous circulation of different solutions piping system should have provision to temporarily by pass chillers, cooling coils etc.

Cooling tower location and maintenance

The importance of location of cooling tower is normally over looked. It should be located at a freely ventilated location with no walls around 12 ft on two opposite sides. And around 20 ft on the other two opposite side walls. It is also necessary to ensure that the water drifting from cooling is not spilling into neighbour's compound creating nuisance for them. Most of the induced draft cooling tower noise level is high and creates nuisance to neighbours. Due attention should be given in the Selection/location of cooling tower from the noise criteria – disturbance.

The other aspect of cooling tower which we ignore is that - it is also a sort of a heat exchanger which exchanges heat to atmosphere by evaporation and that its continuous working in top class condition is equally important for the proper operation and power consumption of chillers.. Normally cooling tower is designed for 7 deg. F approach. If cooling tower performance deteriorates the approach tends to go up to 8/9/10 deg F. Hence the condenser water inlet temp.increases and consequently lower capacity and higher power consumption.. The cooling tower material used also has been changed to pvc from wood fills. The nice corrugated shape of the pvc fill enhances the air to water contact and consequently efficiency. We however find that due to higher affinity of pvc to dissolved solids, the pvc fill contour gets filled up and air to water contact surface gets reduced drastically affecting the performance of cooling tower. HVAC industry has not taken up this issue seriously, and it is time we do some research and use alternate material to avoid this problem. Even though condenser water temp. is monitored in the BMS system we have not been monitoring the approach of cooling tower. This is very critical factor which deserves to be monitored and red flag raised when ever approach goes beyond the desired limit.

Conclusion

The writer had touched upon only few critical challenges and issues. The writer would be happy, if this article could generate some new thoughts, and would welcome comments.

Forthcoming Events

Training program for BEE Energy Auditor / Managers Examination

The 8th National Certification Examination for Energy Managers and Energy Auditors (under the Energy Conservation Act, 2001) is to be held on 16th & 17th May 2009. To train the members of ISHRAE to qualify this examination, ISHRAE Chennai chapter proposes to conduct two day intensive training program followed by Mock examination to discuss the participants' performance at ISHRAE Premises.

Date : 25, 26th April 2009 & 9, 10th May 2009
Fee : Rs 5000 for Training Program and Rs 1000 for Mock Examination.
For further details please contact: ishraechennai@yahoo.com

HVAC Training courses

ISHRAE INSTITUTE OF EXCELLENCE, Chennai is pleased to conduct an application-oriented and interactive short term courses on various topics on Refrigeration and Air conditioning from March 27th 2009 onwards. For the course title, venue, duration and fee structure for the programs up to July 2009 please contact: iiec@ymail.com or Mr. S. Raja (9840992603)

Chapter Regular Programs

The following regular programs are planned for the month of April. For confirmation and venue of the program please contact: Mr.T.R.Seshadri, email : shreesrb@yahoo.com Ph. 96000 96267.

No.	Title of Programs	Proposed Date
1	Heat Pipes and Energy Efficiency	04/04/2009
2	Mystification of control center & outdoor electrical panel	11/04/2009
3	Meet the Manufacturer – Radient Ducts	17/04/2009
4	Measurement Techniques in HVAC Systems	30/04/2009

ACREX 2010

ACREX is the largest biennial International Exhibition and Conference catering to the Air Conditioning, Refrigeration, Ventilation and Building Services' Industries. ACREX India 2010 will be held in Mumbai/ India from 17th to 20th February 2010, at the Bombay Exhibition Centre, Goregaon. The Exposition, the 14th in the series, is being organized by ISHRAE. The Exhibition will provide an ideal platform for exchanges and meetings between professionals and showcase the latest products and innovations in the HVAC & R space. Alongside the products and systems being showcased by manufacturers, ACREX India 2010 will host an International Conference supported by ASHRAE, which will cover a spectrum of technology, opportunities, challenges and concerns facing the Indian HVAC industry. The Conference will chart a roadmap for the sustained growth of the Indian HVAC & R industry and enable global competitiveness to bring innovations and solutions to the vast Indian market. For further details please contact: ishrae_m@vsnl.net , http://www.acrex.org.in/

Institute Links

Institute	Link	Institute	Link
Air Conditioning & Refrigeration Industry Board (ACRIB)	http://www.acrib.org.uk	CIBSE ASHRAE interest group	http://www.cibseashrae.org
Air-Conditioning & Refrigeration Institute (USA)	http://www.ari.org	Institute of Refrigeration	www.ior.org.uk
American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)	http://www.ashrae.org	Institute of Food Science & Technology	http://www.ifst.org
Australian Institute of Refrigeration, Air Conditioning and Heating (AIRAH)	http://www.airah.org.au	Institute of Refrigeration, Heating & Air Conditioning Engineers (New Zealand)	http://www.irhace.org.nz
Carbon Dioxide Interest Group	http://www.c-dig.org	International Institute of Refrigeration	http://www.iifiir.org

New Members

ISHRAE Chennai Chapter welcomes the following New Members for the month of March 2009

No.	Name	Organization	No	Name	Organization
1	Saminathan M	Voltas Limited	16	Nithya V	Bharat Refri. Pvt Ltd
2	Somasundaram J	Voltas Limited	17	Krishna Kumar Deenadayalan	Voltas Limited
3	Narayanan E	Synergy Properties Ltd	18	Saravanan Dhanapalan	Western Air Ducts
4	Anantha Mukesh B	M.N.Dastur & Co (P) Ltd	19	Somasundaram Muruganathan	Best Comfort Systems
5	Lakshminathan M	Zeco Aircon Ndustries Pvt Ltd	20	Ajeish J A	Sterling & Wilson Pvt Ltd
6	Balamurugan Kaliyamurthy	Unimech Systems (Ch.) Pvt Ltd	21	Sankar Natarajan	Sterling & Wilson Pvt Ltd
7	Jeyaraj Kathirvel	Voltas Limited	22	Syed Abdul Lateef M	Sterling & Wilson Pvt Ltd
8	Taiyeb Fakhruddin Palanpurwala	Commercial Establishment	23	Sastry V K	Sterling & Wilson Pvt Ltd
9	Ravikumar Subramanian	Eta Engg Pvt Ltd	24	Vivek Kumar Bachhawat	National Engineers
10	Pradeep Sukumaran	Eta Engg Pvt Ltd	25	Ganesan Murugappa Pillai	Voltas Limited
11	Senthil Kumar J	Voltas Limited	26	Varghese Thelapurathu Titus	Voltas Limited
12	Giridharan	Voltas Limited	27	Velraj Ramalingam	Anna University
13	Louies Fernandas Lobu M	Voltas Limited	28	Raja Balakrishnan	Anna University
14	Biplab Chattopadhyay	Voltas Limited	29	Krishnan Ramaswamy	Emerson Industrial Automation
15	Srinivasan Viswanathan	Voltas Limited	30	M V Ananthakrishna	Mk Raju Constants Pvt Ltd., Chennai

Kindly mail your suggestions, comments, views to Dr.R.Saravanan - ishraesc@rediffmail.com