I take this opportunity to reflect my gratitude and thank you for electing me for the prestigious post of the chapter President for the Society Year 2021-2022. I am humbly obliged to share the set of responsibilities in this great capacity with my colleagues and fellow mates. I have stepped into these big shoes counting onto the capabilities of the young members of the team; and expecting their enthusiasm to enter the working mechanism of the Society.

The disintegration of ASHRAE India into further Regional Chapters would enhance networking within various regions of the country, also it would encourage in the Knowledge Dissemination between the Chapters and intermittently would help in targeting a greater number of topics to be discussed at length. The Knowledge Bank further would have a compilation of the contribution of DL’s from various regions and Chapters; it would ensure the participation of more students and budding professionals One achievement that we as a society have been able to procure during this pandemic is successfully conducting the Virtual Technical Sessions; this by enlarge would expand the prospect of conducting sessions at the dispersal of participants in near future. It also ensures the maximum usage of the available Technology. We shall be targeting the Sustainable Development in Villages; an initiative started by ASHRAE in the Year 2013. Apart from that we plan on encouraging Students to opt for and vogue in to earn ASHRAE Scholarship. The focus of this Society Year would also be on the Young Engineers and Programs related to the enhancement of their skill set and Technical Knowledge base. Furthermore, I am counting on the guidance and experience of the BOG Committee. We would encourage Student Activities with the involvement of Industry Practitioners. We look forward to enroll experts from various other fields; in order to have a holistic approach of working on a conscious built environment. I am overwhelmed in sharing with you that we have been truly successful in having raised funds over the past few years; and we look forward to a greater participation and involvement of all the Students, Members and NonMembers in this Society Year and in times to come. I would once again wholeheartedly thank you again for reposing your faith in me and giving me this opportunity to share my vision with the ASHRAE BOG. I am overwhelmed with the presence and enthusiasm to work of my Team and their domain expertise would certainly help us enhance the experience that we have to offer to our Members of the Society.

Regards,

KANAGARAJ GANESAN
President
ASHRAE INDIA CHAPTER

Thank You AIC Annual Sponsors-2022-23
AGM-22 on 8th July, 2022

Proud to get installed as President Elect for ASHRAE India Chapter for society year 2022-2023
Installation Ceremony of Ashrae India Chapter witnessed approx. 100 HVAC industry stalwarts from various society, #ASHRAE #ISHRAE #III #FSSAI and was one of the greatest time after 2 years of online and hybrid mode on 08.07.2022. New team for society year 2022-2023 took oath under the leadership of Mr Kanagaraj Ganesan and roadmap set by our outgoing President Mr. Abid Husain

Our heartfelt thanks to the guest Mr. Farooq Mehboob, Guest of honours Mr. Ashish Rakheja, Guest of Honour Mr. Richie Mittal and many Presidential members of Ashrae India Chapter Mr. V. K. Wadhwa, Mr. Ashok Virmani, Mr. Uma Shanker, Mr. G. C. Modgil, Mr. Anoop Ballaney, Mr. Dinesh Gupta, Mr. K.D. Singh, Mr. Sunil Kher, Mr. Rajinder Singh, Mr. Priyank S. Garg, Mr. Indrajit Bhattacharya, Dr. Varun Jain

Members from Ishrae Delhi Chapter along with HQ President Mr. Chandrasekar Narayanan along with their President Mr. Ashish Gupta and many more.

ASHRAE India Chapter Officer & Committee Chairs

Mr. Kanagaraj Ganesan
President

Mr. Abid Husain
IPP

Mr. Rajesh Kumar Jain
President Elect.

Ms. Arundhati Singh Khanna
Vice President

Mr. Sandeep Goel
Secretary

Mr. Abhishek Jain
Treasurer

Mr. KD Singh
Chair - CTTC

Mr. Paresh Mishra
Chair - Research Promotion

Mr. Waliullah Siddiqui
Chair - Membership Promotion

Mr. Dharmendra Rathore
Chair - GAC

Mr. Abhishek Jain
Chair - Student Activity

Ms. Dimpy Daroch
Chair - YEA

Ms. Arundhati Singh Khanna
Chair - Sustainability

Dr. Rajinder Singh
Chair - Refrigeration

Dr. Om Taneja
News Letter & Home Page Editor & ECC

Mr. Abid Husain
Historian

Mr. Dinesh Gupta
Chair - Honours & Award

BOG Members

Mr. Praveen Kumar Jha
Mr. Paresh Mishra
Mr. Subir Das
Ms. Vandana Kapuria
Dr. Om Taneja
Mr. Ashish Gupta
Mr. Waliullah Siddiqui
Mr. Mohammed Adnan

This year outlook of AIC Grass Roots Committees Chairs...
...This year outlook of AIC Grass Roots Committees Chairs

Membership Promotion Committee
Chair: Wailullah Siddiqui | Co-Chair: Indrajit Bhattacharya (Mentor AIC) | Co-Chair: Vandana Kapuria
Co-Chair: Nabila Mariyam | Co-Chair: Praveen Jha
The membership promotion committee will engage with the members by fostering industry networking, public-private-academic collaborations and knowledge sharing. The members will be encouraged to contribute to the development and use of ASHRAE technical standards. The membership committee will work closely with student activities and YEA chairs of AIC to bring value and ignite young minds.

Research Promotion Committee
Chair: Paresh Mishra | Co-Chair: Manik Goel | Co-Chair: Dr. Anurag Goyal
The aspect of research is essential to bring new technologies and innovations to meet holistic requirements of functionality, efficiency, reliability and scalability. The research leads to publication of ASHRAE Handbooks, Technical Reports and Formulation of Standards. The committee makes appeal to the fraternity to support, contribute and aid the research works carried out in the enrichment of the systems, design and technologies for the improvisation in the HVAC domain. The RP committee also works collaboratively with the research professional to identify the areas and systems to have excellence in functions and operations. The committee also echoes the HVAC&R research requirements of regional context at Region At Large.

Student Activities Committee
Chair: Abhishek Jain | Co-Chair: Dr. Rajinder Singh (Mentor AIC) | Co-Chair: Vandana Kapuria
Co-Chair: Dr. Anurag Goyal | Co-Chair: Dr. Vaibhav Jain
The purpose of student activity in ASHRAE India is to create a positive learning experience for the student members. This provides opportunities for students to engage in the activities that enrich the value of their education. We provide a variety of programs to enhance educational aspects.

Government Affairs Committee
Chair: Dharmendra Rathore (Mentor AIC) | Co-Chair: Priyank Garg (Mentor AIC) | Co-Chair: Paresh Mishra
• MoU with Ministry of Electronics and Information Technology (MEITY) for co-development of activities around Smart Buildings
• Planning to have collaboration with National Center for Cold Chain Development (NCCD) & National Horticulture Board (NHB) (also as Refrigeration activity)
• An event to be planned with World Bank in the month of April-2023 (to be organized With the support of DCI & RAL).
MoU with Ministry of Electronics and Information Technology (MEITY) for co-development of activities around Smart Buildings

Young Engineers in ASHRAE (YEA) Committee
Chair: Dimpy Daroch | Co-Chair: Shruti Gupta | Co-Chair: Raj Kumar
Increase YEA membership by creating digital forums to engage in skill development and training opportunities.
• Establish the chapter's leadership by engaging YEA to produce position documents in matters of important including climate change, building performance, and technology integration in line with the ASHRAE president's theme.
• Explore new mediums such as podcasts and live streaming for technical programs.

Refrigeration Committee
Chair: Prof. Rajinder Singh (Mentor AIC) | Co-Chair: Ashish Gupta
Planning Solar Cold Storage visit for members as well student members.
• Planning some workshops on Refrigeration.
• Plan a project on Refrigeration to be prepared by student members.
Analytical, Performance & Prescriptive Codes & Standards Essential for Future Of Buildings to enhance IEQ & Improve Building Efficiency

Om Taneja, PhD, PE, FASHRAE

Sustainability goals for buildings are highly acclaimed as public and private sector’s contributions to environmental responsibility, resource efficiency and occupant health and safety.

Building codes, standards, regulations and guidelines form the basic foundation for design, construction and for effective post-construction operations and maintenance. With complexity of high-performance buildings, application of progressive analytical, performance & prescriptive measures for life cycle tracking of high efficiency projects is critical. The need is not just to conserve energy, but to improve comfort, indoor environmental quality while meeting functional needs and resilience over the life-cycle.

Without periodically updating, developing requisite skills of administrative and operating staff and effectively applying codes and standards, buildings would be inundated with unsystematic design, inefficient system and unsafe conditions with regards to comfort, health and IEQ. There is ample evidence that strong and well-enforced building codes can and do save lives, reduce property damage, and improve health and productivity of occupants.

Which codes are applicable is a challenge owners, designers and constructors deliberate about?

There is continuing lack of commitment to include operations and commissioning staff in goal setting and be part of the project and commissioning teams. By such inclusive policies, buildings’ mechanical, electrical, lighting and plumbing systems are kept well-tuned. Engagement of Operations & Maintenance staff can help in making adaptive changes to buildings systems to suit changing uses, or other internal and external factors that directly or indirectly affect performance.

Codes & Standards must Safeguard Against Communicable Diseases, and include guidance for Demand-based Ventilation, Filtration & Resilient Infrastructure

Barriers to deep energy use reduction for buildings have been many, including, first cost versus life cycle costs competing, though unmatched, criteria decision making coupled lack of proper information, unfavorable IEQ predication, lack of trust since many other energy savings investments did not deliver anticipated results. It is further compounded by split incentives between developers, operators and tenants, fluidic financial market conditions, changing national energy policies, lack of trained staff and uncertainties about the future.

Maintaining good environment indoors and outdoors under all times and weather of building occupancy is becoming a paramount factor with prevalence of communicable diseases caused by virus like Covid-19, asthma and respiratory diseases and water-origin Legionnaire’s diseases. It is envisioned that the economy of the 21st century will be renewed and built on how well the industry delivers safe, healthy and high-performance spaces.

It has been estimated that O&M programs targeting energy efficiency can save 5% to 20% on energy bills (USDOE).

Applicable Building Codes, Standards & Guidelines

a) International Building Code (IBC): The IBC is a model building code that addresses both health and safety concerns for buildings

b) International Residential Code (IRC): The IRC is a comprehensive model code for residential buildings that establishes minimum regulations for dwellings of three stories or less;

c) International Existing Building Code (IEBC): The IEBC establishes minimum regulations for upgrades and improvements addressing the alteration, addition or change of occupancy in existing buildings.

d) International Green Construction Code (IgCC): The IgCC provides an effective means of delivering more sustainable, resilient and high-performing buildings. Formed through a partnership between AIA, ASHRAE, ICC, IES, and USGBC, the IgCC represents a formula for green building codes that works toward a new era that includes environmental health and safety as code minimums; International Energy Conservation Code (IECC): The IECC is designed to meet the needs of an up-to-date energy conservation code through model code regulations;

e) Beyond Code Programs - ASHRAE green standards & guides - ASHRAE Reference Standard 90.1 and its Green Standard 189.1 recommend designs that exceed 30, 60, or 100% minimum design basis f)The National Fire Protection
Building Efficiency

Buildings to enhance IEQ & Improve Om Taneja,
constructors deliberate about health and productivity of occupants. There is ample evidence that strong and well-enforced building inefficient system and unsafe conditions with regards to comfort, health standards, buildings would be inundated with unsystematic design, without periodically updating, developing requisite skills of prescriptive measures for life cycle tracking of high efficiency projects is buildings, application of progressive analytical, performance &

ASHRAE green standards & guides - code through model code regulations; code minimums; USGBC, the IgCC represents a formula for green building codes that formed through a partnership between AIA, ASHRAE, ICC, IES, and model code for residential buildings that establishes minimum save 5% to 20% on energy bills (USDOE). It has been estimated that O&M programs targeting energy efficiency can high-performance spaces. It is envisioned that the economy of the 21st century will be prevalence of communicable diseases caused by virus like Covid-19, weather of building occupancy is becoming a paramount factor with tenants, fluidic financial market conditions, changing national energy standards, buildings; Standard 55-2020 – Thermal, environmental conditions for Human Occupancy; Standards 62.1-2019, Ventilation and Acceptable Indoor Air Quality; Standard 62.2-2019, Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings; 30% & 50% & ZNE Advanced Energy Design Guides

Comparing energy use in other similar buildings


• Codes Leading to Zero Net Energy – A ZNE building produces as much energy as it uses, achieved through energy efficiency and renewable technologies. Need to expand the scope of codes to capture all building energy uses, address whole building systems, and shift focus from building design to actual building energy use by adopting outcome-based codes. Require monitoring of performance post-occupancy by including the impact of building occupants and operators and by incorporating future-proofing measures.

• Energy Saving Performance Contracting (ESPC) & Outcome Based Codes – are flexible, inspire innovative design and all players are held accountable for actual performance, complying with targets. For high performance buildings to become credible an outcome-based design process is promising. There is nothing more convincing than actual delivered performance over a stated period. Therefore, more and more public and semi-public agencies are moving towards, “Energy Saving Performance Contracts (ESPC)* that are outcome based.

• Life Cycle Impact Analysis Guidelines & Standards – Over a 30

year period, initial building costs just 2-4% of the total, while O&M costs equal 6-10%, and personnel costs equal 86-92%. A life Cycle cost and performance analysis typically includes -Repair & Maintenance – 25%; Energy Use – 29%; Janitorial Services – 21%; Administration – 15%; Security – 9%; Other - 1% • Codes & Standards & Climate Change – to comply with Montreal Protocol, UNFCC Conference of the Parties( COP10-26)Impacts of global warming and associated climate changes • Energy Use Accounting & Audits – with Advanced metering & smart sub-metering • Commissioning & Retro-Commissioning • Adaptive Building Management System – install building control systems that are adaptive to building use, occupancy and weather changes and provide surveillance and management of energy. These systems use a system of sensors, processors, drive units, communication and feedback systems to measure, control, track, analyze and report operating data for the building’s individual systems and spaces and store building baseline and weekly, monthly and annual operational summaries.

Building Labeling, Benchmarking and Monitoring –

Comparing energy use in other similar buildings

About the Author

OM TANEJA
Ph. D., P.E., Fellow ASHRAE Consulting Engineer

Dr. Taneja holds a Bachelor’s degree in Mechanical Engineering from Indian Institute of Technology, New Delhi, Master’s degree in Control systems and a Ph.D. degree in Systems Sciences and Operations Research from New York University. He is a licensed professional engineer, ASHRAE Fellow, USGBC Member with specialization in innovative technologies adoption, smart infrastructure, smart buildings, smart cities, power generation and distribution, sustainability, energy-efficiency, training and capacity development along with associated, operations and maintenance issues.

Dr. Taneja has more than 40 years of diversified experience in the area of design, construction, operations and maintenance of large facilities, including the United Nations Headquarters, General Electric Headquarters, US Government General Services Administration and a 17 years in the Infrastructure Development for hospitals, court houses and varied commercial, industrial and historical facilities. He also worked as Senior Engineering Manager for long range capital improvements plan for the United Nations Headquarters in New York City, and Refurbishment of the Rockefeller Center for General Electric & National Broadcasting Company. Mr. Taneja has recently been the “Director of Manhattan Service Center” for the United States General Services Administration where he managed the Federally owned and leased Properties with diverse and growing portfolio of assets and with emphasis on smart buildings, greening, energy and water efficiency, analytics, technology adoption, alternate work space designs, emergency preparedness and improved operations, and maintenance.

Dr. Taneja was designated an ASHRAE fellow after serving on different Chapter and Technical Committees with USGBC, ASME and ASHRAE. He was the Program and Student Committee Chairman and President of ASHRAE NY Chapter during 2008-2009. Thereafter, he was the “Regional Vice Chair” for Student Activities for ASHRAE Region 1. He is serving as a Distinguished Lecturer” for ASHRAE since FY 2012, conducting seminars on technology adoption, smart buildings, transformation of facilities management, operations, maintenance and staff development..
1.4 PSYCHROMETRIC PROCESSES

1.4.1 SENSIBLE COOLING OR SENSIBLE HEATING PROCESS

SENSIBLE COOLING PROCESS:

In this process satisfied with moisture content but not satisfied with temperature. To reduce DBT and w remains constant. The given stream of air is allowed to pass over a coil in which cold water is flowing and whose effective surface temperature is less than the DBT and more than the DPT of the incoming air.

Effective surface temperature is the average temperature of the coil responsible for the heat transfer to occur. All air does not come in contact with coil some air by-passed, 80-90 % air comes in contact with coil.

By pass factor, \( BF = \frac{(t_d - EST)}{(t_d - EST)} \)

Efficiency = \( \frac{(t_d - t_f)}{(t_d - EST)} \)

By Pass factor represents inefficiency of the cooling coil.

\( BF = 1 - \text{Efficiency} \)

SENSIBLE HEATING PROCESS:

In this process satisfied with moisture content but not satisfied with temperature. To increase DBT and w remains constant. The given stream of air is allowed to pass over a coil in which hot water or steam is flowing or it can pass over a strip heater whose effective surface temperature is more than the DBT of the incoming air.

By pass factor, \( BF = \frac{(t_d - t_f)}{(t_d - EST)} \)

1.4.2 HUMIDIFICATION OR DEHUMIDIFICATION PROCESS

HUMIDIFICATION PROCESS:

If moisture is added to air but its DBT is maintained constant. During humidification process RH increases i.e. \( RH_i > RH_f \). Pure humidification process is not found in practice. It is an ideal process, practically could not be achieved. If pure humidification is desired, the spray water through which air passes has to be maintained at DBT \( (t_d) \) of the entering air.

DEHUMIDIFICATION PROCESS:

If moisture is removed from air without changing its dry bulb temperature, the process is known as dehumidification process. For this...
1.4 PSYCHROMETRIC PROCESSES

1.4.1 SENSIBLE COOLING OR SENSIBLE HEATING PROCESS

SENSIBLE COOLING PROCESS:
In this process, the moisture content is satisfied but not the temperature. To reduce DBT and w remains constant. The given stream of air is allowed to pass over a coil in which cold water is flowing and whose effective surface temperature is less than the DBT and more than the DPT of the incoming air.

Effective surface temperature is the average temperature of the coil responsible for the heat transfer to occur. All air does not come in contact with the coil; some air bypasses. 80-90% of the air comes in contact with the coil.

By-pass factor, BF = (t_d2 - EST) / (t_d1 - EST)

Efficiency = (t_d1 - t_d2) / (t_d1 - EST)

By-pass factor represents inefficiency of the cooling coil. BF = 1 - Efficiency

SENSIBLE HEATING PROCESS:
In this process, the moisture content is satisfied but not the temperature. To increase DBT and w remains constant. The given stream of air is allowed to pass over a coil in which hot water or steam is flowing or it can pass over a strip heater whose effective surface temperature is more than the DBT of the incoming air.

1.4.2. HUMIDIFICATION OR DEHUMIDIFICATION PROCESS

HUMIDIFICATION PROCESS:
If moisture is added to the air but its DBT is maintained constant. During humidification process, RH increases, i.e., RH_2 > RH_1. Pure humidification process is not found in practice. It is an ideal process, practically could not be achieved. If pure humidification is desired, the spray water through which the air passes has to be maintained at DBT (t_d1) of the entering air.

DEHUMIDIFICATION PROCESS:
If moisture is removed from the air without changing its dry bulb temperature, the process is known as dehumidification process. For this process, a spray dehumidifier having strong affinity for moisture, to condense steam and latent heat liberated.

Absorbent having capability to hold moisture and condense steam. Absorbents used are Glycol, Silica gel, Alumina (Al_2O_3). During this process, steam getting condensed, latent heat of condensation liberated, by this air is heated and we get heating and dehumidification. Dehumidification is an ideal process and practically could not be achieved. Pure humidification or dehumidification could not be achieved, but associated with some cooling and heating.

1.4.3. MIXING OF TWO DIFFERENT STREAMS OF AIR

The practical example of this process is an Air Handling Unit (AHU) room, in which return air is mixed with the fresh air and passed over the AHU coil.

Let properties of one air stream are m_1, h_1, w_1 (where m_1 is the mass of air stream (1) per unit time. h_1 is the specific enthalpy and w_1 is the specific humidity) that mixed with air stream (2) having properties m_2, h_2, w_2 and the resultant air stream is (3) having properties m_3, h_3, w_3. The system is insulated and there is no heat exchange between system and surroundings.

Mass balance: m_1 + m_2 = m_3

Enthalpy balance: m_1 h_1 + m_2 h_2 = m_3 h_3

Enthalpy balance: m_1 h_1 + m_2 h_2 = m_3 h_3 + m_3 h_3

Enthalpy balance: m_1 (h_1 - h_3) = m_2 (h_3 - h_3)

Therefore, m_1 / m_2 = h_3 / h_3

Moisture balance: m_1 w_1 + m_2 w_2 = m_3 w_3

And, m_1 w_1 + m_2 w_2 = m_3 w_3 = (m_3 + m_3) w_3

Therefore, m_1 / m_2 = (w_3 - w_1) / (w_3 - w_2)

Case Study

1 Kg of air stream at 40 °C DBT and 50 % RH is mixed with 2 Kg of air at 20 °C DBT and 12 °C DPT. Calculate Dry bulb temperature and specific humidity of the mixture.

Solution.

First air stream: 40 °C DBT and 50 % RH
Mass, m_1 = 1 Kg

Second air stream: 20 °C DBT and 12 °C DPT
Mass, m_2 = 2 Kg

After mixing, we get the third air stream of mass, m_3

Mass balance: m_1 + m_2 = m_3

Enthalpy balance: m_1 h_1 + m_2 h_2 = m_3 h_3

Enthalpy balance: m_1 h_1 + m_2 h_2 = m_3 h_3 + m_3 h_3

Enthalpy balance: m_1 (h_1 - h_3) = m_2 (h_3 - h_3)

From Psychrometric Chart:

Specific enthalpy, h_i = 99.7 KJ/Kg dry air

h_i = 42.5 KJ/Kg dry air
Therefore, \[ m_1 / m_2 = h_1 - h_2 / h_1 - h_3 \]
\[ 1/2 = h_1 - 42.5 / 99.7 - h_1 \]
\[ 99.7 - h_1 = 2 (h_1 - 42.5) \]
\[ 99.7 - h_1 = 2 h_2 - 85 \]
\[ 99.7 + 85 = 2 h_1 + h_3 \]
\[ 184.7 = 3 h_1 \]
Therefore, \[ h_1 = 61.56 \text{ KJ Kg dry air} \]

From Psychrometric chart at \[ h_1 = 61.56 \text{ KJ Kg dry air} \]
DBT = 26.80 °C
And specific humidity = 0.135 KJ / Kg dry air

### 1.4.4. COOLING AND DEHUMIDIFICATION PROCESS:

Allow the air to pass over a coil in which refrigerant or chilled water or chilled brine is following. When air is passed over a cooling coil whose effective surface temperature is less than the DPT of entering air, condensation of moisture takes place. This separation of moisture results in fall in humidity. Thus both the cooling and dehumidification obtained.

The effective surface temperature is called ADP (Apparatus Dew Point).

Effective Surface Temperature (EST): This is the average temperature of the coil responsible for the heat transfer to occur.

All air does not come in contact with coil some air by-passed; we have to calculate by pass factor (BF).

**By Pass Factor** = Air which is unaffected by the coil / Total air quantity passing over coil.

BF of cooling coil = \[ t_r - ADP / t - ADP \]

1- A = Process of dehumidification.

A-2 = Process of Sensible Cooling.

Heat removed from air = \[ m (h_1 - h_2) \]

Latent heat removed (QL) = \[ m (h_1 - h_2) \]

Sensible heat removed (Qs) = \[ m (h_1 - h_2) \]

Sensible Heat Factor, SHF = SH / SH + LH

#### Case Study

Data for air conditioning of a space of a building is given:

- Inside design conditions maintained: 25 °C DBT, 50 % RH
- Outside air conditions: 43 °C DBT, 27 °C WBT
- Room sensible heat gain: 40 KW
- Room latent heat gain: 10 KW
- By pass factor of cooling coil: 0.2

The return air from the room is mixed with outside air before entry to cooling coil in the ratio of 3:1 by weight.

Determine:

1. Apparatus dew point (ADP) of cooling coil
2. Entry and exit conditions of air for cooling coil
3. Dehumidified air quantity
4. Fresh air mass flow rate
5. Refrigeration load on the cooling coil

**Solution.**

- Sensible heat load, \[ Q_s = 40 \text{ KW} \]
- Latent heat load, \[ Q_l = 10 \text{ KW} \]
- Room sensible heat factor (RSHF) = \[ Q_s / Q_s + Q_l \]  
  = \[ 40 / (40+10) \]
  = 0.8
- By pass factor (BF) = \[ t_r - ADP / t_r - ADP \]  
  = \[ (15.2- 11.0) / (31.0- 11.0) \]
  = 0.21

Thus by trial and error, ADP is located as 11.0 °C

(i) ADP of cooling coil = 11.0 °C

---

**Fig.4.8 Cooling and Dehumidification Process**

**Fig.4.9 (b) Representation on the psychrometric chart**
Sensible Heat Factor, SHF = SH / SH + LH

Sensible heat removed (Qs) = m (h₂ - h₁)

Latent heat removed (QL) = m (h₃ - h₄)

Heat removed from air = m (h₃ - h₄)

A - 2 = Process of Sensible Cooling.

A 1 = Process of dehumidification.

BF of cooling coil = t₃ - ADP / t₃ - ADP passing over coil.

By Pass Factor = Air which is unaffected by the coil / Total air quantity

calculate by pass factor (BF).

All air does not come in contact with coil; some air by-passed; we have to Effective Surface Temperature (EST): This is the average temperature of the effective surface temperature is called ADP (Apparatus Dew Point). obtained.

results in fall in humidity. Thus both the cooling and dehumidification condensation of moisture takes place. This separation of moisture effective surface temperature is less than the DPT of entering air, chilled brine is following. When air is passed over a cooling coil whose chilled brine temperature is higher than the dew point temperature of entering air, the air cools and humidified.

Because of evaporation, air got its temperature reduced but enthalpy remains same whatever sensible heat is removed to drop the temperature, the same heat is added as latent heat for humidification. This is adiabatic saturation process.

Process 1-2 is the process of cooling and humidification.

Humidification efficiency = W₁ - W₄ / W₂ - W₁

= t₃ - t₄ / t₀ - t₄

1.4.5. HEATING AND DEHUMIDIFICATION PROCESS:

Heating and dehumidification can be simultaneously achieved if air is passed through a solid absorbent surface or through liquid absorbent spray. Dehumidification achieved because of the lower water vapours present at the surface of the absorbent. Water vapours condenses out of air and the latent heat of condensation liberated, heats the air sensibly and due to condensation humidity falls and this heat of condensation heats air sensibly increasing its Dry Bulb Temperature.

Absorbent used are Glycol, Silica gel, alumina etc.

In this process no heat is added or removed. This is an adiabatic process. This process is reverse of cooling and humidification process.

1.4.6. COOLING AND HUMIDIFICATION PROCESS

If air is washed through sprays of water maintained at a temperature higher than the dew point temperature of entering air but lower than the dry bulb temperature of entering air the air cools and humidified.

In this case hot water is sprayed, when cold and dry air (month of December) comes in contact with hot water, water evaporates, hence humidified air and due to heat from water air gets up heated up.

If the humidifier or the spray water through which air is washed. It is at a temperature higher than the dry bulb temperature of the entering air, the unsaturated air reaches the condition of saturation and the heat of evaporation of water is absorbed from the spray water itself. Thus the air gets humidified and heated, and the spray water gets cooled. The leaving air can be heated to the spray water temperature and humidified upto
saturation condition corresponding to spray water saturation. The water may get cooled to a minimum of the WBT of the entering air. During the process, the humidity ratio (w), DBT, DPT and h of air increases while passing through hot spray water.

Case Study

Air at 5 ºC DBT and 80 % RH is to be heated and humidified to 24.5 ºC and 45 % RH:

(i) By passing the air through heated water spray air washer.

(ii) By pre heating sensibly, and then passing through water spray washer with re-circulated water till relative humidity rises to 95 % and then again heated sensibly to final required state.

Determine for (i) and (ii) the total heating required, the make up water required in water spray air washer and the humidifying efficiency of the re-circulated spray air washer.

Solution.

(i) Initial condition on psychrometric chart is shown by point 1 and the final condition is shown by point 2, the process followed by line 1-2 in Fig. below when air is passed through “heated water spray air washer”.

From psychrometric chart:

\[ h_1 = 16 \text{ KJ} / \text{kg of dry air} \]
\[ h_2 = 47 \text{ KJ} / \text{kg of dry air} \]
\[ w_1 = 0.00420 \text{ kg} / \text{kg of dry air} \]
\[ w_2 = 0.00880 \text{ kg} / \text{kg of dry air} \]

Hence heating required \[ = h_2 - h_1 \]
\[ = 47.0 - 16.0 \]
\[ = 31.0 \text{ KJ} / \text{kg of dry air} \]

Make up water required in the water spray air washer \[ = w_2 - w_1 \]
\[ = 0.00880 - 0.00420 \]
\[ = 0.00460 \text{ kg} / \text{kg of dry air} \]

(ii) For sensible heating a horizontal line is drawn from point 1, again from point 2 another horizontal line is drawn to cut 95 % RH line, point B

The pre heating is represented by \(1-A\), evaporative cooling to 95 % RH by line A-B and reheating to final condition by line B-2.

Specific enthalpy, \( h_A = h_B = 34.1 \text{ KJ} / \text{kg of dry air} \)

(a) The amount of pre heating required \[ = h_A - h_1 \]
\[ = 34.1 - 16.0 \]
\[ = 18.1 \text{ KJ} / \text{kg of dry air} \]

The amount of reheating required \[ = h_2 - h_B \]
\[ = 47.0 - 34.1 \]
\[ = 12.9 \text{ KJ} / \text{kg of dry air} \]

Therefore, total heat required \[ = 18.1 + 12.9 \]
\[ = 31.0 \text{ KJ} / \text{kg of dry air} \]

(b) Similarly, the make up water in the re-circulated water spray air washer
\[ = w_B - w_A \]
\[ = w_2 - w_1 \]
\[ = 0.00880 - 0.00420 \]
\[ = 0.00460 \text{ kg} / \text{kg of dry air} \]

(c) Humidifying efficiency \[ = \frac{t_B - t_{dA}}{t_B - t_{dA} - t_{wa}} \]
\[ = \frac{23 - 12.5}{23 - 12} \]
\[ = 0.9545 \text{ or 95.45 %} \]

About the Author

Prof. Rajinder Singh
Pusa Institute of Technology
(Past President 2015-16, Co-Chair Student Activities, Chair - Refrigeration - ASHRAE India Chapter & Student Advisor - ASHRAE Pusa Institute of Technology Student Chapter)

This classroom is started in view to strengthen the theoretical knowledge of Engineers from Industries in Refrigeration & Air-Conditioning field. This will also be helpful for the students interested in this field. This will be continuing in our quarterly Newsletter issue. In the fifth class we are covering the remaining portion of Air-Conditioning and Air-Conditioning Design (Applied Psychrometry).
Saturation condition corresponding to spray water saturation. The water may get cooled to a minimum of the WBT of the entering air. During the process, the humidity ratio (w), DBT, DPT and h of air increases while passing through hot spray water.

Case Study

Air at 5 ºC DBT and 80 % RH is to be heated and humidified to 24.5 ºC and 45 % RH:

(i) By passing the air through heated water spray air washer.

(ii) By pre heating sensibly, and then passing through water spray washer with re-circulated water till relative humidity rises to 95 % and then again heated sensibly to final required state.

Determine for (i) and (ii) the total heating required, the make up water required in water spray air washer and the humidifying efficiency of the re-circulated spray air washer.

Solution.

(i) Initial condition on psychrometric chart is shown by point 1 and the final condition is shown by point 2, the process followed by line 1-2 in Fig. below when air is passed through "heated water spray air washer".

From psychrometric chart:

- $h_1 = 16 \text{ KJ} / \text{kg of dry air}$
- $h_2 = 47 \text{ KJ} / \text{kg of dry air}$
- $w_1 = 0.00420 \text{ kg} / \text{kg of dry air}$
- $w_2 = 0.00880 \text{ kg} / \text{kg of dry air}$

Hence heating required = $h_2 - h_1 = 47.0 - 16.0 = 31.0 \text{ KJ} / \text{kg of dry air}$

Make up water required in the water spray air washer = $w_2 - w_1 = 0.00880 - 0.00420 = 0.00460 \text{ kg} / \text{kg of dry air}$

(ii) For sensible heating a horizontal line is drawn from point 1, again from point 2 another horizontal line is drawn to cut 95 % RH line, point B

The pre heating is represented by 1-A, evaporative cooling to 95 % RH by line A-B and reheating to final condition by line B-2.

Specific enthalpy, $h_A = h_B = 34.1 \text{ KJ} / \text{kg of dry air}$

(a) The amount of pre heating required = $h_A - h_1 = 34.1 - 16.0 = 18.1 \text{ KJ} / \text{kg of dry air}$

The amount of reheating required = $h_2 - h_B = 47.0 - 34.1 = 12.9 \text{ KJ} / \text{kg of dry air}$

Therefore, total heat required = $18.1 + 12.9 = 31.0 \text{ KJ} / \text{kg of dry air}$

(b) Similarly, the make up water in the re-circulated water spray air washer

- $w_B - w_A = w_2 - w_1 = 0.00880 - 0.00420 = 0.00460 \text{ kg} / \text{kg of dry air}$

(c) Humidifying efficiency = \frac{t_{dB} - t_{wB}}{t_{dB} - t_{wA}} \times 100 = \frac{24.5 - 12.5}{24.5 - 12} \times 100 = 95.45 %
First members meet of the Young Engineers

The first members meet of the Young Engineers at ASHRAE (YEA) of ASHRAE India Chapter (AIC) was held on 27th July 2022 4 PM over an online meeting. The participants of this meeting included Ms. Dimpy Daroch, Chair (YEA-AIC), Mr.Rajkumar Balasubramaniyan (Co-Chair, YEA-AIC), Dr. Anurag Goyal, Ms. Nidhi Rai Jain, Mr. Pawan Kumar, Mr. Shrey Mahajan, in the presence of the President of AIC Ar. Kanagaraj Ganesan. The meeting initiated with an introduction of the YEA members, followed by a presentation by Mr. Kanagaraj on the various activities under the YEA of the chapter for the current year. Further, the YEA members proposed several ideas for the activities including but not limited to enhancing research and development for professionals and students, developing climate sensitive heating for the buildings in UT of Ladakh, etc. The meeting concluded with the decision to conduct an in-person meeting for all the YEA members and bringing all the 32 YEA members on-board over online meetings in the coming weeks.

Rising Stat Award Winners

Team AKRA of ASHRAE Student Branch Maharaja Agrasen Institute of Technology comprising of members: Akshat Goel (Student, MAIT) and Dhruv M. (Student, MAIT) and Dr. Vaibhav J. (Team mentor) achieved RISING STAR position in the competition Setty Family Foundation Applied Engineering Challenge 2021 organized by ASHRAE, USA. The theme of the competition was to design a cost effective and sustainable indoor farming system. Mr Akshat Goel from the team received the opportunity to get free transportation and two nights lodging for attendance at the 2022 ASHRAE Winter Meeting; where, the award was presented at the ASHRAE Student Program. Unfortunately, He could not attend the same because of the VISA issue due to Pandemic COVID 19.
6th July, 2022

YEA Meeting

We the Youth Engineers Association at ASHRAE INDIA CHAPTER had a humble beginning to the year, with a meeting in person on 6th July 2022. There were discussions about engagement of young fellow professionals and student members in the activities of the chapter. Members from the YEA Team planned on the association with institutions and organisations in times to come.

Mumbai: 21st August, Delhi: 17th August, 2022

Supported ASHRAE Mumbai Chapter for organizing & Supported Delhi ISHRAE Chapter

23rd August, 2022

Visit to Industrial Training Facility for Student

On 23rd August, AIC with the MEPa2z organized a technical visit for Delhi Technological University (Formerly DCE) engineering students. The session started with the talk on ‘Harvesting Information in the service of our members’ by Ms. Vandana Kapuria, Director Enmax Smart Systemz. This topic covered the theme of the ASHRAE Presidential Initiative of ‘Securing our Future’. The MEPa2z institute instructor demonstrated HVAC components servicing to the students.
**ACTIVITIES**

**10th September, 2022**

**On 10th September AMU Student visits BRY-AIR**

**14th-16th September, 2022**

**Membership Promotion Campaign**

Membership promotion campaign at the event organized (14th -16th September, 2022) by Bureau of Energy Efficiency, named 'Angan' at Ashoka Hotel, New Delhi

**15th September, 2022**

**Engineers Day Celebration**

Engineers Day Celebration in Ashrae Student Chapter held on 15th September, 2022

**10th October, 2022**

**Supporting partner with IAQA conference held on 10th October**
ACTIVITIES

Membership Promotion Campaign
Membership promotion campaign at the event organized (14th - 16th September, 2022) by Bureau of Energy Efficiency, named 'Angan' at Ashoka Hotel, New Delhi on 10th September, 2022.

Engineers Day Celebration
Engineers Day Celebration in Ashrae Student Chapter held on 15th September, 2022.

On 10th September AMU Student visits BRY-AIR
Supporting partner with IAQA conference held on 10th October.

Website and contact information:
| Email : ashraeic@gmail.com |

ASHRAE India Chapter Bulletin Newsletter wants ideas from readers on what you would like to see in future newsletters. 
Tell us what you think.

Members interested to send their technical articles are requested to send the same at ashraeindia6@gmail.com