
UNIT 6 PROPERTIES OF MOIST AIR

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6.1 INTRODUCTION

The art of air conditioning developed only gradually from the predecessor arts of cooling, cleaning, heating and ventilating. Towards the latter half of the 19th century, the developments in the art of humidifying air went along with the progress of textile industry in England. It is worth mentioning here the name of A.R. Wolff who designed air-conditioning systems for as many as hundred buildings during his life-time. But it is W.H. Carrier (1876-1950) who is known as the 'Father of Air Conditioning'. He engineered and installed the first year-round air-conditioning system, providing for the four major functions of heating, cooling, humidifying and dehumidifying. He made use of air washers for controlling the dew point of air by heating or chilling recirculated water. Carrier presented his remarkable paper 'Rational Psychrometric Formulae' in an ASME meeting. Carrier also employed the centrifugal compressor for refrigeration in 1922. As far as air conditioning for comfort is concerned, it got off the ground in motion-picture theatres in 1920 in Chicago employing CO₂ machines and in 1922 in Los Angeles employing NH₃ compressors.

In the following chapters, attention will henceforth be focused on the art and science of air conditioning which is the greatest single application of

refrigeration, in addition to that of heating and ventilation. For this purpose it is necessary to study the properties of the working substances in air conditioning, viz., moist air.

Objectives

After studying this unit, you should be able to

- know the composition of moist air,
- know the properties of moist air,
- study of psychrometric chart, and
- know the terminology of psychrometric chart.

6.2 WORKING SUBSTANCE IN AIR CONDITIONING

An important thing for the student of air conditioning is to appreciate that the working substance under study, viz., moist air, is a mixture of two gases. One of these is dry air which itself is a mixture of a number of gases and the other is water vapour which may exist in a saturated or superheated state.

One might ask whether moist air can be considered as a pure substance. But a pure substance is *homogeneous* and *invariable* in *chemical composition*. Thus, a homogeneous mixture of gases is a pure substance until its components do not change in phase. Dry air is a good example of such a kind of pure substance. Water vapour is certainly a pure substance. But moist air is not a pure substance in any process in which condensation or evaporation of moisture occurs. In such a case, regular charts have to be developed to describe the thermodynamic properties of the mixture under different conditions and compositions.

It is, thus, seen that moist air consists of two parts: one, comprising dry air, considered as the fixed part, and the other, solely of water vapour, considered as the variable part.

The dry air part is a mixture of a number of permanent gases with approximate compositions as given in Table 6.1.

Both dry air and water vapour can be considered as perfect gases since both exist in the atmosphere at low pressures. Hence, perfect gas laws can be applied to them individually. In addition, Gibbs-Dalton laws for non-reactive mixtures of gases can be applied to the dry air part only to obtain its properties as a single pure substance, before establishing the properties of moist air.

6.2.1 Gibbs-Dalton Laws

Dalton's Law of Partial Pressures

Consider a homogeneous mixture of non-reacting ideal gases 1, 2, etc., at temperature T , pressure p and occupying volume V as shown in Figure 6.1. Let the number of moles of individual gases be n_1, n_2, \dots etc., and their respective masses be m_1, m_2, \dots etc. Then we have for total number of moles n and total mass m

$$n = n_1 + n_2 + \dots = \sum n_i \quad \dots 6.1$$

$$m = m_1 + m_2 + \dots = \sum m_i \quad \dots 6.2$$

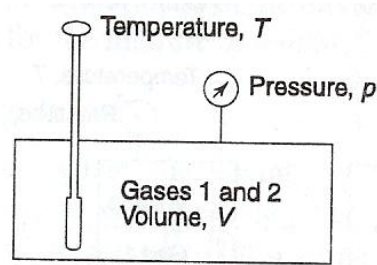


Figure 6.1: Gas Mixture

where i is the number of each gas.

In the Dalton's model, each gas is conceived of as existing separately at the temperature T and total volume V of the mixture as shown in Figure 6.2.

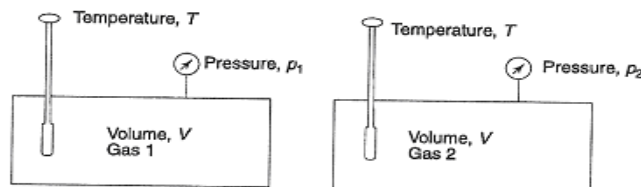


Figure 6.2: Illustrating Dalton's Model

If one were to measure the pressures exerted by individual gases, they would be found to be p_1, p_2, \dots etc., viz., less than the total pressure p of the mixture. These are referred to as *partial pressures*. Considering mixture and each component gas existing separately at T and V , we have for a binary gas mixture:

$$\text{Mixture} \quad pV = nRT \quad n = \frac{pV}{RT}$$

$$\text{Components} \quad p_1V = n_1RT \quad n_1 = \frac{p_1V}{RT}$$

$$p_2V = n_2RT \quad n_2 = \frac{p_2V}{RT}$$

$$n_1 + n_2 = n \text{ gives } = \frac{V}{RT} (p_1 + p_2)$$

$$= p = (p_1 + p_2)$$

Thus, for a mixture of ideal gases, the total pressure p is equal to the sum of the partial pressures. This is known as the *Dalton's law of partial pressures*.

$$p = p_1 + p_2 \text{ or } p = \sum_i p_i$$

6.2.2 Mole Fractions of Component Gases

The ratio of partial pressure to total pressure, and volume fraction are equal to the *mole fraction* of the gas.

$$\text{Let } \frac{p_1}{p} = \frac{V_1}{V} = \frac{n_1}{n} = y_1 \text{ (Let)} \quad \dots 6.4$$

Molecular Mass of Mixture

Since $m = m_1 + m_2$, and $m = Mn$, $m_1 = M_1 n_1$, $m_2 = M_2 n_2$, we have

$$Mn = M_1 n_1 + M_2 n_2$$

Thus

$$M = y_1 M_1 + y_2 M_2 \quad \text{or} \quad M = \sum_i y_i M_i \quad \dots 6.5$$

where M represents the molecular mass of the mixture and

$$n_1 = m_1/M_1, n_2 = m_2/M_2, \text{ etc. similarly, for the mixture, } n = m/M.$$

Gibbs' Theorem

Gibbs' Theorem further enunciates that the internal energy of a mixture is equal to the sum of internal energies of the individual components, taken each at the temperature and volume of the mixture. Thus, we have for the internal energy of the mixture.

$$mu = m_1 u_1 + m_2 u_2 \quad \dots 6.6$$

It can also be shown that the enthalpy and specific heat of the mixture can, similarly, be written as

$$mh = m_1 h_1 + m_2 h_2 \quad \dots 6.7$$

$$mc = m_1 c_1 + m_2 c_2 \quad \dots 6.8$$

6.2.3 Molecular Weights and Gas Constants for Dry Air and Water Vapour

From the respective mole fractions and molecular masses of component gases, the molecular mass of the dry air part may be computed.

Since a part by volume represents the mole fraction. Using the values for mole fraction from Table 6.1: We have molecular Mass of dry air

$$M_a = \sum M y \quad \dots 6.9$$

$$\begin{aligned} & 28.02 (0.7803) + 32 (0.2099) + 39.91 \\ & (0.0094) + 44(0.0003) + 2.02 (0.0001) \\ & = 28.966 \end{aligned}$$

Table 6.1: Composition of Dry Part in Atmospheric Air

Component	Molecular Mass	Part by Volume	Part by Mass
N ₂	28.02	0.7803	0.7547
O ₂	32.0	0.2099	0.2319
Ar	39.91	0.0094	0.0129
CO ₂	44.0	0.0003	0.0005
H ₂	2.02	0.0001	0.0000

Knowing that the value of the universal gas constant is 8.3143 kJ/kg mole K, the gas constants for the two parts of moist air are as follows:

Dry air

$$M_a = 28.966$$

$$R_a = \frac{8.3143}{28.966} = 0.2871 \text{ kJ/kg. K}$$

$$M_v = 18.016$$

$$R_v = \frac{8.3143}{18.016} = 0.461 \text{ kJ/kg} \cdot \text{K}$$

where subscript v refers to water vapour.

6.3 PSYCHROMETRIC PROPERTIES

The properties of moist air are called *psychrometric properties* and the subject which deals with the behaviour of moist air is known as *psychrometry*.

Moist air is a mixture of dry air and water vapour. They form a binary mixture. A mixture of two substances requires three properties to completely define its thermodynamic state, unlike a pure substance which requires only two. One of the three properties can be the composition. Water vapour is present in the atmosphere at a very low partial pressure. At this low pressure and atmospheric temperature, the water vapour behaves as a perfect gas. The partial pressure of dry air is also below one atmosphere which may also be considered to behave very much as a perfect gas. The Gibbs-Dalton laws of perfect gas mixture can be applied to the moist air.

Since the water vapour part is continuously variable, all calculations in air-conditioning practice are based on the dry air part.

For calculating and defining the psychrometric properties, we may consider a certain volume V of moist air at pressure p and temperature T , containing m_a kg of dry air and m_v kg of water vapour as shown in Figure 6.3. The actual temperature t of moist air is called the *dry bulb temperature* (DBT). The total pressure p which is equal to the *barometric pressure* is constant.

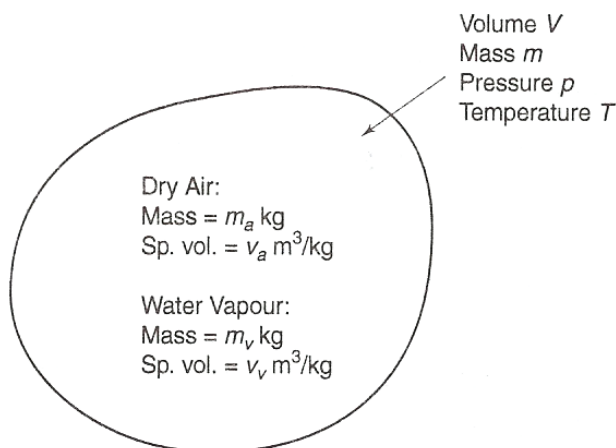


Figure 6.3

6.3.1 Specific Humidity or Humidity Ratio

Specific or *absolute humidity* or *humidity ratio* or *moisture content* is defined as the ratio of the mass of water vapour to the mass of dry air in a given volume of the mixture. It is denoted by the symbol ω .

$$\omega = \frac{m_v}{m_a} = \frac{\frac{V}{v_v}}{\frac{V}{v_a}} = \frac{v_a}{v_v} \quad \dots 6.10$$

where the subscripts a and v refer to dry air and water vapour respectively.

Now

$$p_a v_a = \frac{R}{M_a} T \quad P_a V = m_a \frac{R}{M_a} T$$

$$p_v v_v = \frac{R}{M_v} T \quad P_v V = m_v \frac{R}{M_v} T$$

Substituting for m_v and m_a from these expressions in Eq. (6.10) ,we obtain

$$\omega = \frac{M_v p_v}{M_a p_a} = \frac{18.016 p_v}{28.966 p_a} = 0.622 \frac{p_v}{p_a} \quad \dots 6.11$$

The units of ω are kg of water vapour per kg of dry air. Also, since p denotes the actual total atmospheric pressure, then from Dalton's law

$$p = p_a + p_v \quad \dots 6.12$$

So that

$$\omega = 0.622 \frac{p_v}{p - p_v} \quad \dots 6.13$$

Considering that the total atmospheric pressure remains constant at a particular locality, we can see that

$$\omega = f(p_v)$$

viz., the specific humidity is a function of the partial pressure of water vapour only.

6.3.2 Dew Point Temperature

The normal thermodynamic state 1 as shown in the Figure 6.4 (a) of moist air is considered as *unsaturated air*. The water vapour existing at temperature T of the mixture and partial pressure p_v of the vapour in the mixture is normally in a superheated state.

If a sample of such unsaturated moist air containing superheated water vapour is cooled (at constant pressure), the mixture will eventually reach the saturation temperature t_d of water vapour corresponding to its partial pressure p_v , at which point the first drop of dew will be formed, i.e., the water vapour in the mixture will start condensing. This temperature t_d is called the *dew point temperature* (DPT).

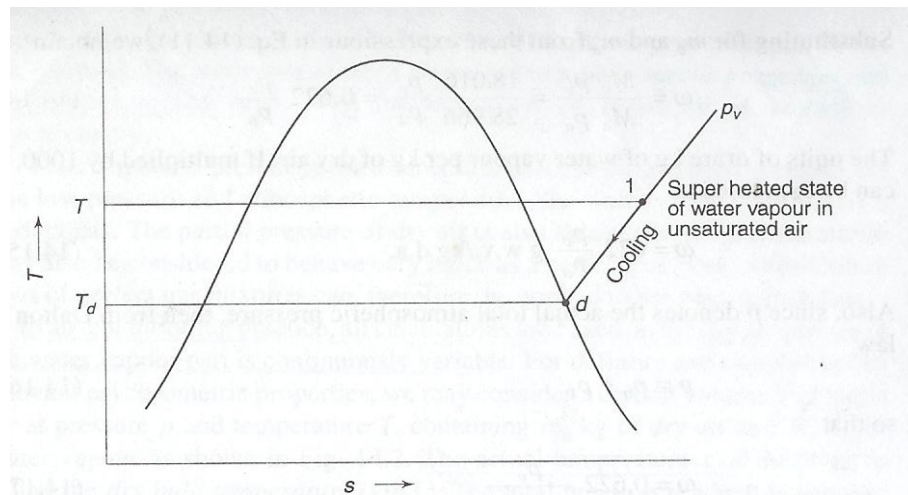


Figure 6.4(a) : Thermodynamic State of Water Vapour in Moist Air

Moisture can be removed from humid air by bringing the air in contact with a *cold surface* or *cooling coil* whose temperature is below its dew point temperature. During the process of cooling, the partial pressure p_v of water vapour and specific humidity ω remain constant until the vapour starts condensing.

6.3.3 Degree of Saturation

Consider the water vapour in the super heated thermodynamic state 1 in unsaturated moist air representing the control volume V . the water vapour exists at the dry bulb temperature T of the mixture and partial pressure p_v as shown in the Figure 6.4 (b).

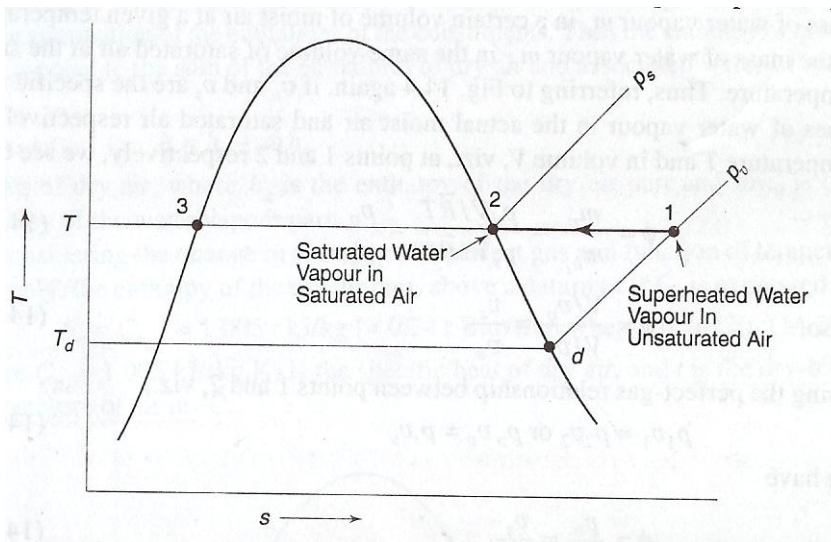


Figure 6.4 (b) : An Imaginary Isothermal Process Showing the Change of State of Water Vapour

Now consider that more water vapour is added in this control volume V at temperature T itself. The partial pressure p_v will go on increasing with the addition of water vapour until it reaches a value p_s corresponding to state 2 in Figure 6.4 after which it cannot increase further as p_s is the saturation pressure or maximum possible of water at temperature T . the thermodynamic state of water vapour is now saturated at point 2. the air containing moisture in such a state is called *saturated air*. In this state the air is holding the maximum amount of water vapour (the specific humidity being ω_s , corresponding to the partial pressure p_s) at temperature T of the mixture. The maximum possible specific humidity, ω_s at temperature T is thus

$$\omega_s = 0.622 \frac{p_s}{p - p_s} \quad \dots 6.14$$

The ratio of the actual specific humidity ω to the specific humidity ω_s of saturated air at temperature T is termed as the *degree of saturation* denoted by the symbol μ . Thus

$$\mu = \frac{\omega}{\omega_s} = \frac{p_v}{p_s} \left[\frac{1 - p_s/p}{1 - p_v/p} \right] \quad \dots 6.15$$

Thus the degree of saturation is a measure of the capacity of air to absorb moisture.

6.3.4 Relative Humidity

The relative humidity ϕ is defined as the ratio of the mole fraction of water vapour in moist air to mole fraction of water vapour in saturated air at the same

temperature and pressure. From perfect-gas relationships another expression for ϕ is

$$\phi = \frac{\text{existing partial pressure of water vapor}}{\text{saturation pressure of pure water at same temperature}}$$

$$\phi = \frac{m_v}{m_{v_s}} = \frac{p_v v / RT}{p_s v / RT} = \frac{p_v}{p_s} \quad \dots 6.16$$

$$\text{Also, } \phi = \frac{V/v_v}{V/v_s} = \frac{v_s}{v_v} \quad \dots 6.17$$

When p_v is equal to p_s , ϕ is equal to unity, and the air is saturated and is considered to have 100 per cent RH.

From Eqs (6.14) and (6.17), we can write

$$\omega = 0.622 \phi \frac{p_s}{p_a} \quad \dots 6.18$$

$$\phi = \frac{\omega}{0.622} \frac{p_a}{p_s} \quad \dots 6.19$$

Also we may write

$$\mu = \phi \left[\frac{1 - p_s/p}{1 - p_v/p} \right] \quad \dots 6.20$$

$$\phi = \frac{\mu}{1 - (1 - \mu) p_s/p} \quad \dots 6.21$$

6.3.5 Enthalpy of Moist Air

According to Gibb's law, the enthalpy of a mixture of perfect gases can be obtained by the net summation of the enthalpies of the respective constituents. Therefore the enthalpy of the moist air h is equal to the summation of the enthalpies of dry air and of the water vapour associated with the air. Hence,

$$h = h_a + \omega h_v \quad \dots 6.22$$

Per kg of dry air, where h_a is the enthalpy of the dry air part and ωh_v is the enthalpy of the water vapour part. The change in enthalpy of a perfect gas being considered as a function of temperature only, the enthalpy of the dry air part above a datum of 0°C is expressed as:

$$h_a = C_{pa} t = 1.005 t \text{ kJ/kg} (=0.24 t \text{ Btu/lbm where } t \text{ is in } ^\circ\text{F})$$

where $C_p = 1.005 \text{ kJ/kg.K}$ is the specific heat of dry air, and t is the dry-bulb temperature of air in $^\circ\text{C}$.

Assuming the reference state enthalpy as zero for saturated liquid at 0°C , the enthalpy of water vapour at point A in the above Figure can be expressed as:

$$h_v = h_A = C_{pw} t_d + (h_{fg})_d + C_{pv} (t - t_d) \text{ kJ/kg} \quad \dots 6.24$$

where C_{pw} = specific heat of liquid water

t_d = dew point temperature

$(h_{fg})_d$ = latent heat of vaporization at DPT

C_{pv} = specific heat of superheated vapour

Properties of Moist Air

At low pressure for an ideal gas, the enthalpy is a function of temperature only. Thus in Figure 6.5 the enthalpies at point B and C are also the same as the enthalpy at A. Accordingly, enthalpy of water vapour at A, at DPT of t_d and DBT of t , can be determined more conveniently by the following two methods:

$$(b) \quad h_A = h_B = (h_{fg})_0 \text{ C} + C_{pv}(t - 0) \quad \dots 6.27$$

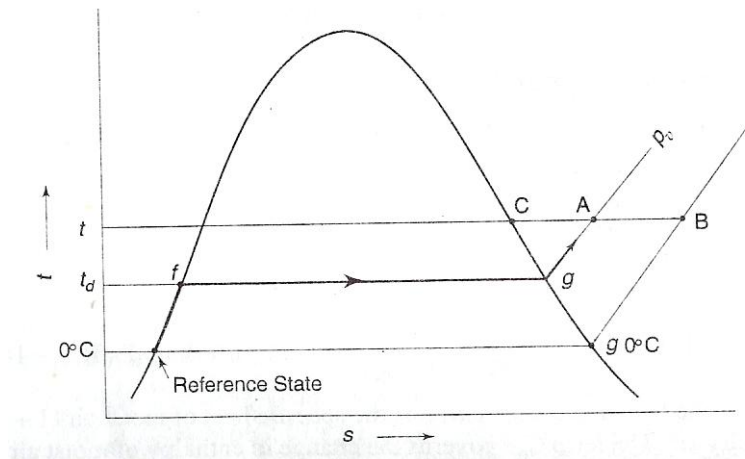


Figure 6.5: Evaluation of Enthalpy of Water Vapour Part

$$h_v = 2501 + 1.88t \text{ kJ/kg} \quad \dots 6.28$$

$$h = 1.005t + \omega(2500 + 1.88t) \text{ kJ/kg d.a.} \quad \dots 6.29$$

6.4 HUMID SPECIFIC HEAT

$$\begin{aligned} h &= (C_{pa} + \omega C_{pv}) t + \omega(h_{fg})_0^{\circ} \text{C} \\ &= C_p t + \omega(h_{fg})_0^{\circ} \text{C} \end{aligned} \quad \dots 6.30$$

$$\text{where } C_p = C_{pa} + \omega C_{pv} \quad \dots 6.31$$

$$= (1.005 + 1.88 \omega) \text{ kJ/ (kg d.a.) (K)}$$

is termed as the *humid specific heat*. It is the specific heat of moist air $(1 + \omega)$ kg per kg of dry air.

6.5 WET BULB TEMPERATURE (WBT)

indicates the temperature of liquid water in the wick and is called the *wet bulb temperature*. It is denoted by the symbol t' .

The difference between the dry bulb and wet bulb temperatures is called *wet bulb depression* (WBD).

$$\text{WBD} = (t - t')$$

If the ambient air is saturated, i.e. the RH is 100 per cent, then there will be no evaporation of water on the bulb and hence WBT and DBT will be equal. The WBT is an indirect measure of the dryness of air.

6.6 ADIABATIC SATURATION AND THERMODYNAMIC WET BULB TEMPERATURE

The thermodynamic wet bulb temperature or adiabatic saturation temperature is the temperature at which the air can be brought to saturation state, adiabatically, by the evaporation of water into the flowing air.

The equipment used for the adiabatic saturation of air, in its simplest form, consists of an insulated chamber containing adequate quantity of water. There is also an arrangement for extra water (known as make-up water) to flow into the chamber from its top, as shown in Figure 6.6.

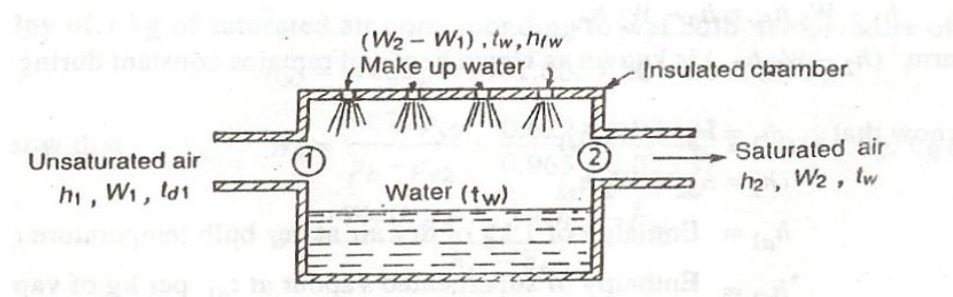


Figure 6.6: Adiabatic Saturation of Air

Let the unsaturated air enters the chamber at section 1. As the air passes through the chamber over a long sheet of water, the water evaporates which is carried with the flowing stream of air, and the specific humidity of the air increases. The make up water is added to the chamber at this temperature to make the water level constant. Both the air and water are cooled as the evaporation takes place. This process continues until the energy transferred from the air to the water is equal to the energy required to vaporise the water. When steady conditions are reached, the air flowing at section 2 is saturated with water vapour. The temperature of the saturated air at section 2 is known as *thermodynamic wet bulb temperature or adiabatic saturation temperature*.

The adiabatic saturation process can be represented on T-s diagram as shown by the curve 1-2 in Figure 6.7.

During the adiabatic saturation process, the partial pressure of vapour increases, although the total pressure of the air-vapour mixture remains constant. The unsaturated air initially at dry bulb temperature t_{d1} is cooled adiabatically to dry bulb temperature t_{d2} which is equal to the adiabatic saturation temperature t_w . It may be noted that the adiabatic saturation temperature is taken equal to the wet bulb temperature for all practical purposes.

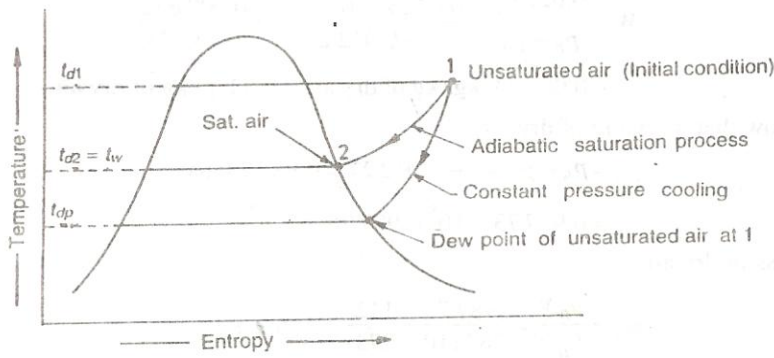


Figure 6.7: T-S Diagram for Adiabatic Saturation Process

Let h_1 = Enthalpy of unsaturated air at section 1,
 W_1 = Specific humidity of air at section 1,
 h_2, W_2 = Corresponding values of saturated air at section 2, and
 h_{fw} = Sensible heat of water at adiabatic saturation temperature.

Balancing the enthalpies of air at inlet and outlet (i.e. at sections 1 and 2),

$$h_1 + (W_2 - W_1) h_{fw} = h_2 \quad \dots 6.32$$

$$h_1 - W_1 h_{fw} = h_2 - W_2 h_{fw} \quad \dots 6.33$$

The term $(h_2 - W_2 h_{fw})$ is known as sigma heat and remains constant during the adiabatic process

We know that $h_1 = h_{a1} + W_1 h_{s1}$

$$h_2 = h_{a2} + W_2 h_{s2}$$

where

h_{a1} = Enthalpy of 1 kg of dry air at dry bulb temperature t_{d1} ,
 h_{s1} = Enthalpy of superheated vapour at t per kg of vapour,
 h_{a2} = Enthalpy of 1 kg of air at wet bulb temperature t_w , and
 h_{s2} = Enthalpy of saturated vapour at wet bulb temperature t_w per kg of vapour.

Now the equation (6.33) may be written as:

$$(h_{a1} + W_1 h_{s1}) - W_1 h_{fw} = (h_{a2} + W_2 h_{s2}) - W_2 h_{s2} \quad \dots 6.34$$

$$W_1(h_{s1} - h_{fw}) = W_2(h_{s2} - h_{fw}) + h_{a2} - h_{a1} \quad \dots 6.35$$

$$W_1 = \frac{W_2(h_{s2} - h_{fw}) + h_{a2} - h_{a1}}{h_{s1} - h_{fw}} \quad \dots 6.36$$

6.7 PSYCHROMETRIC CHART

All data essential for the complete thermodynamic and psychrometric analysis of air-conditioning processes can be summarised in a psychrometric chart. At present, many forms of psychrometric charts are in use. The chart which is most commonly used is the ω - t chart, i.e. a chart which has specific humidity or water vapour pressure along the ordinate and the dry bulb temperature along the abscissa. The chart is normally constructed for a standard atmospheric pressure of 760 mm Hg or 1.01325 bar, corresponding to the pressure at the mean sea level. A typical layout of this chart is shown in Figure 6.8.

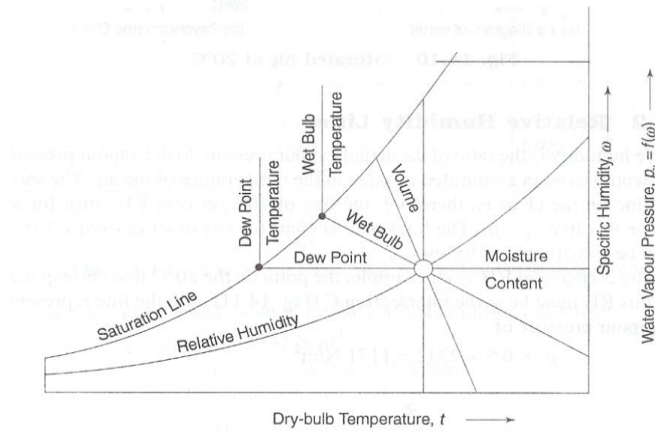


Figure 6.8 : Constant Property Lines on a Psychrometric Chart

6.7.1 Saturation Line

The saturation line represents the states of saturated air at different temperatures. As an example of fixing such a state on the chart, consider an atmosphere A at 20 °C and saturation as shown in Figure 6.9. From the steam tables at 20 °C, water vapour pressure

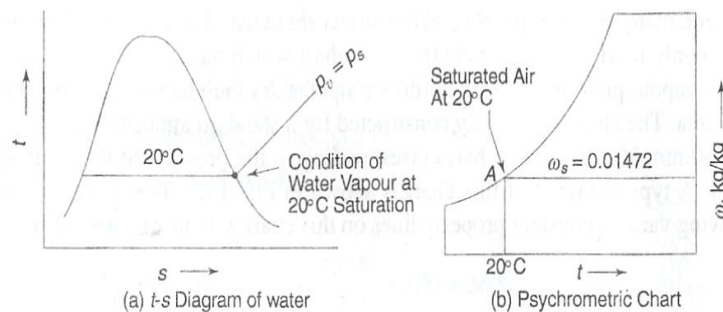


Figure 6.9: Saturated Air at 20 °C

$$p_s = p_v = 17.54 \text{ mm Hg} = 2342 \text{ N/m}^2$$

Partial pressure of dry air

$$p_a = p - p_v = 101325 - 2342 = 98983 \text{ N/m}^2$$

Specific humidity at 20 °C saturation

$$\omega_s = \frac{0.622 p_v}{p_a} = \frac{0.622(2342)}{98983} = 0.01472 \text{ kg w.v./kg d.a.}$$

knowing t and ω , point a can be plotted. In a similar manner, saturation states at other temperatures can also be plotted to draw the saturation line on the psychrometric chart.

6.7.2 Relative Humidity Lines

The relative humidity ϕ is defined as the ratio of the mole fraction of water vapour in moist air to mole fraction of water vapour in saturated air at the same temperature and pressure. From perfect-gas relationships another expression for ϕ is

$$\phi = \frac{\text{existing partial pressure of water vapor}}{\text{saturation pressure of pure water at same temperature}}$$

The relative humidity lines are curved lines and follow the saturation curve.

Generally, these lines are drawn with values 10%, 20%, 30% etc. and up to 100%. The saturation curve represents 100% relative humidity. The values of relative humidity lines are generally given along the lines themselves as shown in Figure 6.10.

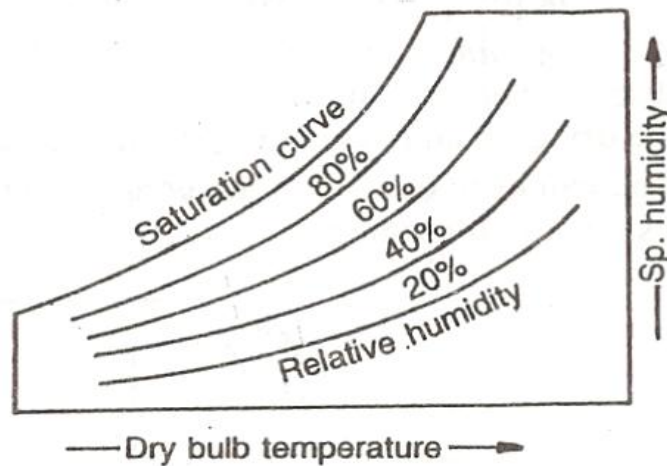


Figure 6.10: Relative Humidity Lines

The lines on psychrometric chart for any other desired value of RH can be constructed as follows. Taking 50 per cent RH as an example, the point on the 20°C line corresponding to this RH must be at the intersection C (Figure 6.11) with the line representing a vapour pressure of

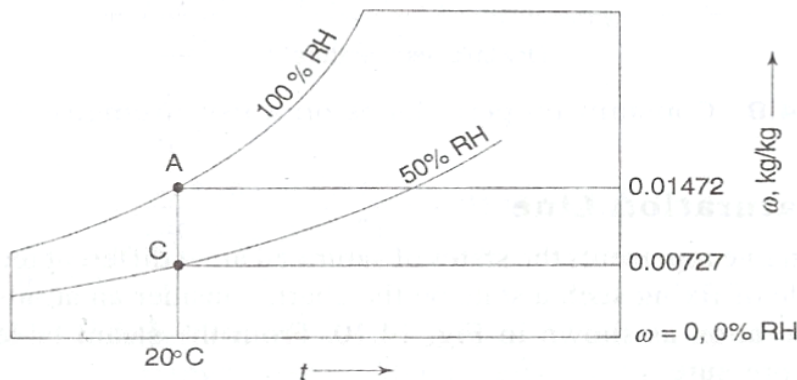


Figure 6.11: Drawing 50 percent RH Line

$$p_v = 0.5 \times 2342 = 1171 \text{ N/m}^2$$

At this point

$$p_a = 101325 - 1171 = 100154 \text{ N/m}^2$$

$$\omega = \frac{0.622(1171)}{100154} = 0.00727 \text{ kg w.v. /kg d.a.}$$

Likewise, points for other temperatures can be plotted to construct the complete 50 per cent RH line. It may be noted that $\omega = 0$ line also corresponds to zero per cent RH.

6.7.3 Constant Specific Volume Lines

The constant specific volumes lines are obliquely inclined straight lines and uniformly spaced as shown in Figure 6.12. These lines are drawn up to the saturation curve. To establish points on a line of constant specific volume, 0.90 m³/kg for example, From the perfect-gas equation, the specific volume v is

$$v = \frac{R_a T}{p_a} = \frac{R_a T}{p_t - p_s} \quad \text{m}^3/\text{kg dry air}$$

substitute 0.90 for v , the barometric pressure for p_t , and at arbitrary values of T solve for p_s . the pairs of p_s and t values then describe the line of constant v .

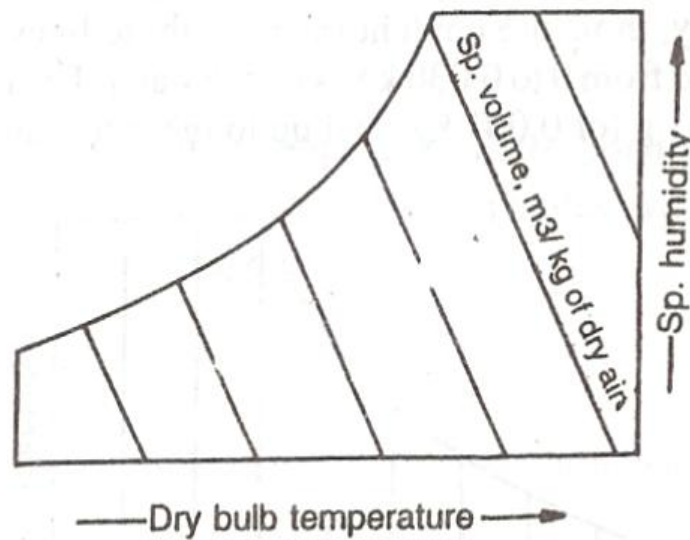


Figure 6.12: Specific Volume Lines

6.7.4 Constant Thermodynamic Wet Bulb Temperature Lines

The wet bulb temperature lines are inclined straight lines and non-uniformly spaced as shown in Figure 6.13 any point on the saturation curve, the dry bulb and wet bulb temperatures are equal.

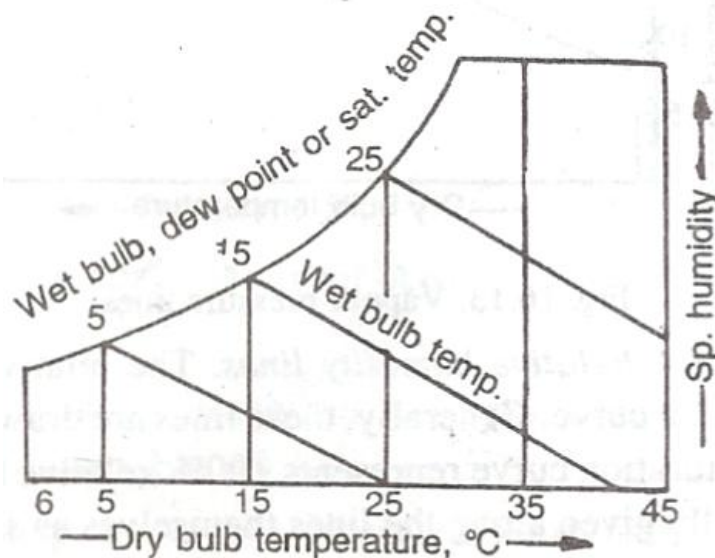


Figure 6.13: Wet Bulb Temperature Lines

The values of wet bulb temperatures are generally given along the saturation curve of the chart as shown in the Figure.6.13.

6.7.5 Constant Enthalpy Lines

The enthalpy (or total heat) lines are inclined straight lines and uniformly spaced as shown in Figure 16.14. These lines are parallel to the wet bulb temperature lines, and are drawn up to the saturation curve. Some of these lines coincide with the wet bulb temperature lines also.

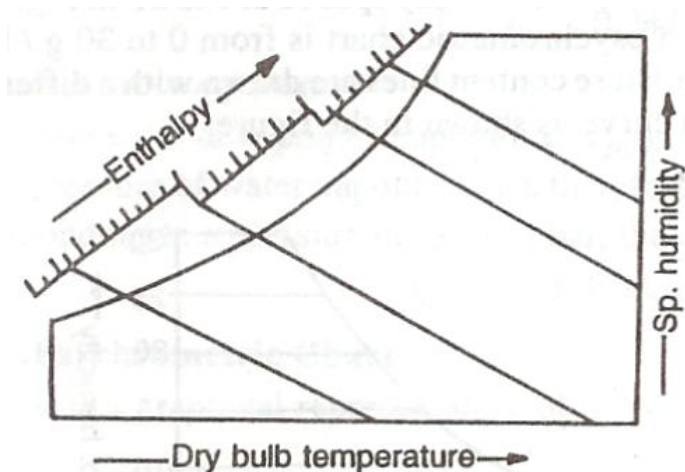


Figure 6.14: Constant Enthalpy Lines

The values of total enthalpy are given on a scale above the saturation curve as shown in the Figure 6.14.

SAQ 1



- What is the working substance in air conditioning? Would you call it a pure substance? How do you calculate its molecular mass?
- Distinguish between specific humidity and relative humidity correlate degree of saturation with specific and relative humidity.
- Differentiate between specific heat of vapour and humid specific heat.
- What is adiabatic saturation process? Show it on T - S diagram and psychometric chart.

6.8 SUMMARY

The application of air-conditioning for the industrial purpose has opened a new era in the air-conditioning industry. The air-conditioning is commonly used now-a-days for the preservation of food, in automobiles and railways, jute and cloth industries and many others. Air-conditioning is a field of work which never stagnates. Indian atmospheric conditions are varied in different parts of the country. No doubt, air-conditioning will become a necessity for Indians in coming few decades with the rapid industrial development and with the economic growth of the country.

6.9 ANSWERS TO SAQs

Refer the relevant preceding texts in the unit or other useful books on the topic listed in the section “Further Readings” to get the answers of the SAQs.