B.Tech, A G- 2nd SEM, Lecture-11- Thermodynamics

Topic- Psychrometry Contd---- by - Yogesh Kumar

11 → **Relative Humidity (RH)** → It is denoted by ϕ. It is the ratio of the Partial Pressure water vapour in the mixture to the saturated Partial Pressure at the dry bulb temp^r and it is expressed as Percentage.

12 - **Sensible Heat** → It is the heat that changes the temp^r of a substance when added to or removed from it.

13 - **Latent Heat** → It is the heat that does not affect the temp^r but changes the state of substance when added to or removed from it.

14 - **Enthalpy** → It is the total energy which represent the sum of internal and flow energy in a steady flow process.

(Note) → When air is saturated, DBT, WBT and DPT are equal.

Psychrometric Relations -

Pressure → **Dalton's law of Partial Pressure** → This law is used to determine the Pressure of a mixture of a gas. It states that "the total Pressure of a mixture of gas is equal to the sum of Partial Pressures which the Component gases would exert if each exist alone in the mixture volume at the mixture temperature.

For calculating partial pressure of water vapour in the air Dr. Carrier's equation is used

$$P_v = (P_{vs})_{wb} - \frac{[P_t - (P_{vs})_{wb}](t_{db} - t_{wb})}{1527.4 - 1.3 t_{wb}}$$

where, P_v = Partial pressure of water vapour

P_{vs} = Partial pressure of water vapour when air is fully saturated.

P_t = Total pressure of moist air

t_{db} = Dry bulb temp^r (C°)

t_{wb} = wet bulb temp^r (C°)

Specific Humidity (W) →

$$\text{Specific Humidity}(W) = \frac{\text{mass of water vapour}}{\text{mass of dry air}} = \frac{m_v}{m_a}$$

Also $m_a = \frac{P_a V}{R_a T}$ $[PV = mRT]$ —(i)

and $m_v = \frac{P_v \times V}{R_v \times T}$ ——(ii)

where P_a = Partial pressure of dry air,

P_v = Partial pressure of water vapour,

V = volume of mixture

R_a = characteristic gas constant for dry air

R_v = gas constant for water vapour

from eq^n (i) & (ii)

$$W = \frac{P_v \times V}{R_v \times T} \times \frac{R_a T}{P_a V} = \frac{R_a}{R_v} \times \frac{P_v}{P_a}$$

But $R_a = \frac{R_0}{M_a}$

$R_a = \frac{8.3143}{28.97} = 0.287$ kJ/kg K

$R_v = \frac{R_0}{M_v}$ $\left[\frac{8.3143}{18} = 0.462 \text{ kJ/kg K}\right]$

where R_0 = universal gas constant

M_a = molecular weight of air

M_v = molecular weight of water vapour

$$\therefore W = \frac{0.287}{0.462} \cdot \frac{P_v}{P_a} = 0.622 \frac{P_v}{P_t - P_v}$$

i.e. $W = 0.622 \left(\frac{P_v}{P_t - P_v}\right)$ —(iii)