DEPARTMENT OF AGRICULTURAL ENGINEERING

AI3601 POST- HARVEST TECHNOLOGY

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AI3601 – POST-HARVEST TECHNOLOGY
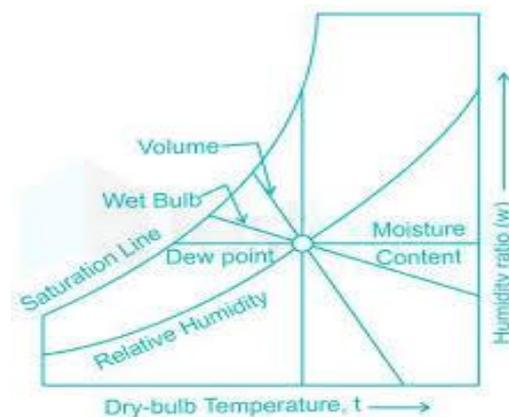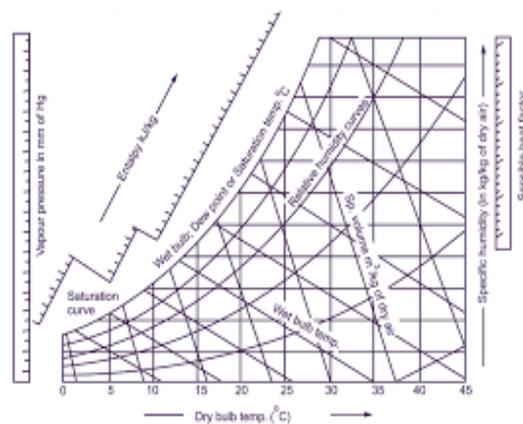
# UNIT II: PSYCHROMETRY AND DRYING

CO2: To perform drying of agricultural products and analyze performance of dryers.

Psychrometry - Problems

Problem 1:

Using a standard psychrometric chart, determine the following psychrometric properties for moist air at a dry bulb temperature of 30°C and a relative humidity of 50%:

i) Humidity ratio (ω) in g/kg dry air,

ii) Wet bulb temperature (WBT) in °C,

iii) Dew point temperature (DPT) in °C,

iv) Enthalpy (h) in kJ/kg dry air, and

v) Specific volume (v) in m³/kg dry air.
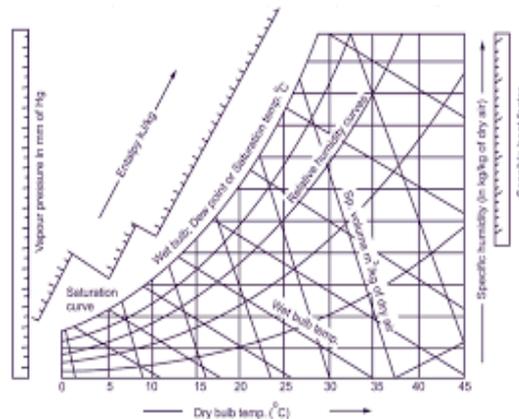
Steps to read from Psychrometric Chart:

i)   Locate 30°C on the horizontal DBT axis.

ii)   Move vertically up to the 50% RH curve.

iii)   From this intersection point, read: Results:

    a) Humidity Ratio (ω): Follow the horizontal line to right-side scale ($\approx$ 0.0135 kg/kg) = 13.5 g/kg of dry air

    b) Wet Bulb Temperature (WBT): Follow diagonal constant wet-bulb lines (down-left to saturation curve). Approx: 22.5°C.

c) Dew Point Temperature (DPT): Follow the horizontal line left to saturation curve (100% RH). Approx: 18.8°C

d) Enthalpy (h): Follow diagonal constant enthalpy lines (parallel to WBT lines) to enthalpy scale. Approx: 64 kJ/kg dry air.

e) Specific Volume (v): Follow diagonal constant specific volume lines to scale. Approx: 0.875 m³/kg dry air

Problem 2:

Air at an initial condition of 20°C dry bulb temperature and 40% relative humidity undergoes a sensible heating process until it reaches a final dry bulb temperature of 30°C, while the humidity ratio remains unchanged. Using the psychrometric chart, determine the enthalpy of air at the initial and final states, and calculate the amount of heat added per kilogram of dry air during this process.
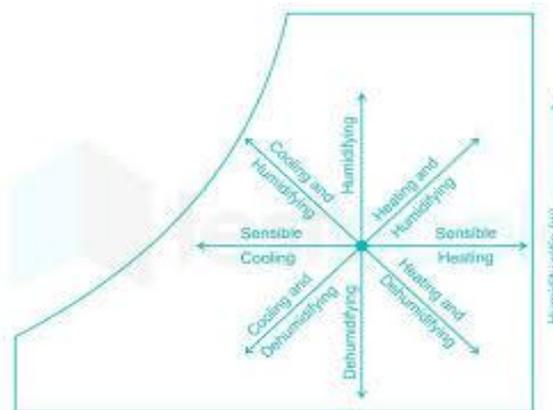
Data given:

- Initial air: $DBT_1 = 20°C$, $RH_1 = 40\%$
- Final air: $DBT_2 = 30°C$,
- $\omega_2 = \omega_1$ (sensible heating)

To find:

i) Enthalpy at initial state (h_1),

ii) Enthalpy at final state (h_2),

iii) Heat added per kg dry air = $h_2 - h_1$

Solution:

Step 1:

- Locate the initial state (20°C DBT & 40% RH) on psychrometric chart.
- From the point, read: $h_1 \approx 34.5$ kJ/kg dry air.

Step 2:

- Locate the final state (30°C DBT & same ω) (From initial point, move horizontally right along the constant ω line to DBT = 30°C).
- At the 2nd point, read $h_2 \approx 45.5$ kJ/kg dry air.

Step 3:

- Calculate the heat added Heat added per kg dry air = $h_2 - h_1 = 45.5 - 34.5 = 11.0$ kJ/kg dry air

Results:

i)   Initial enthalpy (h_1) = 34.5 kJ/kg dry air,

ii)   Final Enthalpy (h_2) = 45.5 kJ/kg dry air,

iii)   Heat added = 11.0 kJ/kg dry air.