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Review Article

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A simple way to understand and read Psychrometric chart

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Abstract

Many of us are not sofamiliar with Psychrometric chart which is used in HVAC system. The main aim of present work is to identify parts of the phychrometric chart, to determine moist air properties and to use chart to analyze processes involving moist air.

Keywords: Temperature, Psychrometry, Dew Point, Humidity

Contents

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1. Introduction

Psychrometry is the science which involves the determination of physical and thermodynamic properties of gas-vapor mixtures [1-4]. Psychrometric chart (fig.1) has followingapplications [5-7].

- Applied in Heating, Ventilating and Air Conditioning (HVAC) and meteorology.
- Human comfort
- These chars are helpful for storing substances which are hygroscopic, deliquescent and efflorescent. E.g., cotton, paper, cellulose, other wood products, sugar, calcium oxide and many chemicals and fertilizers.
- Air-conditioning devices
- Cooling towers
- Food sciences and engineering
- Animal housing
- Plant systems (Greenhouses, growth chambers, plant based bio regenerative life support systems etc.)
- Evaporative coolers
- Water harvesting in arid lands
- Molds and fungi can be controlled by keeping relative humidity low.
- Wood destroying fungi generally do not grow at relative humidity below 75%.

Psychrometric chart has lines and scales (fig.2) which were individually explained (fig.3.) here [8-10].

Dry-bulb temperature (DBT) (T_{DB}; °C or F)

The dry-bulb temperature is the temperature indicated by a thermometer exposed to the air in a place sheltered from direct solar radiation. It is the true air temperature we “feel.” It is represented as vertical lines (parallel to each other) in phychrometric charts.

Wet Bulb Temperature (T_{WB}; °C or °F) (Adiabatic saturation temperature)

The temperature at which water, by evaporating into air, can bring the air to saturation adiabatically at the same temperature. T_{WB} is the minimum temperature that the moist air couldachieve if enough water was addedto achieve saturation (RH = 100%).T_{WB} is often used to indicate howmuch water can be addedto the air through evaporation. These lines are oblique lines that differ slightly from the enthalpy lines. They are identically straight but are not exactly parallel to each other. These intersect the saturation curve at DBT point.

Dew Point Temperature (T_{DP}; °C or F)

The temperature at which saturation is reached (RH = 100%) when the moisture content of the air (W) stays constant. In other words, T_{DP} is the temperature at which water will begin to condense out of moist air. Condensation occurs when T_{DP}>Tair. T_{DP} is typically achieved by sensible cooling. They are represented as horizontal lines (parallel to each other) in phychrometric chart

Moisture Content(kg/kg dry air)

The actual water content of the air. It is expressed as a ratio of watervapor content to totalamount of dry air. They are represented as horizontal lines parallel to each other at the right side of the chart.

Relative Humidity (φ/RH; %)

It is a measure of how much water is in the air versus how much water the air can hold at the same temperature. These hyperbolic lines are shown in intervals of 10%. The saturation curve is at 100% RH, while dry air is at 0% RH.

Specific enthalpy (h; kJ/kg dry air or B_{TU}/lb air)

This is the amount of energy contained in the moist air. Enthalpy represents the amount of sensible and latent energy contained in the moist air. These are oblique lines drawn diagonally downward from left to right across the chart that are parallel to each other. These are not parallel to wet bulb temperature lines.

Specific Volume(v; m^3/kg dry air or ft^3/lb dry air)

This is the volume of the moist air mixture (volume D) Volume occupied by both dry air and water vapor) versus the unit mass of dry air. They are represented as oblique lines in phychrometric chart.

Example:

Given data: T_{DB} = 25°C, T_{WB} =20°C

Then Relative humidity = 63%; Dew-point temperature = 17.6^{0}C, Humidity ratio = 12.6 g/kg dry air, Specific volume = 0.862 m^3/kg dry air, Specific enthalpy (h) = 57.5 kJ/kg dry air.

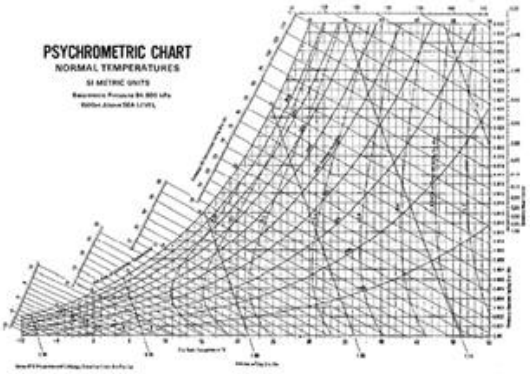

Figure 1. Psychrometric chart

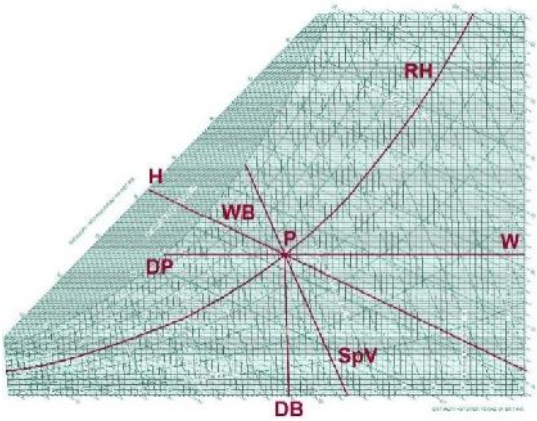

Figure 2. Lines and scales in Psychrometric chart

(Where P-point; DB-Dry Bulb Temperature; WB- Wet Bulb Temperature; DP-Dew point; RH-Relative Humidity; SpV-Specific Volume; H- Enthalpy; W-moisture content)

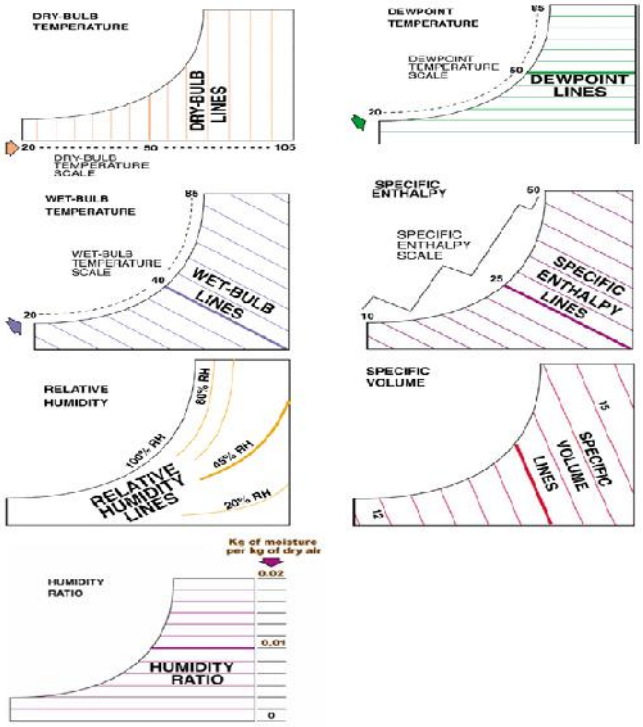

Figure 3. Diagrammatic representation of parameters in phychrometric chart

2. Conclusion

This is a simple way to read and understand phychrometric chart

3. References

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