A simple way to understand and read Psychrometric chart

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APOTHEKE-2014, 8 Nov 2014, Organized by Balaji College of Pharmacy, Ananthapuramu, Andhra Pradesh, India

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

Keywords: Temperature, Psychrometry, Dew Point, Humidity

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Manuscript ID: IJCP-APOTHEKE2393

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 following applications [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) \( (T_{DBT}; \degree \mathrm{C \ or \ F}) \)
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 psychrometric 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 could achieve if enough water was added to achieve saturation (RH = 100%). $T_{WB}$ is often used to indicate how much water can be added to 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 $T_{DP} > T_{air}$. $T_{DP}$ is typically achieved by sensible cooling. They are represented as horizontal lines (parallel to each other) in psychrometric chart.

Moisture Content (kg/kg dry air)
The actual water content of the air. It is expressed as a ratio of water vapor content to total amount of dry air. They are represented as horizontal lines parallel to each other at the right side of the chart.

Relative Humidity ($\varphi$/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 BTU/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 ($\nu$; 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 psychrometric chart.

Example:
Given data: $T_{DB} = 25^\circ$C, $T_{WB} = 20^\circ$C
Then Relative humidity = 63%; Dew-point temperature = 17.6°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
Figure 3. Diagrammatic representation of parameters in psychrometric chart

2. Conclusion

This is a simple way to read and understand psychrometric chart

3. References