

Introduction to Psychrometry

Psychrometry

Study of thermodynamic properties of moist air.

Deals with mixture of dry air and water vapour.

Composition of Atmospheric Air

Nitrogen – 78%

Oxygen – 21%

Other gases – 1%

- **Applications**
- Air Conditioning Systems
- Refrigeration
- Drying Processes
- Cooling Towers
- HVAC Systems

Psychrometric Properties of Air

1. Dry Bulb Temperature (DBT)

Temperature measured by ordinary thermometer.

2. Wet Bulb Temperature (WBT)

Temperature measured using thermometer covered with wet wick.

3. Dew Point Temperature (DPT)

Temperature at which water vapour starts condensation.

- **Relation:**

$$DBT \geq WBT \geq DPT \quad DBT \setminus \geq WBT \setminus \geq$$

$$DPT \quad DBT \geq WBT \geq DPT$$

- **Moist Air Properties**
- **Specific Humidity (Humidity Ratio)**
- $\omega = \frac{m_v}{m_a}$
Ratio of mass of water vapour to mass of dry air.
- **Relative Humidity**
- $RH = \frac{P_v}{P_s} \times 100$
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- **Adiabatic Saturation & Psychrometric Chart**
- **Adiabatic Saturation**
- Process in which no heat transfer occurs.
- Air comes in contact with water.
- Used for humidity measurement.
- **Psychrometric Chart Contains**

- **Air Standard Thermodynamic Cycles**
- **Air Standard Assumptions**
- Working fluid is air.
- Air behaves as ideal gas.
- Combustion replaced by heat addition.

- **Otto, Diesel and Dual Cycles**
- **Otto Cycle**
- Constant volume heat addition.
- Used in Spark Ignition engines.
- Thermal Efficiency:
- $\eta = 1 - \frac{1}{r^{\gamma-1}}$
- **Diesel Cycle**
- Constant pressure heat addition.
- Used in Compression Ignition engines.

- **Stirling, Ericsson, Atkinson and Lenoir Cycles**
- **Stirling Cycle**
 - External combustion cycle.
 - Uses regenerative heat transfer.
- **Ericsson Cycle**
 - Two isothermal and two constant pressure processes.
- **Atkinson Cycle**
 - High efficiency cycle used in hybrid engines.
- **Lenoir Cycle**
 - Constant volume heat addition cycle.

- **Refrigeration Cycles**
- **Vapour Compression Refrigeration Cycle**
- Main Components:
 - Compressor
 - Condenser
 - Expansion Valve
 - Evaporator
- **Processes**
 - Compression
 - Condensation
 - Expansion
 - Evaporation
- **Coefficient of Performance**