Class-9
Sub-Gegraphy
Chapter-15
Humidity
Part-I

CHAPTER 15

Humidity

Syllabus

Humidity: *Humidity — meaning and difference between relative and absolute humidity.*

Condensation — forms (clouds, dew, frost, fog and mist).

Precipitation — forms (rain, snow, and hail).

Types of rainfall — relief/orographic, convectional, cyclonic/frontal with examples from the different parts of the world.

Moisture continuously enters and leaves the atmosphere. When present in air, it gives air a different character. The process by which water vapour enters the atmosphere on heating is known as *evaporation*. The process by which water vapour forms water droplets on cooling is known as *condensation*. The process by which the droplets fall to ground in liquid, solid or frozen form is known as *precipitation*. The amount of water vapour present in air is known as the *humidity*.

The total volume of water in the oceans and seas is constant. This is because all the water that evaporates from the earth's water bodies is eventually returned to it directly by the process of condensation and precipitation; and indirectly by stream and overflow from land surfaces.

Vapour is the gaseous state of water. A certain amount of energy is required to change water into water vapour. Heating of water over oceans, lakes and rivers causes water to evaporate. Generally 600 calories of heat is required to change one gram of liquid water into its vaporous state. Heat loss occurs during evaporation. The heat passes into water vapour in a hidden form. It is known as *latent heat*. When condensation occurs, this latent heat is released back into atmosphere causing a slight rise in temperature. That is why during the rainy season, one feels more heat than when the skies are clear. In low latitudes owing to a relatively higher temperature, evaporation is greater. However in Equatorial regions, the sky often remains overcast with clouds and evaporation is relatively low. In tropical deserts, surrounded by seas, evaporation is maximum because of high temperatures and clear skies. Thus, it is clear that the factors favouring evaporation are as follows.

(i) ***Humidity:*** Dry air promotes greater evaporation. This is because dry air has more capacity to hold water vapour than humid air.

(ii) ***Supply of heat:*** The greater the heat of the water surface and air above it, the greater will be the rate of evaporation.

(iii) ***Winds:*** Strong winds promote evaporation. Wet clothes dry more quickly on a windy day than when it is calm.

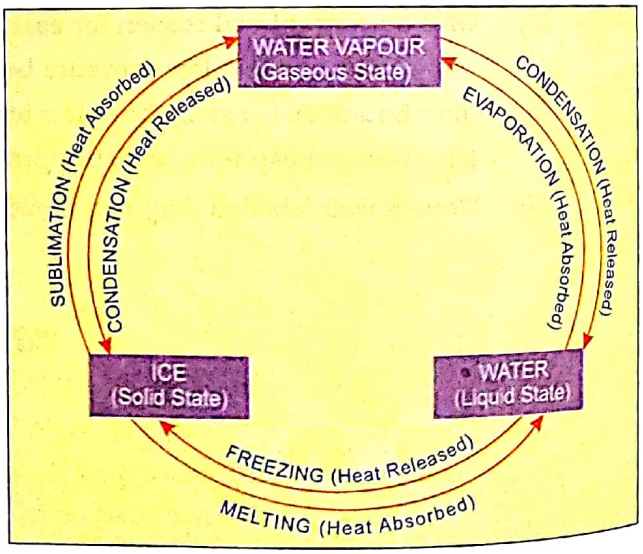

Fig. 15.1. Water

Difference between Absolute Humidity and Relative Humidity

Absolute Humidity	Relative Humidity
It is the measure of the actual amount of water vapour in the air, regardless of temperature.	It measures water vapour in air but relative to the maximum vapour that the air can hold at that temperature.
It is expressed as grams of moisture per cubic meter of air (g/m^3).	It is expressed as the ratio (percentage value) between the absolute humidity of a given mass of air and the maximum amount of water vapour that it can hold at the same temperature.
The higher the amount of water vapour, the higher is the absolute humidity.	Warm air possesses more water vapour than cold air, so with the same amount of absolute humidity, air will have a different relative humidity depending on temperature.
In weather calculations, absolute humidity is generally not taken into account.	It is the essential characteristic of weather forecasts, which indicates the likelihood of precipitation, dew or fog.

HUMIDITY

Water is added to the atmosphere by the process of evaporation. It changes from liquid to gaseous form. This water vapour in air is called *humidity*. Humidity is inversely proportional to heat, the hotter the air, the more is the water vapour present in it. When the atmospheric temperature is low, water vapour is less.

Absolute Humidity

The amount of water vapour held by air at a certain temperature and volume is called *Absolute Humidity*.

Absolute Humidity is the mass or weight of vapour per unit volume of air, usually calculated in grams per cubic metre. Since air rises upward, absolute humidity may change. Therefore, in weather calculations, absolute humidity is generally not taken into account.

Relative Humidity

The ratio between the absolute humidity of a given mass of air and the maximum amount of water vapour that it can hold at the same temperature is called the *relative humidity*. Relative humidity is generally expressed in percentage.

$$\text{Relative Humidity (RH)} = \frac{\text{Actual amount}}{\text{Water holding Capacity}} \times 100$$

If the temperature of an air mass is 25°C and if its relative humidity is 60%, then it can still add 40% more water vapour at the same temperature before it becomes saturated or Relative humidity reaches 100%.

If a sample of air holds 20 gm/cu.m at 25°C but has the capacity to hold 25 gm/cu.m at this temperature; the Relative Humidity would be:

$$\text{R.H} = \frac{20}{25} \times 100 = 80 \text{ or } 80\%$$

Thus the RH of air is 80% at 25°C temperature.

Relative Humidity increases with more water vapour in atmosphere but decreases with reduction in the vapour content. When the air is fully *saturated,* Relative Humidity is 100%. Saturated air will not hold any more vapour at that temperature. *Dew point* is the temperature at which air gets fully saturated.

Relative humidity is the most essential characteristic of climate. It generally helps to determine the amount of precipitation. Above all, human comfort depends on humidity. Highly humid air is more oppressive. The human body dissipates heat through perspiration and its evaporation. Under conditions of high relative humidity, the rate of evaporation of sweat from

the skin decreases and the human being feels warm and uncomfortable.

MEASUREMENT OF HUMIDITY

The humidity of the atmosphere is measured with the help of a *Hygrometer*, also known as *Dry and Wet Bulb Thermometer*. In the Dry and Wet Bulb Thermometer, a piece of wet cloth is tied around one bulb, the other end of the cloth dips into a small container of water. The rate of evaporation of water vapour from the wet bulb keeps the temperature of this bulb lower than the dry bulb. A difference in temperature between the two thermometers indicates the relative humidity. Saturated air will not allow evaporation and in that case the temperature reading on both the dry and wet thermometers will be the same. This would mean that Relative Humidity is 100%.

CONDENSATION

Condensation is the reverse process of evaporation. In condensation, water vapour in the atmosphere get converted into water droplets or ice. During condensation, the latent heat locked in water vapour is released back into the atmosphere. Condensation can take place only when water vapour is added to saturated air or when the temperature falls below the temperature at which air becomes saturated. For example at 25°C temperature, air can hold 30 gm of water vapour per cubic metre. If the temperature falls to 20°C, it can hold only 24 gm of water vapour. The remaining 6 gm of water vapour will get condensed.

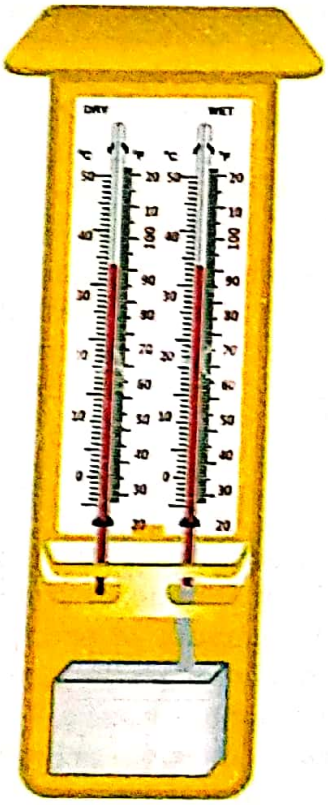

Fig. 15.2. Hygrometer

Condensation takes place when the following atmospheric conditions exist:

(i) There should be a high amount of water vapour present in atmosphere.

(ii) Minuscule particles of dust, salt, and even smoke act as condensation nuclei (i.e., particles around which the water vapour condenses).

(iii) The temperature of air must be below dew point temperature so as to encourage condensation.

Forms of Condensation

1. *Clouds*: Clouds are formed when minute droplets of water vapour condense on a nuclei and remain suspended in air.

When a cloud is fully saturated and relative humidity reaches 100%, precipitation occurs. Warm moist air near the ground rises into the sky. Since temperature decreases with height, the ascent causes reduction in temperature below dew point. Moving air on colliding with dust particles in air, sheds the extra moisture. This leads to condensation in the form of tiny droplets of water. It is important to remember that condensation occurs only around tiny solid particles like dust or carbon dioxide in smoke.

These impurities in air are known as *condensation nuclei. Without condensation nuclei condensation does not take place. Without condensation, clouds do not form and without clouds, precipitation cannot occur.* The products of condensation are so tiny that they remain in suspension and do not fall to the ground. Clouds then rise. As more and more droplets are added, the cloud slowly grows in size. When it cannot hold any more moisture, or when the air is fully saturated with Relative Humidity 100%, the moisture comes down as rain.

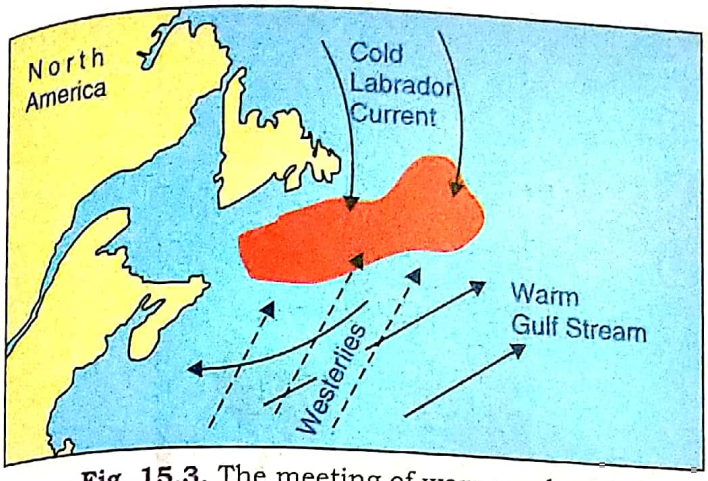

Fig. 15.3. The meeting of warm and cold currents gives rise to fog

Classification of Clouds

When clouds rise, they take on different shapes but not all clouds cause precipitation. Clouds may be grouped according to their formation in the atmosphere and their shape.

Clouds can be of three types mainly—

(i) **Cirrus** clouds are fleecy like wool generally at high altitude.

(ii) **Cumulus** have a cauliflower-like shape.

(iii) **Stratus** clouds have a layered structure.

The base of cumulus clouds is horizontal but they have a vertical structure and their top is dome-shaped. They are generally termed as rain-bearing clouds.

2. *Dew*: When water vapour condenses on the surface, it forms tiny droplets of water called dew. Dew commonly occurs during winter on account of cooling of air below dew point.

3. *Frost*: In very low temperature, when condensation occurs at zero metre or ground level, water vapour freezes into minute crystals of ice on objects near the ground such as blades of grass, leaves and tiny rock particles. Frost is harmful to plants.

4. *Fog and Mist*: Fog and Mist are two related terms. Droplets of water suspended in the atmosphere close to the surface of the earth are termed as fog. On long winter nights, the ground cools more rapidly than the air above. Such cooling reduces temperature at the surface to below dew point. Water vapour at lower levels get condensed around minute solid particles to form fog.

Mist is less dense than fog and the visibility is relatively better. Visibility during fog extends to less than one kilometre but under conditions of mist, it may go up to two kilometres.