

## 1.17 ACID RAIN ( अम्ल वर्षा )

### Introduction:

The term 'acid rain' was first used by Robert Young in 1872. The word meaning of acid rain is that **there is more acid in rain than water**. The problem has reached to the dangerous point in **USA, UK, Germany, Canada and Norway**

**Presence of excessive acids in precipitation (rain, snow and dew) is called acid rain.** Burning of fossil fuels in thermal power plants, automobiles and industrial complexes, produce sulphur dioxide and nitrogen oxides. **The acid rain is caused by (i) sulphur dioxide; (ii) nitrogen oxides; and (iii) hydrogen chloride, emitted from many industries.** These air pollutants react with oxygen and moisture

in the air to form sulfuric acid, nitric acid and hydrochloric acid respectively, which reach to the earth surface with rain water. Therefore, **acid rainfall is the resultant of air pollution.**

Normal precipitation without acidification has pH value 5.6 which is a little acidic in nature because it absorbs the atmospheric carbon dioxide. **The acid rains, therefore, have pH below 5.6.** The pH scale is used to measure acidity or alkalinity of water or any other liquid. The 7 pH denotes a neutral solution, below 7 it is acidic and above the neutral basic.

The oxides of sulphur and nitrogen are important gaseous pollutants of air. They are produced mainly by:

- Combustion of fossil fuels
- Power Plants
- Automobile exhausts, domestic fires etc.

Combustion of fossil fuels like coal, firewood etc. in thermal power plants, automobiles and industrial complexes, produce air pollutants like sulphur and Nitrogen. When gaseous emissions of sulphur oxides and nitrogen oxides interact with water vapour and sunlight, they are chemically converted into strong acidic compounds such as sulphuric acid ( $H_2SO_4$ ) and nitric acid ( $HNO_3$ ). Acid Rain or Acid precipitation results when these compounds along with the other organic or inorganic chemicals are carried to the earth by rain, fog, dew or snow. Therefore, acid rainfall is the resultant of air pollution.

Snow and ice formed over lakes and rivers contain large doses of sulphuric acid. In spring when the snow melts and enters lakes and rivers, thus sulphuric acid is released into the water bodies making them highly acidic. This condition is commonly referred to as 'Spring Shock' or 'Acid Shock'. The water from the sea, lakes and rivers evaporates. When the water vapour reaches the atmosphere, it condenses on fine particles and some of the atmospheric gases get dissolved in this condensed water vapour. These atmospheric pollutants get deposited on soils, vegetation, surface waters, property and materials when these condensed water vapours come down in the form of acid rain causing immense damage because of the acidity of the pollutants.

As the name suggests, acid-rain means the presence of excessive acids in rain water. Acid rain has an average 5.6 pH level (the pH scale measures the acidity and alkalinity of a solution. The value of 7 is neutral. Values above 7 indicate alkalinity and below 7 indicate acidity).

### TYPES OF ACID RAIN (अम्ल वर्षा के प्रकार):

1. **Dry Acid Rain:** The particles of sulphate and nitrates are deposited on the earth surface.
2. **Wet Acid Rain:** When sulphuric, nitric and hydrochloric acids are mixed with atmospheric water vapours and make rain water more acidic.

### EFFECTS OF ACID RAIN (जल वर्षा के प्रभाव):

- (i) Acid precipitation is responsible for corrosion of metals and disintegration of marble. Taj Mahal, like other buildings, is also affected by acid rain.
- (ii) Soil becomes acidic due to acid rains. Population of soil organisms like earthworm decreases.
- (iii) Many aquatic organisms such as algae and bacteria are found to disappear or decrease their population. In many countries like Germany, Sweden, Japan and New York, many aquatic

systems (lakes and ponds) have totally become sterile due to death of fish and other aquatic life under high acidity. The reproductive potentials of aquatic.

- (iv) The aquatic systems face another problem of deposition of excessive amount of many heavy metals, Cu, Zn, Cd and Pb in water due to high acid rainfall.
- (v) Forest trees and herbaceous vegetations are adversely affected by acid rain due to the damage caused to the foliage.
- (vi) Imbalance in minerals found in forests, fields and lakes etc. (Because of acidity in water, in New York, about 200 lakes have been declared dead since no aquatic life is found there. Similarly, 4000 lakes in Sweden, 1500 lakes in Norway are now without fishes. It is estimated that by the end of this century, about 4800 lakes in Canada would be dead.)
- (vii) The Taj Mahal in India, and some other heritage of the world are become pale (yellow) because of acidity/sulphur.

### Consequences of Acidification:

Lakes in the United States, Eastern Canada and Europe and eighteen thousand lakes in Sweden are dead, i.e. no aquatic life except algae survives in them. Building and monuments in highly industrialized areas suffer considerable damage due to acid rain. Even areas far removed from such industrial areas are not safe from the effects of acid rain damage as the tall stacks on these industries merely disperse these pollutants into the upper areas of the troposphere from where they are carried to long distances and eventually return to earth as acid rain.

Acid rain is known to be corrosive to basic materials such as lime stone and marble. Some of the historic monuments which are being attacked by acid precipitation in India are:

- Taj Mahal in Agra
- Red Fort in Delhi & Agra
- Gol Gumbaz in Byapur
- Konark Temple in Orissa
- Jama Masjid in Delhi
- Qutab Minar in Delhi
- Victoria Memorial in Kolkata
- Ajanta Ellora caves in Aurangabad.

Vast areas of forests and crop lands have been destroyed as there is a decrease of tree growth and forest productivity.

The unnaturally low pH of these acid rain changes the pH of the rivers and streams which in turn has many adverse effects, namely –

- Death of the first, species of algae, bacteria and plant life inhabiting such water bodies.
- Making the aquatic ecosystem sterile by altering their internal system, thereby reducing their reproduction (egg-producing) ability and often resulting in deformation.
- Changes in metabolic rates of organisms depending on acid or base catalysts.
- The aquatic systems face another problem of deposition of excessive amount of many heavy metals, Cu, Zn, Cd and Pb in water due to high acid rainfall.
- Forest trees and herbaceous vegetations are adversely affected by acid rain due to the damage caused to the foliage.

The contaminating air, water and food, acid rain includes many species at different levels of the food chain and is a threat to human health and well-being. In the future, the problem of acid pollution will be serious in developing country like India. Situation is critical in industrial cities like Delhi, Mumbai, Kolkata, Nagpur, Pune, Firozabad etc. The average pH value of acid rains is likely to worsen throughout the world in the near future with the increasing demand of the age, and more rapid spread of many industries.

### **STEPS TO BE TAKEN TO CHECK ACID RAIN ( अम्ल वर्षा को रोकने के प्रभावी कदम ):**

- (i) The lime should be mixed in the soil and lakes to reduce the quantity of acidity.
  - (ii) Non-conventional energy sources should be used in place of Petroleum and thermal power plants.
  - (iii) Height of the chimneys should be enhanced to reduce the impact.
  - (iv) Three-way catalytic convertor technology be used to reduce the emission of gases from the vehicles.
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