

## ENVIRONMENTAL STUDIES

### LECTURE-40

#### **Acid Rain**

Acid Rain, as the name suggests, can be said as the precipitation of acid in the form of rain in the simplest manner. When atmospheric pollutants like oxides of nitrogen and sulphur react with rainwater and come down with the rain, then this results in Acid Rain.

Acid rain is made up of highly acidic water droplets due to air emissions, most specifically the disproportionate levels of sulphur and nitrogen emitted by vehicles and manufacturing processes. It is often called acid rain as this concept contains many types of acidic precipitation.

The acidic deposition takes place in two ways: wet and dry. Wet deposition is any form of precipitation which removes acids from the atmosphere and places them on the surface of the earth. In the absence of precipitation, dry deposition of polluting particles and gases sticks to the ground through dust and smoke.

#### **Causes of Acid Rain**

The causes of acid rain are ***Sulphur and Nitrogen particles which get mixed with the wet components of rain.*** Sulphur and Nitrogen particles which get mixed with water are found in two ways either man-made i.e as the emissions that are given out from industries or by natural causes like lightning strike in the atmosphere releasing nitrogen oxides and volcanic eruptions releasing sulphur oxide.

According to the Royal Society of Chemistry, which considers him the “father of acid rain,” the word acid rain was invented in 1852 by Scottish chemist Robert Angus Smith. Smith decided on the word while studying rainwater chemistry near industrial towns in England and Scotland.

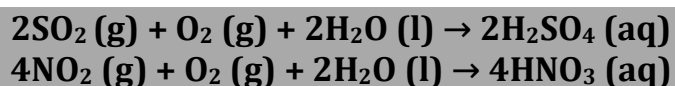
The regular clean rain we experience, even though it is not clean i.e water and carbon dioxide react together to form weak carbonic acid which essentially by itself is not extremely harmful. The reaction occurring is :



***The pH value of regular rainwater is around 5.7, giving it an acidic nature.*** The oxides of nitrogen and sulphur are blown away by the wind along with the dust particles. They settle on the earth’s surface after

coming down in the form of precipitation. Acid rain is essentially a by-product of human activities which emit oxides of nitrogen and sulphur in the atmosphere. Example – the burning of fossil fuels, unethical waste emission disposal techniques.

Sulphur dioxide and nitrogen dioxide undergo oxidation, and then they react with water resulting in the formation of sulphuric acid and nitric acid, respectively. The following reaction will clarify the acid formation reaction:



### Effects of Acid Rain

- Acid rain is very harmful to agriculture, plants, and animals. It washes away all nutrients which are required for the growth and survival of plants. Acid rain affects agriculture by the way it alters the composition of the soil.
- It causes respiratory issues in animals and humans.
- When acid rain falls down and flows into the rivers and ponds it affects the aquatic ecosystem. It alters the chemical composition of the water, to a form which is actually harmful to the aquatic ecosystem to survive and causes water pollution.
- Acid rain also causes the corrosion of water pipes, which further results in leaching of heavy metals such as iron, lead and copper into drinking water.
- It damages the buildings and monuments made up of stones and metals.

### Real-Life Examples

- **Taj Mahal**, one of the 7 wonders of the world, is largely affected by acid rain. The city of Agra has many industries which emit the oxides of sulphur and nitrogen in the atmosphere. People continue to use low-quality coal and firewood as a domestic fuel, adding to this problem. Acid rain has the following reaction with the marble (calcium carbonate):



The formation of calcium sulphate results in the corrosion of this beautiful monument.

- **Statue of Liberty** which is made of copper has also been damaged by the cumulative action of acid rain and oxidation for over 30 years and is, therefore, becoming green.

### **Prevention of Acid Rain**

- The only precaution that we can take against acid rain is having a check at the emission of oxides of nitrogen and sulphur.
- Acid rain is harmful to animals, plants and the monuments.
- Being responsible citizens, one should be aware of the harmful effects they cause and of the industries which give out nitrogen and sulphur compound wastes unethically.

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