ACID RAIN

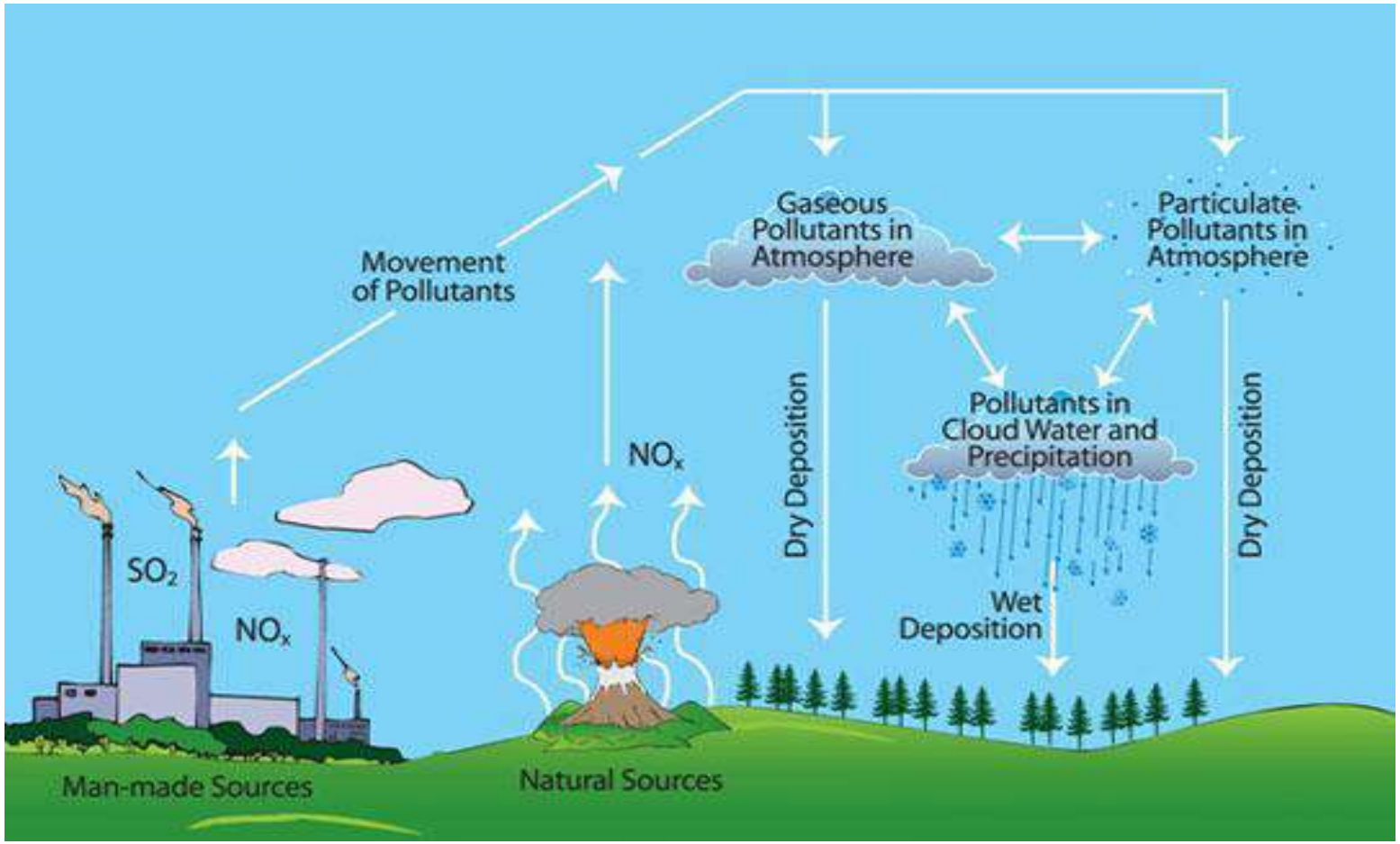
What is ACID RAIN?

- Acid rain is the rain water containing sulphuric acid and nitric acid along with small amount of HCL which are formed from the oxides of Sulphur and nitrogen present in the air as pollutants and has a **pH** of 4-5.
- On an average H_2SO_4 contributes 60-70% of the acidity while HNO_3 contributes remaining 30-40%.

These acids are deposited over earth in two forms-

- **WET Deposition-** It occurs in the form of rain, snow and fog.
- **DRY Deposition-** It refers to settling down of wind blown acidic gases(Nitrogen oxides and Sulphur oxides) and other particles in dry state.

Dry and wet acid deposition-



Formation of acid rain-

- Natural sources such as bacterial action or volcanic eruptions or human activities involving combustion of fuels or from chemical industries the oxides of nitrogen and sulphur enter into atmosphere as pollutant.

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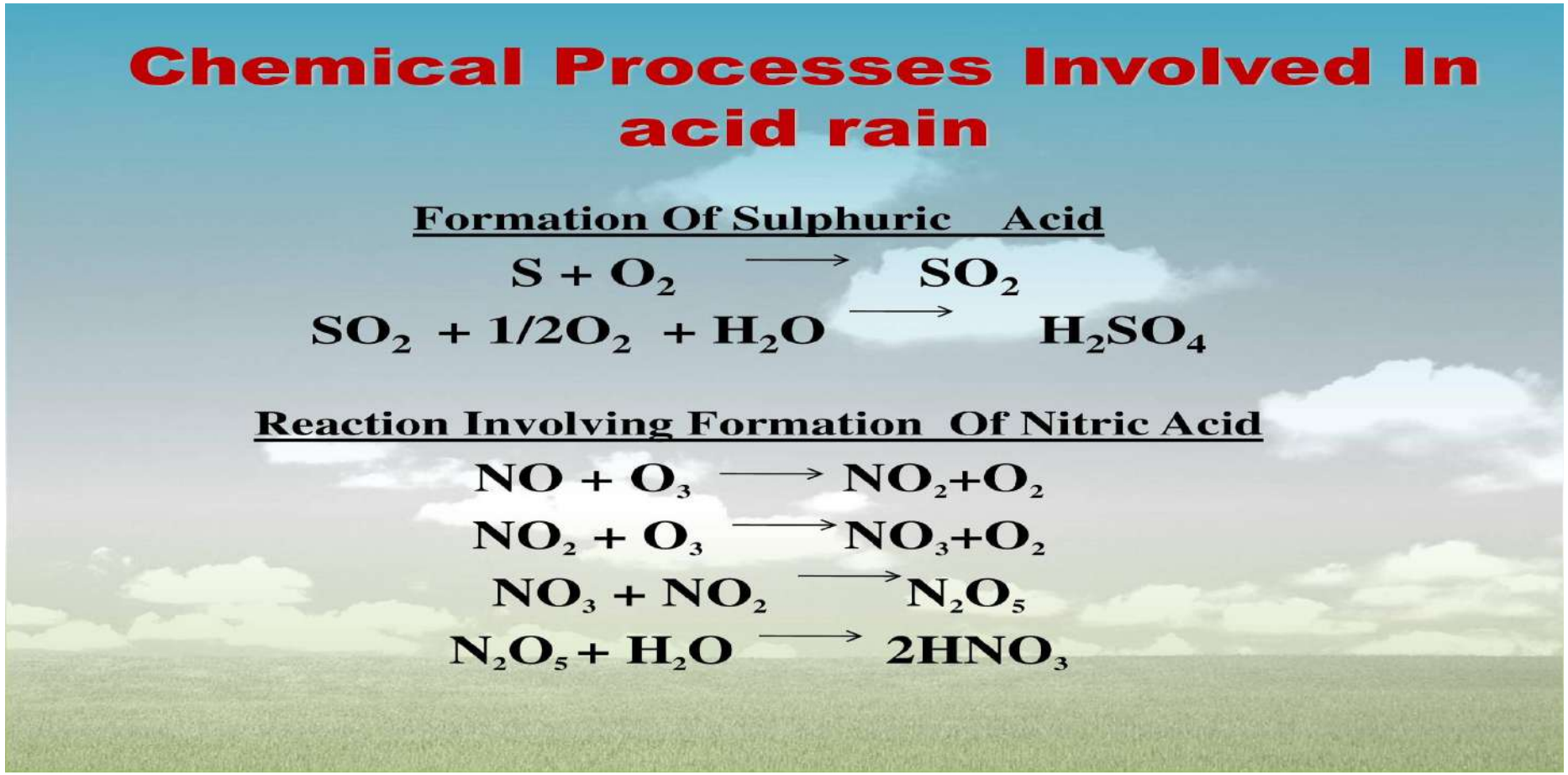

Effects of acid rain-

- Weathering of Rocks: **Soil Acidification**
- Consequences of soil acidification-
- **Leaching of plant nutrients-**The nutrients, particularly the base cations, such as magnesium, calcium and potassium are leached out. These are replaced by hydrogen ions owing to ion exchange.
- The increased acidity combined with nutrient deficiency leads to decrease in soil fertility. The girth size, foliage and yield may decrease.

- **Mobilization of Toxic Metals-** An increase in acidification of soil, results in the leaching of potentially toxic metal ions such as aluminum, cadmium, manganese, copper, iron, etc.
- An increase in metal ion concentrations also affects the microorganisms living in soil negatively. So under conditions of high acid, that is low pH, the biodegradation in the soil is slowed down.
- **Inaccessibility of Phosphates and Micronutrients-**The vital nutrient phosphorus is available in soil as phosphate. The aluminum ions, Al3+, are able to bind the phosphate very strongly and so the latter becomes unavailable to plants. Likewise, micronutrients such as boron, selenium and molybdenum also become less accessible.

Effect on Plant Life

- Al3+ ions damage the root fibers and lead to forest decline.
- Acidity coupled with presence of tropospheric ozone and other oxidants cause stress, which when combined with drought, temperature extremes and disease and insect attack, leads to forest decline.
- The forests at high altitude are more susceptible to damage due to their exposure to the base of low level clouds, where the acidity may be high.
- Fogs and mist are more acidic than clouds due to much less water than clouds and hence the trees may suffer from dieback in regions of acid fogs.

Aquatic Life-

- Acidification of lakes and rivers has serious consequence for aquatic life.
- Below pH = 5, many fish species, such as trout and bass cannot survive and disappear and in general the population of living organisms decreases.
- If the pH of lake/river water falls below 4.7, the lake/river becomes virtually sterile and unable to support aquatic life.
- Dead lakes occur at pH below 3.5. This is due to the mobilization of toxic metals, particularly aluminum as Al3+. Soil contains aluminum compounds, such as feldspar.

Buildings-

- Limestone and marble buildings are highly susceptible to damage due to acid rain.
- Both SO2 and O2 are absorbed on to the wet surface. Amount of gases absorbed on stone surface increases with increase in relative humidity.
- The absorbed gas is oxidized to sulfate, which becomes a part of $CaCO_3$ matrix and $CaCO_3$ is converted into $CaSO_4$. This phenomenon is termed '**Stone leprosy**'. Chemical reaction involved are-
- $CaCO_3 + H_2SO_4 \longrightarrow CaSO_4 + CO_2 + H_2O$
- $CaCO_3 + 2HNO_3 \longrightarrow Ca(NO_3)_2 + H_2O + CO_2$

Paper and Leather-

- The absorption of SO_2 by paper in humid atmosphere is responsible for yellowing and loss of mechanical strength of paper.
- The acid hydrolyses cellulose, and SO_2 reacts with lignin on surface moisture to form lignosulfonic acid. In a similar manner, the hydrolysis of leather proteins deteriorates the leather goods.

Rusting of Iron and Other Damaging Effects-

- Acid rain is known to accelerate the rusting of iron. It also damages the painted surfaces, and damages glass articles.
- It accelerates the decay of building materials and paints, including buildings, statues, and sculptures and irreplaceable monuments like Taj Mahal.

Thank You