

# Chemistry of the environment

## Air and water

### Air

- **Composition:** Approximately 78% nitrogen, 21% oxygen, 1% other gases (argon, carbon dioxide, etc.).
- **Separation:** Liquefy air and then fractionally distill it to separate nitrogen and oxygen.
- **Pollutants:** Oxides of nitrogen, carbon monoxide, particulate matter.
- **Catalytic converters:** Reduce pollution by converting harmful gases into less harmful ones.
- **Rust:** Oxidation of iron in the presence of air and moisture.

### Water

- **Chemical tests:**
  - Anhydrous copper(II) sulfate turns blue.
  - Anhydrous cobalt(II) chloride turns pink.
- **Treatment:** Filtration, chlorination, and other processes to make it safe to drink.
- **Implications of inadequate supply:** Health problems, reduced agricultural productivity, and economic impacts.

### Nitrogen and Fertilizers

- **Nitrogen:** Essential nutrient for plants.
- **Fertilizers:** Contain nitrogen, phosphorus, and potassium to improve plant growth.
- **Displacement of ammonia:** Stronger bases can displace ammonia from its salts.

## Haber Process

- **Production of ammonia:** Reaction between nitrogen and hydrogen.
- **Conditions:** High temperature (450°C), high pressure (200 atm), iron catalyst.

## Carbon Dioxide and Methane

- **Sources:** Combustion of fossil fuels, respiration, decomposition of organic matter.
- **Greenhouse gases:** Contribute to global warming.
- **Carbon cycle:** The natural circulation of carbon between the atmosphere, biosphere, hydrosphere, and lithosphere.

### Remember:

- Air and water are essential for life.
- Pollution and inadequate supply of these resources can have significant consequences.
- Understand the processes involved in the production and purification of air and water.
- Be aware of the environmental impacts of human activities on air and water quality.

## Sulfur

### Sources of Sulfur

- **Underground sulfur beds:** Found in the USA, Mexico, and Poland.
- **Natural gas and petroleum:** Contain sulfur compounds that can be extracted.
- **Metal sulfides:** Occur as ores, such as zinc blende.

### Uses of Sulfur Dioxide

- **Contact process:** Production of sulfuric acid.
- **Bleaching:** Manufacture of paper from wood pulp.

- **Food preservation:** Killing bacteria.

## Contact Process

- **Steps:**
  1. Sulfur is burned to form sulfur dioxide.
  2. Sulfur dioxide reacts with oxygen to form sulfur trioxide.
  3. Sulfur trioxide reacts with water to form sulfuric acid.
- **Conditions:** 400-450°C, 1-2 atmospheres, vanadium(V) oxide catalyst.

## Properties and Uses of Sulfuric Acid

- **Dilute sulfuric acid:**
  - Strong acid.
  - Used in making fertilizers, treating metals, laboratory reagents, car batteries, and various industries.
- **Concentrated sulfuric acid:**
  - Strong acid, dehydrating agent, oxidizing agent.
  - Used in making detergents, as a catalyst, and as a dehydrating agent.

### Remember:

- Sulfur is a versatile element with various applications.
- The contact process is a key industrial process for producing sulfuric acid.
- Sulfuric acid has a wide range of uses due to its strong acidic properties and other characteristics.

# Carbonates

## Manufacture of Calcium Oxide (Lime)

- **Decomposition of calcium carbonate:** Calcium carbonate (limestone) decomposes upon heating to form calcium oxide (lime) and carbon dioxide.
- **Hydration of lime:** Calcium oxide reacts with water to form calcium hydroxide (slaked lime).
- **Limewater:** Aqueous solution of calcium hydroxide, turns milky in the presence of carbon dioxide.

## Uses of Calcium Compounds

- **Calcium oxide (lime):** Used to treat acidic soils and neutralize acidic wastes.
- **Calcium hydroxide (slaked lime):** Used in the manufacture of mortar and plaster.
- **Calcium carbonate:**
  - Used in the manufacture of cement, glass, and steel.
  - Neutralizes acidic soils and lakes.

### Remember:

- Carbonates are compounds containing the carbonate ion ( $\text{CO}_3^{2-}$ ).
- Calcium carbonate is a common mineral found in limestone.
- Calcium oxide and hydroxide are important industrial chemicals with various applications.