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Environmental Chemistry

Environmental Pollution

Pollution refers to the introduction or presence of harmful substances in the environment. These unwanted materials are called pollutants.

Types of Pollutants

1. **Primary pollutants:** Released directly into the environment and retain their original form.
2. **Secondary pollutants:** Formed by reactions of primary pollutants within natural systems like the atmosphere.

Biodegradable vs Non-Biodegradable Pollutants

- **Biodegradable:** Organic wastes like sewage, cow dung; decomposed by microbes but harmful in excess.
- **Non-biodegradable:** Substances like DDT, mercury, and aluminum; resist degradation and accumulate in nature.

Atmospheric Pollution

Contamination of air through harmful substances.

Common Gaseous Pollutants

- **Sulphur dioxide (SO_2):** Released from burning coal/diesel in power plants.
- **Sulphur trioxide (SO_3):** Produced by SO_2 oxidation.

$$2SO_2 + O_2 \rightarrow 2SO_3$$

- **Hydrogen sulphide (H_2S):** Found near decomposing waste and certain industries.
- **Nitrogen oxides (NO_x):** Formed at high temperatures from atmospheric nitrogen and oxygen.
- **Carbon monoxide (CO):** Emitted from partial fuel combustion.
- **Carbon dioxide (CO_2):** Result of complete fuel combustion.
- **Hydrogen fluoride (HF):** Released by fertilizer, aluminum, and metallurgical plants.
- **Hydrocarbons:** Harm lungs at high concentrations.

Particulate Matter

- **Dust:** From crushing and grinding solids.
- **Smoke:** Combustion-generated carbon particles.
- **Mist:** Formed via liquid sprays or condensation.
- **Fumes:** Vapor condensates like mercury fumes.
- **Smog:** Combination of smoke and fog.

Effects of Impurities in Water

Suspended Impurities

Impurity	Effect
Suspended solids	Cause turbidity
Bacteria	Cause waterborne diseases
Parasites	Cause worm infections
Viruses	Cause enteroviral infections
Algae	Foul smell and filter blockage

Dissolved Impurities

Impurity	Effect
Hardness (Ca, Mg salts)	Corrosion, laxative effect
Sulphates	Cause diarrhea

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Sodium carbonate/bicarbonate	Lead to alkalinity
Fluorides	Cause fluorosis and dental issues
Sodium chloride	Indicates sewage pollution
Iron/Manganese	Stains fabrics, bad taste, toxicity
Lead	Neurotoxin, causes brain damage
Mercury	Bioaccumulates; neurological damage
Zinc	Vomiting, dizziness
Arsenic	Extremely poisonous
Detergents	Cause foaming, disrupt purification
Phosphates	Algal bloom and decay
PCBs	Carcinogenic; skin issues

Land Pollution

Soil contamination from added/removed substances reducing fertility and harming organisms.

- **Insecticides:** Prevent diseases and protect crops.
- **Herbicides:** Eliminate weeds (e.g., $NaClO_3$, Na_3AsO_3).
- **Fungicides:** Control fungal growth.

Controlling Environmental Pollution

Waste Management

Proper disposal and treatment reduce pollution significantly.

Recycling

Recycling reduces raw material use and disposal costs.

Sewage Treatment

Removes contaminants from wastewater including domestic and industrial sources.