

Pollution

These notes are your ultimate revision weapon to revise Pollution. We've distilled years of previous exam questions (PYQs) into one powerful, concise resource. Everything you need to know, nothing you don't.

- **PYQs, Decoded:** All key concepts from past exams, organized and simplified.
- **Revise in Record Time:** Short, precise, and designed for last-minute review.
- **Focus on What Matters:** Master high-probability topics and boost your confidence.

1. Types of Pollutants

Origin-Based Classification

- **Anthropogenic Pollutants:** Human-made pollutants.
- **Anthropogenic Environment:** The environment modified by human activities.

Degradability-Based Classification

- **Biodegradable Pollutants:** Can be broken down by microorganisms (e.g., bacteria).
 - *Examples:* Sewage, domestic waste, urine, feces, cattle dung, animal bones, rubber.
- **Non-Biodegradable Pollutants:** Cannot be easily broken down by natural means.
 - *Examples:* Polythene bags (made of polymers), plastic, mercury.

Formation-Based Classification

- **Primary Pollutants:** Emitted directly into the air.
 - *Examples:* Sulphur dioxide (SO₂), Nitrogen oxide (NO_x), Carbon monoxide (CO), lead.
- **Secondary Pollutants:** Formed when primary pollutants react in the atmosphere.
 - *Examples:* PAN (Peroxyacetyl Nitrate), Ozone (O₃), Smog.

2. Air Pollution

Major Sources

- **Combustion:** Burning of coal, petrol, and diesel, releasing carbon and nitrogen oxides.
- **Industries:**
 - **Steel Industry:** Releases SO_x, NO_x, CO, and CO₂.
 - **Thermal Power Plants:** A major source of fly ash (from low-grade coal), CO₂, NO_x, and SO_x.
- **Automobiles:** Exhaust is a source of CO, benzene, and lead (from leaded fuel).
- **Indoor Sources:** The most significant indoor air pollutant is **Radon gas**.

Specific Pollutants & Health Effects

Pollutant	Source	Primary Health Effect
Carbon Monoxide (CO)	Incomplete combustion (vehicles, cigarettes)	Binds with haemoglobin to form carboxyhaemoglobin (COHb), causing poisoning.
Ozone (O ₃)	Secondary pollutant in photochemical smog	Component of smog; respiratory irritant.
Lead	Automobile exhaust (leaded fuel), smelting,	Affects the brain and central nervous system.

	paints	
Asbestos Dust	Construction materials	Affects the lungs (asbestosis).
Mercury	Industrial processes	Causes damage to the liver and kidneys.
Oxides of Nitrogen (NOx)	Vehicle exhaust, power plants	Can cause cancer.
Benzene	Auto exhaust, tobacco smoke, varnished furniture	Carcinogenic.
Soil Particles	Dust, construction	Causes breathing ailments.

Phenomena & Events

● Smog:



- **General Smog:** Smoky fog caused by oxides of nitrogen/sulphur, ozone, smoke. Caused by coal burning, vehicle exhaust.
- **Photochemical Smog:** Forms in sunlight from reactions among NO₂, O₃, and PAN. Contains aldehydes and formaldehyde. More frequent in summer. Caused by unsaturated hydrocarbons.

● Acid Rain:

- **Cause:** Primarily by Sulphur Dioxide (SO₂) and Nitrous Oxide (NOx).
- **pH:** Less than 5.6.
- **Affected Countries:** Canada and Norway (often from pollutants drifting from the UK/Germany). Norway receives the most.

- **Asian Brown Cloud (2002):** A large layer of pollution over South Asia, composed of aerosol particles, sulphate, and black carbon.

- **Delhi's Winter Pollution:** Reaches maximum levels due to temperature inversion (cold air trapping pollutants), not increased vehicle combustion.

Measurement & Control

- **Air Quality Index (AQI):** In India, calculated based on **8 pollutants**, including CO, NO₂, SO₂. (Excludes CO₂ and CH₄).
- **Bioindicators: Lichens** are sensitive indicators of air pollution (especially SO₂).
- **Emission Standards:**
 - **Euro Norms:** Set limits for vehicle exhaust pollutants (CO, hydrocarbons, NO_x, lead, PM).
 - **Euro-II Diesel:** Requires sulphur content of **0.05% or less**.
- **National Clean Air Programme (NCAP):** Launched in **2019** in India with a target to reduce PM 2.5 and PM 10 by 20-30% by 2024.
- **Control Devices:**
 - **Catalytic Converter:** Uses palladium/platinum to convert CO to CO₂.
 - **Bag Filter:** For particles <50 micrometers.
 - **Cyclone Collector/Separator:** Uses centrifugal force for larger dust particles.
 - *(A Cyclone Divider is not a pollution control device).*
- **Natural Cleaning: Rain** cleans polluted air by removing particulate matter (>2.5 and 10 microns).

3. Water Pollution

Measurement & Indicators

- **Dissolved Oxygen (DO):** Key measure of water pollution in rivers.
- **Biological Oxygen Demand (BOD):** Key indicator of pollution in the aquatic environment.
 - **High BOD:** Indicates contamination with organic matter (e.g., sewage).
 - **Low BOD:** Indicates clean water.

- **In Ganga River:** Maximum BOD is found between **Kanpur and Prayagraj (Allahabad)**.

Sources & Contaminants

- **Industrial Effluents:** The **leather industry** causes the highest chemical pollution.
- **Arsenic:** A non-biotic (abiotic) pollutant in underground water.
 - **Maximum contamination** in groundwater is found in **West Bengal** (Brahmaputra, Gangetic, and Padma Meghna plains).
 - **Permissible limit:** 10 micrograms per liter.
- **Fertilizers:** Indiscriminate use leads to chemical leaching into water bodies.
- **Other Drinking Water Pollutants:** Fluoride, Uranium.

Processes & Effects

- **Eutrophication:** Water pollution caused by excessive nutrient enrichment (from fertilizers, detergents, sewage), leading to algal blooms and oxygen depletion.
- **Harmful Algal Blooms (in Indian seawaters):** Caused by nutrient discharge from estuaries, monsoon run-off, and upwelling.
- **Polluted Rivers:** The **Damodar River** is called a '**biological desert**' due to extreme pollution.

4. Soil & Land Pollution

Sources & Effects

- **Fertilizers & Pesticides:** Indiscriminate use leads to soil pollution (nitrogen loss, degradation). This is dangerous as chemicals can enter the food cycle.
- **Agricultural Soils:** Can release **nitrogen oxides**, especially when heavily fertilized.

4.2. Solid Waste Management

- **Solid Waste Management Rules, 2016:** Include criteria for identifying landfill and waste processing sites.

5. Other Pollution Types

Noise Pollution

- **Maximum Source: Jet Flights** (up to 120 decibels). Other sources: heavy traffic, rock music.
- **Control Method: Green Muffler** technique (planting 4-5 rows of trees to absorb sound).

Radioactive Pollution

- **Effects:** Causes hereditary changes, hinders blood circulation, and causes cancer. It does **not** cause a mineral disbalance in soil.
- **Example:** The **Chornobyl (Chernobyl) nuclear accident** on **April 26, 1986**, in Ukraine.



6. Pollution Control & Remediation

Bioremediation

- **Definition:** Elimination of toxic pollutants using organisms like microorganisms.
- **Process:** Enhances natural biodegradation.
- **Application: Oil Zapper** technology uses bacteria (e.g., *Pseudomonas putida*) to clean oil spills.
- **Limitation:** Cannot readily treat contaminants with heavy metals (e.g., cadmium, lead).

Waste-to-Energy Technologies

- **Thermal Technologies: Pyrolysis and Plasma Gasification** (which produces gases like CO, H₂, CH₄ for fuel).

Fly Ash Utilization

- **Uses:** Production of bricks; partial replacement for Portland cement in concrete.
- **Composition:** Contains silicon dioxide (SiO_2) and calcium oxide (CaO), but also toxic elements like lead and arsenic.

7. Clean Energy & Alternatives

Solar Energy

- A **renewable energy** source.
- Produces **no atmospheric pollution** when converted to electricity.

Alternative Fuels

- **Hydrogen-enriched CNG (H-CNG):**
 - Reduces CO emissions by up to **70%**, and also reduces CO_2 and hydrocarbons.
 - Hydrogen can be blended up to one-fifth by volume.
 - It is **not** less expensive than CNG.

8. Health, Toxins & Contamination

Food Contamination

- **Aflatoxins:** Poisonous, cancer-causing chemicals produced by moulds on improperly stored grains (corn, peanuts, etc.). Not destroyed by normal cooking.
- **Mustard Seed Adulteration:** Commonly adulterated with **Argimon seeds** (native to Mexico), which can cause **dropsy**.
- **Knock-Knee Syndrome:** Caused by **Fluoride** pollution (fluorosis).

Specific Disasters

- **Bhopal Gas Tragedy:** Occurred on **December 3, 1984**. The gas leaked was **Methyl Isocyanate (MIC)** from a pesticide plant.

9. Emerging Pollutants & Initiatives

Microplastics

- **Microbeads:** Tiny particles of **polyethylene** found in personal care products (shampoo, face cream). Harmful to marine ecosystems.

Other Pollutants

- **Brominated Flame Retardants** (in mattresses/upholstery): Highly resistant to degradation and accumulate in humans/animals, disrupting brain and hormone functions.
- **Nanoparticles** (e.g., Zinc Oxide, Titanium Dioxide): Can accumulate, contaminate environments, enter the food chain, and trigger free radical production.

International Cooperation

- **SACEP (South Asia Cooperative Environment Programme):** India approved an MoU on **March 28, 2018**, for cooperation on tackling oil and chemical pollution in South Asian seas.
- **International Maritime Organization (IMO):** UN agency for global shipping; headquartered in **London**.

10. Sustainable Practices

Agriculture

- **Crop Rotation:** Conserves soil fertility, reduces erosion, and increases production.
- **Nutrient Pollution:**
 - **Cattle** release **ammonia**.
 - **Poultry industry** releases reactive nitrogen compounds (ammonia, nitrate).

Sanitation

- **Indian Railways' Bio-Toilets:** Use **bacteria** to decompose waste into water and gases. The water is treated with chlorine before disposal.

Climate Mitigation (Geoengineering)

- **Cirrus Cloud Thinning:** Proposed to allow more heat to escape.
- **Injection of Sulphate Aerosol into Stratosphere:** Proposed to reflect sunlight and reduce warming.
- **Ocean Acidification:** Caused by CO₂ absorption, adversely affecting calcareous phytoplankton, coral reefs, and animals with phytoplanktonic larvae.

Know More About Pollution:

- [Pollution – Old Year Questions](#)
- [Pollution One Liner Questions & Answers](#)

