

Occurrence of Toxicants

- A large number of pollutants are present in the environment, often in very large quantities. They arise from **many sources and exposure** to these pollutants may occur through a **range of routes**.
- For example, the ambient air in urban areas may contain sulfur dioxide (SO₂), carbon monoxide (CO), and nitrogen oxides (NO_x), as well as smoke and suspended particles containing metals and hydrocarbons produced mainly from coal or heavy-oil combustion by industries, power plants, and some households.
- Several pollutants are also found in the **indoor environment**.
- Some examples include CO arising from incomplete combustion of fossil fuels and tobacco smoke, lead (Pb) from paint used in old houses, batteries, and **formaldehyde** from insulation and wood preservatives and adhesives.
- Focus on: where and **how certain pollutants may occur in the environment**

The new Humanitarian

- Indoor air pollution **kills thousands every year**
- DHAKA: Over **46,000 people die** of acute lower respiratory infections (ALRI) in Bangladesh each year due to indoor air pollution (IAP), according to Andrew Trevett, acting country representative for the World Health Organization (WHO)
- His findings and those of others set out at a workshop in Dhaka on 15 June revealed that **70 percent of IAP victims were children under five**
- The risk of diseases like **pneumonia, asthma, low birth weight, cardiovascular failure and tuberculosis** among children doubles due to IAP.
- **Cooking, heating with solid fuels on open fires or traditional stoves results in high levels of IAP.**
- Some **4 percent of all diseases** in Bangladesh can be attributed to IAP.
- IAP from burning wood, animal dung and other solid biofuels is a major cause of ALRI.
- Over 92 percent of households in Bangladesh use solid biofuel for cooking purposes, releasing toxic substances like carbon monoxide, formaldehyde and **high levels of harmful particulate matter**.
- **Lack of proper ventilation in most kitchens** contributes towards the heavy concentration of particulate matter indoors.
- **Women and children** are particularly vulnerable as they **spend most of their time indoors**.
- **Low-income groups** are particularly vulnerable as they can only afford solid biofuel.

Visible Smoke and Smog

- Presence of visible **smoke** or **smog** is a manifestation of air pollution
- **Smoke:** is composed of the gaseous products of burning carbonaceous materials made visible by the presence of small **particles of carbon**. e.g., brownish to blackish materials emitted from the stack of an inadequately controlled coal burning industrial plant, or **from chimney of a wood-burning brick field**.



Visible Smoke and Smog

- **Smog:** is a natural fog made heavier and darker by smoke and chemical fumes. It formed as a result of photo-chemical reactions. In the presence of UV rays in sunlight, nitrogen dioxide (NO_2) is broken down into nitric oxide (NO) and atomic oxygen. Atomic oxygen can then react with molecular oxygen in the air to form ground level ozone (O_3) or smog. A large number of chemical reactions- among hydrocarbons or between hydrocarbons and NO, NO_2 , O_3 or other chemical species-to form numerous chemical species.
- Smog is also ugly. It makes the sky brown or gray
- Smog is common in big cities with a lot of industry and traffic. Cities located in basins surrounded by mountains may have smog problems because the smog is trapped in the valley and cannot be carried away by wind.



Visible Smoke and Smog

- Primary air pollutants: NO and NO₂
- Secondary air pollutants: Compounds produced from chemical reactions that occur after the primary pollutants are emitted e.g. O₃, Peroxyacyl nitrate (also known as Acyl peroxy nitrates (PAN))
- Smog composed of both primary and secondary air pollutants: NO₂, O₃, and other photochemical oxidants and large number of other chemical species

Visible Smoke and Smog

Effects:

- Both Smoke and smog cause **reduction in visibility** because light is scattered by the surfaces of airborne particles. They both cause adverse effects on **vegetation, animals, and humans**
- Ozone can be **helpful or harmful**. The ozone layer high up in the atmosphere protects us from the sun's dangerous ultraviolet radiation. But when ozone is close to the ground, it is bad for human health. Ozone can damage lung tissue, and it is especially dangerous to people with respiratory illnesses like asthma. Ozone can also cause itchy, burning eyes.

Offensive Odors

➤ Malodors are often the first symptom of air pollution. Present in natural air, households, farms, sewage treatment plants, solid waste disposal sites, and in many industrial sites.

Source:

- Decomposition of protein-containing organic matter derived from vegetation and animals
- Cooking, Fresh paints, furniture polish, Cigarette
- Industrial source: pulp mills (H_2S), Oil refineries (H_2S), chemical plants (aniline or organic solvents), food processing plants, tannery (acidic smell), and phosphate fertilizer manufacturing plants

Agricultural Damage

- Acid rain: changes in plant growth that are marked by stunted growth, lack of vigor, reduced productivity, and early senescence of leaves.
- NO_2 , O_3 , PAN (peroxyacetylnitrate) and fluoride: injuries to plants (fruit trees and vegetables)
- Plant damage marked by: **chlorosis** (fading of natural green color) and **necrosis** (general death of plant tissue: brownish or black discoloration)

Intoxication of Animals

- **Where:**

- Air pollutants emitted from industrial facilities like, phosphate fertilizer manufacturing plants, aluminum manufacturing plants, iron and other types of smelters, and coal-burning power plants.

- **What:**

- Animals residing in areas adjacent to these industrial sources are exposed to the pollutants emitted from these sources, resulting in injuries.
- Similarly, reports of the injuries of fish and wildlife caused by water pollution also abound.
- Scientists fear that many species of amphibians that have been around for 350 million years will not survive the 21st century. They view these population losses as an indication that there may be something seriously wrong with the environment. Some scientists suspect that infections, and the effects of synthetic organic compounds (such as pesticides), metallic contaminants, acid precipitation, UV radiation, and increased temperatures may be responsible for the phenomenon.

Injuries to humans

- Air pollutants, such as SO_2 , O_3 , and other oxidants, and particulate matters: responsible: causing coughing, degeneration of the lining of the throat, pulmonary disease, and heart failure
- Some of the injuries result in permanent disability, while others are fatal
- Before was occupational now non-occupational!
- Rise in the prevalence of asthma among children and young adults
- Agricultural workers: pesticides- long term effect
- Heavy metals: example **Minamata** disease and **itai-itai-byo**

Some of the major environmental pollution episodes that occurred in recent decades

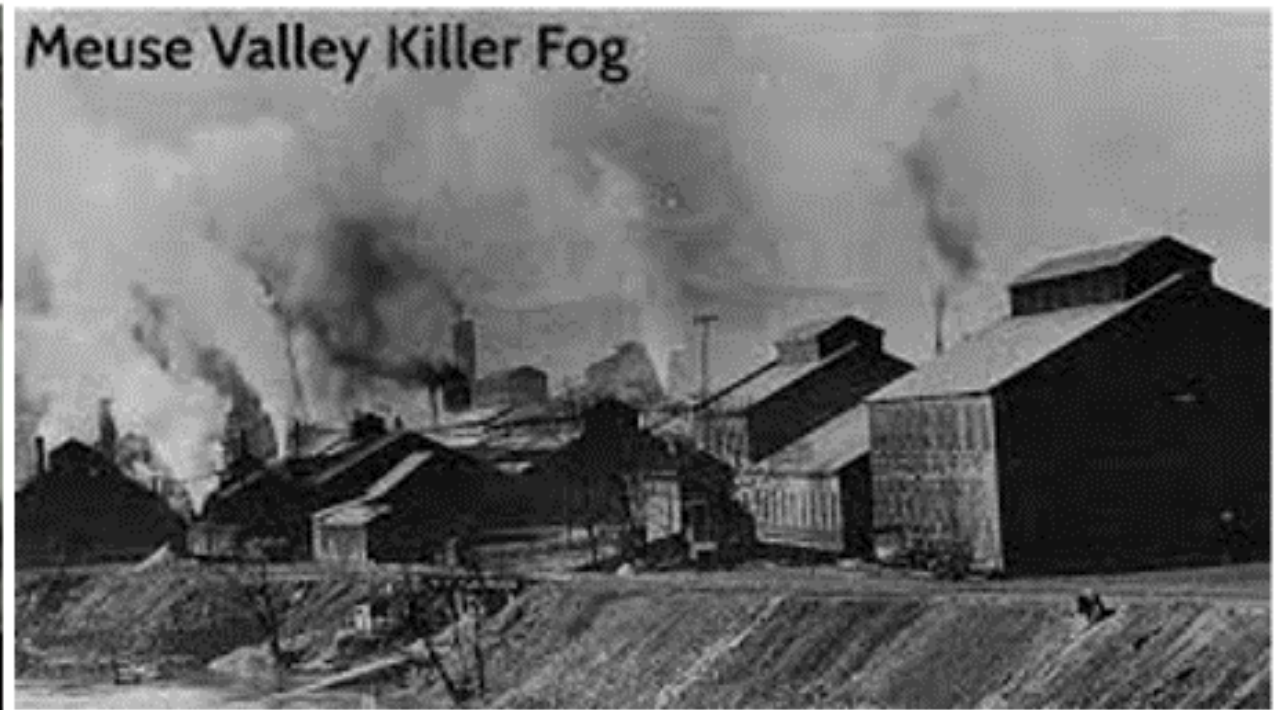
➤ Acute effects:

- Meuse Valley, Belgium, 1930
- London, England, 1952
- Bhopal, India, 1984
- Gas Well Accident, Gaoqiao, China, 2003

Meuse Valley, Belgium, 1930 (Acute effects)

- Meuse valley where a number of industrial plants were located
- Thermal inversion (the settling of a layer of warm air on top of colder air) contributed to the air pollution by keeping the pollutants near the ground (Between 1-5 December).
- Reported casualties include 63 human deaths and some deaths in cattle.
- Many people became ill with respiratory discomforts.
- These events brought worldwide attention to the danger from the emission of toxic substances (sulfur dioxide, nitrogen oxides, etc.) as by-products of fossil-fuel combustion, especially coal combustion.

Meuse Valley Killer Fog Fog. 1930



London, England, 1952 (Acute effects)

- It occurred during December 5 through 8, 1952
- The result of fog and thermal inversion
- Many people suffered from shortness of breath. Cyanosis, some fever, and excess fluid in the lungs were reported
- High levels of SO_2 , fluoride, and smoke were reported in the air
- Approx. 4000 deaths occurred: mostly in the older age group



Bhopal, India, 1984 (Acute effects)

- 3 December 1984: worst industrial accident.
- Forty tons of the highly toxic gas methyl isocyanate (MIC) leaked from a pesticide plant and diffused into densely populated areas.
- The lung was the main target organ of MIC. Suffered different types of illness. Resulted in approximately 3,500 deaths and almost 100,000 injuries.
- Even The gas leak impact trees and animals too. Within a couple of days, trees in the nearby area became barren.



Chernobyl, USSR, 1986 (Acute effects)

- By far the gravest disaster in the history of commercial atomic power occurred on April 26, 1986, at Chernobyl in Ukraine
- The No.4 of the reactor of the Chernobyl power station partly melted down and exploded killing 32 people in the immediate area and causing 237 cases of acute radiation sickness
- Radioactive forms of iodine, cesium, strontium, and plutonium were released into the environment deposited through the northern hemisphere.
- The total radioactivity of the material released from the reactor was estimated to be 200 times that of the combined releases from the atomic bombs dropped in Hiroshima and Nagasaki (WHO, 1995)

Gas Well Accident, Gaoqiao, China, 2003

- 23 December 2003, a leak from a well in a natural gas field at Gaoqiao, a town in southwest China
- The leak spewed out toxic fumes, containing H_2S : cause was drilling mishap, which broke open a gas well
- 191 people killed and 31,000 people forced to run away from home

Chronic Effects

- Minamata Bay incident and itai-itai-byo: water pollution
- Chronic bronchitis
- Respiratory cancer; lung cancer

Minamata Disease

- Minamata Disease is a toxic nervous disease caused by eating seafood contaminated with methyl mercury (MeHg) compounds discharged from the Minamata plant (in Kumamoto Prefecture) of Shin-Nippon Chisso Hiryo K.K. Which was manufacturing acetaldehyde using mercuric sulfate as a catalyst.
- Its major symptoms include sensory disturbance, ataxia, concentric constriction of the visual field, and auditory disorders. If a mother is highly exposed to methylmercury during pregnancy, her baby might suffer from fetal Minamata Disease, which sometimes shows different symptoms from the adult one.
- The history of Minamata Disease, from its official acknowledgement in 1956 to the final identification of its cause in the form of a consensus opinion of the government issued in 1968 is described next along with the background of these events.



Chisso Minamata Factory (1959)
Photograph: Minamata Disease Municipal Museum

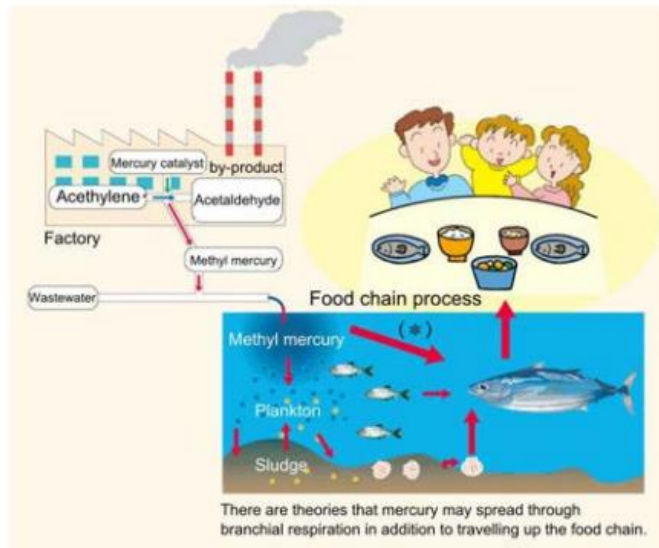


Fig. 2 The Route of Methyl Mercury

Source: Ministry of the Environment Japan



**Fig. 6 Installation of Dividing Nets
(As of October 1, 1977)**

Source: Ministry of the Environment Japan

Itai-Itai-byo (Cd Contamination)

- “itai-itai-byo” or “ouch-ouch disease” occurred along the Jintsu River in northern Japan in the mid-1950s.
- Victims of this disorder suffered severe bone pains. Eventually, the victims’ softened bones disintegrated under even slight pressure, leading to multiple fractures. Death also occurred, and this was attributed to kidney failure that developed during the course of the disease.
- The disease was caused mainly by ingestion of Cd-contaminated rice produced from rice paddies that had received irrigation water contaminated with high levels of the metal.