

4. Environmental Pollution and Their Management: An Synopsis on Current Practices, Progresses, and New Perceptions in Environmental Pollution Treatment

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Abstract:

Today all over the world there is a great concern and worry as to what will become of the earth considering the essential effect of the ever increasing Environmental pollution that has undesirably distorted the Ecosystem? Urbanization and industrialization along with economic development have led to increase in energy consumption and waste discharges. Most Countries of the world that previously had wonderful and untouched nature. Now days this nature is polluted by Motor ways, Sky crappers, Nuclear power stations and Smoking Industrial Plants etc., Environmental pollution created the need to search for new environmentally friendly, low-cost, and more efficient environmental clean-up techniques for its removal or reduction. Microbes are suitable candidates to recover and decontaminate different environments from soluble metal ions, either via reduction or precipitation to generate insoluble, non-toxic derivatives. Biodegradation, Bioremediation, Bioleaching, and Bio augmentation are branch of environmental biotechnology, is nowadays deliberated as one of the most auspicious alternatives. These technology uses the astonishing ability of microorganisms or plants to accumulate, detoxify, degrade, or remove environmental contaminants. Biological treatment affords the transformation or even removal of organic and inorganic pollutants, even when they are present at low concentration. Incessant efforts are still made to comprehend the mechanisms by which microorganisms and plants remove or transform environmental pollutants. To remediate polluted sites, biological processes have many advantages from economic, environmental, and practical aspects. Adsorption and biodegradation of organic contaminants and the immobilization, and/or transformation of metal (loids) are the main remediation processes that can be mediated by the action of several microorganisms especially those extremophiles surviving in antagonistic environments with high concentrations of pollutants. Thus, the perseverance of this special issue is to explore different visions on various Environmental pollutants and their management, while addressing recent advances and new ideas in the perspective of efficient process scale-up in view of application at larger scales.

Keywords: Environmental Pollution, Biodegradation, Microorganisms.

4.1 Introduction:

The problem of pollution have become very serious in recent years. The people of the developed nations try to solve this problem. But in India we have not paid sufficient attention to it. Our future generation suffer from the harmful effect of the pollution if we do not tackle the problem now.

There are different form of pollution Air, water, soil, and noise etc., Pollution of all these kinds' results from the greed of men of getting more and more money. Trees are cut down in a large scale.

A Number of industries have been set up in almost every region of the country. So unbalanced industrial growth is the main cause of all type of pollution. All the industrial waste materials are dumped on the environment. [Saving Earth, Encyclopedia Britanica, 2021].

4.2 Types of Pollutants:

- Biodegradable Pollutants- Degrades or decomposes rapidly by natural processes.
- Non –Biodegradable Pollutants-Do not decompose or decompose very slowly

4.3 Air Pollution:

“Air pollution refers to the release of pollutants into the air that are detrimental to human health and the planet as a whole.”

4.3.1 Common Air Pollutants:

The U.S. Clean Air Act requires EPA to set National Ambient Air Quality Standards for six common air pollutants. They are particulate matter (often referred to as particle pollution), ground-level ozone, carbon monoxide, sulfur dioxide, nitrogen dioxide, and lead.

These pollutants can harm human health, harm the environment, and cause property damage. Of the six pollutants, particle pollution and ground-level ozone are the most widespread health threats.

EPA calls these six pollutants "criteria" air pollutants because it regulates them by developing limits that are based on human health and/or environmental criteria.

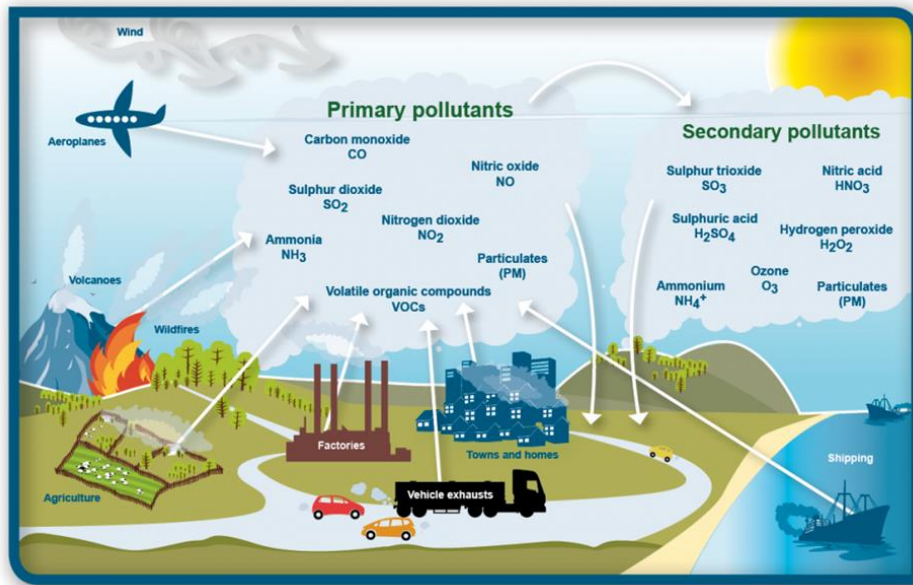


Figure 4.1: The Ultimate Guide to Air Quality Data (2022)

4.3.2 Hazardous Air Pollutants:

Toxic air pollutants, also known as hazardous air pollutants (HAPs), are those pollutants that are known or suspected to cause cancer, other serious health effects (including reproductive effects or birth defects), or adverse environmental effects. EPA is working with state, local, and tribal governments to reduce air emissions of HAPs to the environment. Examples of HAPs include benzene, which is found in gasoline; perchloroethylene, which is emitted from some dry cleaning facilities; and methylene chloride, which is used as a solvent and paint stripper by a number of industries. Other examples are dioxins, asbestos, toluene, and metals such as cadmium, mercury, chromium, and lead compounds.

4.3.3 Types of Air Pollutants:

There are two types of air pollutants:

a. Primary Pollutants:

- The pollutants that directly cause air pollution are known as primary pollutants.
- The major primary pollutants are Oxides of Sulphur, Oxides of Nitrogen, Oxides of Carbon,
- Particulate Matter, Methane, Ammonia, Chlorofluorocarbons, Toxic metals etc.

Examples of primary Air pollutants:

- Car exhaust, smokestacks (CO, SO₂, NO)

- Particulate material (soot, ash)
- Toxic metals (lead, mercury)
- Volatile organic compounds (VOCs) (methane, propane, CFCs, etc.)

b. Secondary Pollutants:

The pollutants formed by the intermingling and reaction of primary pollutants are known as secondary pollutants. Most important secondary level Air Pollutants are Ground Level Ozone, Smog and POPs (Persistent Organic Pollutants) [[www anits.edu.in](http://www.anits.edu.in)]

4.3.4 Sources of Air Pollution:

Sources of air pollution are of two types.

- a. Natural sources: Natural sources of pollution are those that are caused due to natural phenomena. Ex: Volcanic eruptions, Forest fires, Biological decay, Pollen grains, Marshes, Radioactive materials.
- b. Artificial sources: Artificial sources are those which are created by man. Ex: Thermal power plants, Vehicular emissions, Fossil fuel burning, agricultural activities etc.

4.3.5 Causes of Air Pollution:

Following are the important causes of air pollution:

- Burning of Fossil Fuel, Automobiles, Agricultural Activities, Factories and Industries, Mining Activities and Domestic Resources.

4.3.6 Effects of Air Pollution:

The hazardous effects of air pollution on the environment include:

- Carbon dioxide cause global warming because it is a potent greenhouse gas.
- Ozone depletion
- Carbon monoxide is a poisonous gas even at low concentration.
- Acid Rain: Oxides of Sulphur and nitrogen mix with rainwater to create acid rain.
- Respiratory and Heart problem.

4.3.7 Control of Air Pollution:

Following are the measures to control air pollution:

- Avoid using vehicle
- Energy Conservation
- Use of Clean energy Resources- solar, wind and geothermal energies reduce air pollution at larger level.

Other air pollution control measures include:

- By minimizing and reducing the use of fire and fire products.
- Since industrial emissions are one of the major causes of air pollution, the pollutants can be controlled or treated at the source itself to reduce its effects. For example, if the reactions of a certain raw material yield a pollutant, then the raw materials can be substituted with other less polluting materials.
- Fuel substitution is another way of controlling air pollution. In many parts of India, petrol and diesel are being replaced by CNG – Compressed Natural Gas fuel vehicles. These are mostly adopted by vehicles that aren't fully operating with ideal emission engines.
- Although there are many practices in India, which focus on repairing the quality of air, most of them are either forgotten or not being enforced properly. There are still a lot of vehicles on roads which haven't been tested for vehicle emissions.
- Another way of controlling air pollution caused by industries is to modify and maintain existing pieces of equipment so that the emission of pollutants is minimised.
- Sometimes controlling pollutants at the source is not possible. In that case, we can have process control equipment to control the pollution.
- A very effective way of controlling air pollution is by diluting the air pollutants.
- Reducing the ill effects of air pollution is tree plantation. Planting trees in areas of high pollution levels will be extremely effective.

Techniques and Tools used in control of Air Pollution:

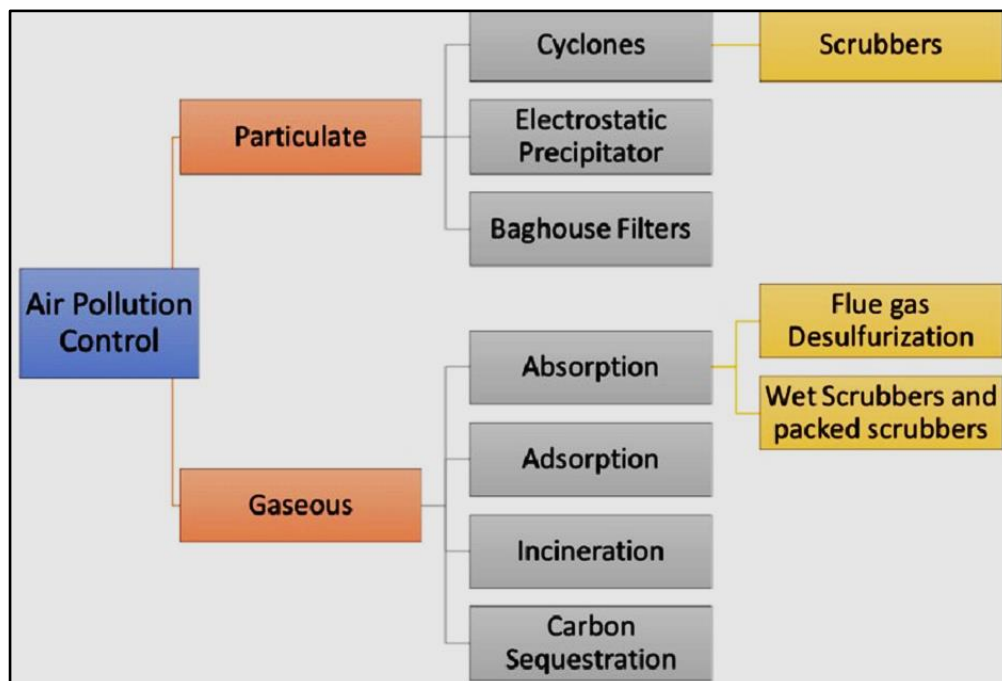


Figure 16.2: Earth and Environmental Science (2020)

4.4 Water Pollution:

Water pollution is caused when water bodies such as rivers, lakes, oceans, groundwater and aquifers get contaminated with industrial and agricultural effluents. When water gets polluted, it adversely affects all lifeforms that directly or indirectly depend on this source. The effects of water contamination can be felt for years to come.

4.4.1 Sources of Water Pollution:

The key causatives of water pollution in India are:

- Urbanization.
- Deforestation.
- Industrial effluents.
- Social and Religious Practices.
- Use of Detergents and Fertilizers.
- Agricultural run-offs- Use of insecticides and pesticides.

Nearly 6 billion kilograms of garbage is dumped every year in the oceans. Apart from industrial effluents and untreated sewage, other forms of unwanted materials are dumped into various water bodies.

4.4.2 Effects of Water Pollution:

The effect of water pollution depends upon the type of pollutants and its concentration. Also, the location of water bodies is an important factor to determine the levels of pollution.

- Water bodies in the vicinity of urban areas are extremely polluted. This is the result of dumping garbage and toxic chemicals by industrial and commercial establishments.
- Water pollution drastically affects aquatic life. Dioxin is a chemical that causes a lot of problems from reproduction to uncontrolled cell growth or cancer. This chemical is bio accumulated in fish, chicken and meat.
- The effect of water pollution can have a huge impact on the food chain. Cadmium and lead are some toxic substances, these pollutants upon entering the food chain through animals (fish when consumed by animals, humans) can continue to disrupt at higher levels.
- Humans are affected by pollution and can contract diseases such as hepatitis through faecal matter in water sources. Poor drinking water treatment and unfit water can always cause an outbreak of infectious diseases such as cholera, etc.,

4.4.3 Minemata Disease:

In 1932, a factory in Minamata City, Japan began dumping its industrial effluent – Methylmercury, into the surrounding bay and the sea. Methylmercury is incredibly toxic to humans and animals alike, causing a wide range of neurological disorders.

4.4.3 Pollution of Ganges:

Some rivers, lakes, and groundwater are rendered unfit for usage. In India, the River Ganges is the sixth most polluted river in the world. This is unsurprising as hundreds of industries nearby release their effluents into the river. Furthermore, religious activities such as burials and cremations near the shore contribute towards pollution.

4.4.4 Control of Water Pollution:

Water pollution, to a larger extent, can be controlled by a variety of methods. Rather than releasing sewage waste into water bodies, it is better to treat them before discharge.

- a. Stage 1: Screening
- b. Stage 2: Primary treatment
- c. Stage 3: Secondary treatment
- d. Stage 4: Final treatment

Preliminary treatment	Physical-Sedimentation, Screening, Aeration, Particle filtration Floatation and skimming, Degasification, Equalization
Primary treatment	Chemical-Chlorination, Ozonation, Neutralization, Coagulation, Adsorption, Ion exchange
Secondary treatment	Biological-Aerobic treatment- Activated sludge, Trickling filter, Oxidation pond, Lagoons. Anaerobic treatment-Anaerobic digestion, Septic tank, Lagoons
Tertiary treatment	Final treatment-Disinfection, Oxidation, Chemical dosing for water quality correction, chemically aided settling, Filtration, Softening, Activated carbon treatment, Ion exchange, Membrane processes.

A very special plant, the Water Hyacinth can absorb dissolved toxic chemicals such as cadmium and other such elements. Establishing these in regions prone to such kinds of pollutants will reduce the adverse effects to a large extent.

The Water (Prevention and Control of Pollution) Act was enacted in 1974 to provide for the prevention and control of water pollution, and for the maintaining or restoring of wholesomeness of water in the country.

The Act was amended in 1988. The Water (Prevention and Control of Pollution) Cess Act was enacted in 1977, to provide for the levy and collection of a process on water consumed by persons operating and carrying on certain types of industrial activities.

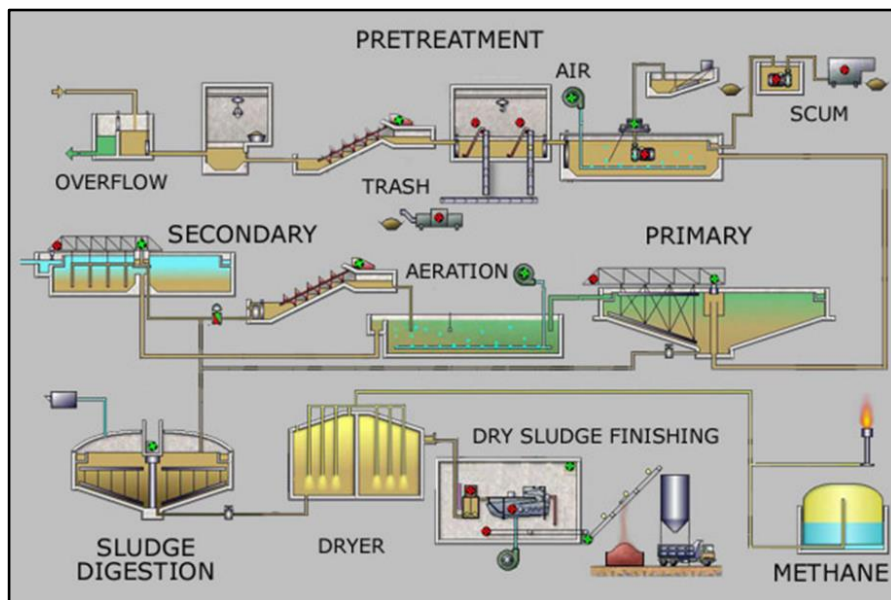


Figure 4.3: Water Treatment-Environmental Biology

4.5 Land Pollution:

The basic definition of land pollution is the destruction and contamination of the land through the direct and indirect actions of humans. The pollution leads the changes in the land, such as soil erosion.

4.5.1 Causes of Land Pollution:

- Deforestation and soil erosion, Agricultural chemicals, Industrialization, Mining, Landfill, Human sewage, Construction activities, Nuclear waste.

4.5.2 Effects of Land Pollution:

- Ground water poisoning, Water nutrient enrichment, Soil pollution, Air pollution, soil infertility etc.,

4.5.3 Control of Land pollution:

- Proper waste disposal that focuses on treating waste and disposing it in the safest manner possible.
- Reusing materials to reduce the need for harvesting of resources. Products that are not reusable can likely be recycled.
- Reducing the usage of non-biodegradable materials, such as plastic shopping bags. The simple act of switching to a reusable cloth bag for groceries can help cut down on the need for non-biodegradable materials.

Organic gardening can reduce the usage of pesticides and insecticides. Non-gardeners can help by buying organic food.

Control of Land Pollution:

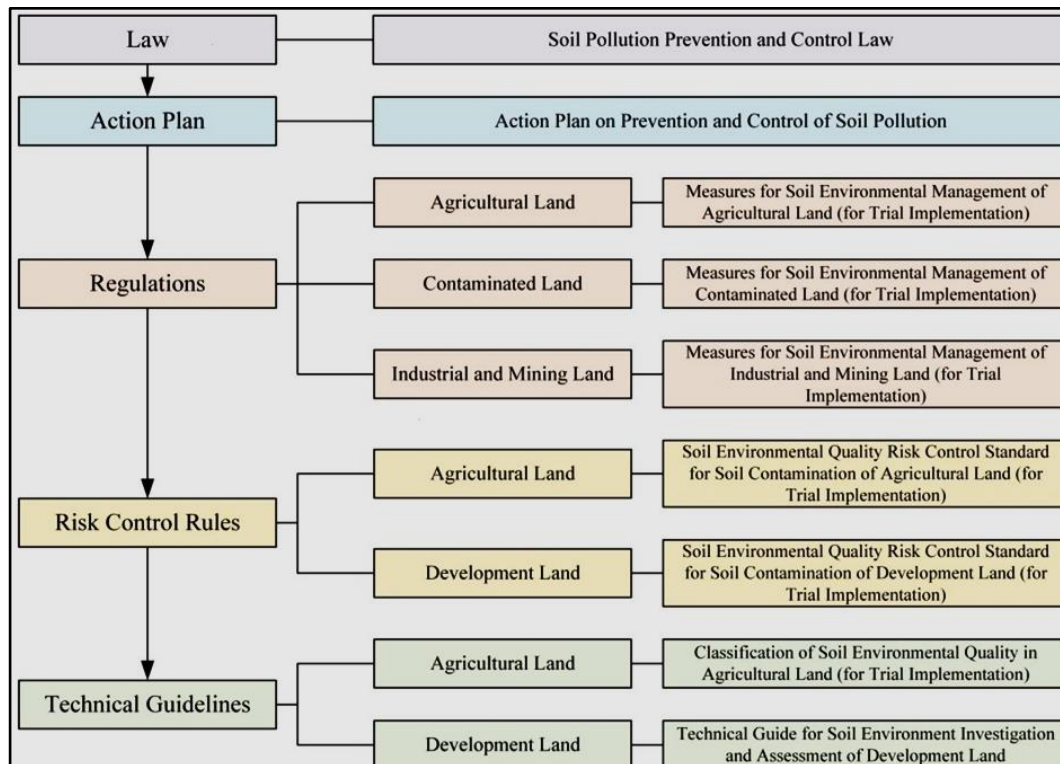


Figure 4.4: Sustainability, Soil Pollution Management in China (2019)

4.6 Noise Pollution:

Noise is the unpleasant and undesirable sound which leads to discomfort in human beings.

The intensity of sound is measured in decibels (dB). The faintest sound that the human ear can hear is 1 Db.

4.6.1 Causes of Noise pollution:

- Unnecessary usage of horns
- Using loudspeakers either for religious functions or for political purposes
- Unnecessary usage of fireworks
- Industrial noise
- Construction noise
- Noise from transportation such as railway and aircraft

4.6.2 Effects of Noise pollution:

- Hypertension, Hearing loss, Sleeping disorder, cardiovascular issues.

Control measures:

- Honking in public places like teaching institutes, hospitals, etc. should be banned.
- In commercial, hospital, and industrial buildings, adequate soundproof systems should be installed.
- Musical instruments' sound should be controlled to desirable limits.
- Dense tree cover is useful in noise pollution prevention.
- Explosives should not be used in forest, mountainous and mining areas.
- Require Legislative measures.

4.7 Thermal Pollution:

Thermal pollution is the degradation of water quality by any process that changes ambient water temperature.

4.7.1 Sources:

Nuclear Power Plant, Coal-fired power Plant, Industrial Effluents, Domestic Sewage, Hydro-electric power, Thermal Power Plant.

4.7.2 Effects:

The harmful effects of the thermal pollution are discussed below:

- **Reduction in dissolved Oxygen:**

The pollutant from various industrial plants are heated decreases the concentration of oxygen with an increase in the temperature of water.

- **Change in water properties:**

The decrease in density, viscosity and solubility of gases in water increases the settling speed of suspended particles which seriously affect the food supplies of aquatic organism.

- **Increase in toxicity:**

The concentrated pollutant causes the rise in the temperature of water which increases the toxicity of the poison present in water.

The toxicity in water will increase the mortality rate in marine life.

- **Disruption of Biological activities:**

Temperature changes disrupt the entire marine ecosystem because changes in temperature causes change in physiology, metabolism and biological process like respiration rate, digestion, excretion and development of an aquatic organism

- **Damage of biotic organism:**

Aquatic organisms like juvenile fish, plankton, fish, eggs, larva, algae and protozoa which pass through screens and condenser cooling system are extremely sensitive to abrupt temperature changes.

- **Control of Thermal pollution:**

Cooling ponds or reservoirs, Cooling Towers, Artificial Lake are the simplest method of controlling thermal discharges.

4.8 Current Trends:

Environmental Pollution is a Major hazard fronting the World Today and there is Increase Awareness of the fact that a Clean Environment is Necessary for Smooth Eloquentes on Society and the Environment not only in Term of welfares but also in Risks and Hazards.

The document titled “Recent Developments for Remediating Acidic Mine Waters using Sulfidogenic Bacteria” highlights the efficiency and drawbacks of the types of treatments for metal recovery and points to future research for enhancing the use of novel acidophilic and acid-tolerant sulfidogenic microorganisms in effluent treatment process [Maria Gavrilscuet al., 2017].

The application of biological tools in solving environmental problems has a long history and is broad, covering many underpinning and allied technological areas. [Jin li et al.,2021]. Recently novel techniques (Biodegradation, Bioremediation, Bioleaching, Bio augmentation etc.,) are being used for removal of toxic pollutants present in the environment.

4.8.1 Future Prospects and Outlook:

Emerging pollutants or micro pollutants are contaminants present at very low concentrations ($\mu\text{g/L}$) but with very high environmental impact. Environmental pollutants are chemicals that have ended up in the environment as a result of human activities and that are hazardous to health. Chemicals, such as flame retardants, surfactants, chloro alkanes, pesticides, or drugs (and their metabolic derivatives), are included in this family of pollutants. Most of these compounds are demonstrated to be very dangerous for living organisms (because of their toxic character, endocrine disruptor properties, etc.). Biological treatment is one of the important method for controlling different types of pollutants in the atmosphere. Now a days genetically modified microorganism are used for treating Organic and Inorganic pollutants.

4.9 Conclusion:

Environmental awareness has opened up opportunities for the development of international policy-making and for the development of environmentally friendly industrial processes and products [Richard Welford, 2003]. Various types of membrane are being developed and patented for removal of various pollutants present in the environment. Electrolysis and fluidized bio reactors have been developed for treating different types of pollutants [P.K.SEN, 1996].

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