UNIT 5 AIR AND WATER POLLUTION

Structure

5.1 INTRODUCTION

Pollution is the fusion of contaminants into the environment that causes instability, harm or discomfort to the system. It is the undesirable change in physical, chemical and biological characteristics of our air, land and water. The pollution may be natural or manmade. Natural pollution is due to causes like dust, storm, forest fires, volcanic eruptions, water erosion, landslides, pollen grains, ultraviolet radiation etc. and man-made pollution is caused by human activities like industries, automobiles, sewage, runoff from crop fields, pesticides, noise, etc.

Pollutants are the constituents or factors, which harm the natural quality of any component of the environment. For example, smoke from industries and automobiles, chemicals from factories, radioactive substances from nuclear plants, sewage from houses and discarded household articles are common pollutants. According to the form in which they are present after release into the environment, the pollutants may be classified into primary and secondary

pollutants. Primary pollutants are present in the form in which they are added to the environment and they directly cause air pollution. Secondary pollutants are formed by interaction among the primary pollutants. For example, peroxyacetyl nitrate (PAN) is formed by the interaction of nitrogen oxides and hydrocarbons. According to their existence in nature, the pollutants may be classified into quantitative and qualitative pollutants. Quantitative pollutants occur in nature and become pollutants when their concentration reaches beyond a threshold level. e.g., carbon dioxide, and nitrogen oxide. Qualitative pollutants do not occur in nature and are man-made. e.g., fungicides, herbicides, DDT etc. According to their nature of decomposition, the pollutants may be classified into biodegradable and non-biodegradable pollutants. Biodegradable pollutants are degraded by microbial action. e.g., sewage. Non-biodegradable pollutants are not decomposed by microbial action. e.g., plastics, glass, DDT, salts of heavy metals, radioactive substances etc. According to the origin, the pollutants may be classified into natural and anthropogenic pollutants. Natural pollutants occur in nature. e.g., dust, storm, forest fires, volcanic eruptions, water erosion, landslides, pollen grains, and ultraviolet radiations. Anthropogenic pollutants occur due to human activities. e.g., industries, automobiles, sewage, runoff from crop fields, pesticides, noise etc. This unit will give you an overview of the Water (Prevention and Control of Pollution) Act, 1974 and the Air (Prevention and Control of Pollution) Act, 1981. Through this unit, we would be discussing the National Water Quality Monitoring Programme (NWMP) and National Air Quality Monitoring Programme (NWMP). Further, we will be discussing the air and water quality standards.

5.2 Objectives

After studying this unit, you should be able to:

- explain the features of the Water (Prevention and Control of Pollution) Act, 1974;
- explain the features of the Air (Prevention and Control of Pollution) Act, 1981;
- explain the National Water Quality Monitoring Programme (NWMP) and National Air Quality Monitoring Programme (NWMP);
- explain the functions of the Central Pollution Control Board and State Pollution Control Board; and
- describe the air and water quality standards.

5.3 AIR POLLUTION

Air pollution is defined as the condition in which the ambient atmosphere contains harmful materials in concentrations, which are noxious to man and his surrounding environment. It may be described as contamination of the atmosphere by pollutants, that can endanger human health and the welfare of plants and animals. Although some pollutants are released by natural

resources like volcanic eruptions and forest fires. The effect of this pollution is very small when compared to that caused by emissions from industrial sources, power and heat generation, waste disposal and the operation of internal combustion engines. Fuel combustion is the largest contributor to air pollution.

Various human activities, particularly industrial and transport activity have led to the emission of a variety of pollutants into the atmosphere. The adverse effect of air pollution appears in the form of poor quality of air, acidic precipitation and deposition, and health hazards.

5.3.1 Causes of Air Pollution

The causes of pollution are uncontrolled growth in human population and rapid industrialization, urbanization, uncontrolled exploitation of nature, forest fires, radioactivity, volcanic eruptions and strong winds, etc. The main sources of air pollution are emissions from industrial stacks, vehicles and power plants, burning of fuel in the domestic sector, construction and demolition, and burning of agricultural residues during the harvesting season.

Industrial Emissions

The industries have been categorized into three categories namely Red, Orange and Green by the pollution control board, according to their pollution potential. The Red category industries require environmental clearance from the Competent State Authority of the Department of Environment. Together these contribute to suspended particulates, oxides of nitrogen and sulfur, organic compounds and other pollutants in the air.

Table 5.1 Types of Air Polluting Industries

Name of Industry	Major Air Pollutants
Rice, Sugar, Food Products	Particulates, SO_2, NO_x
Beverages	Particulates, Odour
Cotton/Woolen/Synthetic/Textile/Dying	Particulates
Paper Products & Printing	Particulates, Mercaptans
Leather & Leather Products	Particulates, Odour
Rubber & Plastic Products	Particulates, Odour, VOCs
Chemical Products	Cl_2, HCl, Acid mist, Acid fumes, Hydrocarbons
Non-Metallic Mineral Products	Particulates
Metal Products	Particulates, CO, SO_2, Acid Mist
Transport Equipments & Parts	Particulates

Brick Kilns	Particulates, SO_2, CO
Pharmaceuticals	Odour, Particulates
Rolling, Forging & Galvanizing units	Particulates, SO_2, NO_x
Fertilizer, Vanaspati, Thermal, Cement	Odour, Particulates

Vehicular Emissions

Vehicular emissions are of particular concern since they have the maximum impact on the human population and other biotic components. The gases emitted from vehicles such as jeeps, trucks, cars, buses, etc. pollute the environment. These are the major sources of greenhouse gases and also result in diseases. The major pollutants released as vehicle emissions are carbon monoxide, nitrogen oxides, photochemical oxidants, air toxics namely benzene, aldehydes, 1-3 butadiene, lead, particulate matter, hydrocarbon, oxides of sulphur and polycyclic aromatic hydrocarbons.

While the predominant pollutants in petrol/gasoline-driven vehicles are hydrocarbons and carbon monoxide, the predominant pollutants from diesel-based vehicles are oxides of nitrogen and particulates. As per studies by Central Pollution Control Board, vehicular emissions are responsible for most hydrocarbons (90-95%) and carbon monoxide (70-80%) emissions.

Burning of Garbage and other Biomass

The garbage burning increases during the winter season as the general public tend to burn the waste for heating purposes. The smoke also impairs visibility which can cause road accidents. Further, due to high per capita income and the adoption of the modern lifestyle, the use of air conditioners and refrigerators is increasing rapidly. This contributes to air pollution by ozone-depleting substances.

Road Dust Emissions

Road dust emission is one of the major sources of air pollution. The pollution from road dust can be controlled with carpeting of roads, maintenance of potholes-free roads for free-flow of traffic, water sprinklers, mechanical sweeping of roads, creation of green buffers along the roadsides and water fountains at major traffic intersections, etc.

Construction & Demolition Activities

Infrastructure development has been growing with many major construction projects like housing, industrial units/commercial units etc. which contribute to pollution.

Emissions from Diesel Generator Sets

DG sets are one of the major sources of air pollution as well as noise pollution. These emit oxides of Nitrogen, Carbon monoxide and particulate

matter. These emissions are directly released into the atmosphere and tend to substantially reduce the quality of air. The emissions from diesel generators make it difficult for people living around to breathe. Standards have been laid by the government in terms of noise levels, emission levels and other guidelines for manufacturers and buyers.

Burning of Fossil Fuels

The combustion of fossil fuels emits a large amount of sulphur dioxide. Carbon monoxide released by incomplete combustion of fossil fuels also results in air pollution.

Agricultural Activities

Ammonia is one of the most hazardous gases emitted during agricultural activities. The insecticides, pesticides and fertilizers emit harmful chemicals into the atmosphere and contaminate it.

Factories and Industries

Factories and industries are the main sources of carbon monoxide, organic compounds, hydrocarbons and chemicals. These are released into the air, degrading its quality.

Mining Activities

In the mining process, the minerals below the earth are extracted using large pieces of equipment. The dust and chemicals released during the process not only pollute the air but also deteriorate the health of the workers and people living in the nearby areas.

Domestic Sources

The household cleaning products and paints contain toxic chemicals that are released into the air. The smell from the newly painted walls is the smell of the chemicals present in the paints. It not only pollutes the air but also affects breathing.

5.3.2 Effects of Air Pollution

Atmospheric pollution has serious health implications. When these pollutants occur in higher concentrations in the atmosphere, they result in a high general morality rate in the concerned region. The hazardous effects of air pollution on the environment include:

Diseases

Air pollution has resulted in several respiratory disorders and heart diseases among humans. The cases of lung cancer have increased in the last few decades. People living near polluted areas are more prone to pneumonia and asthma.

Global Warming

Due to the emission of greenhouse gases, there is an imbalance in the gaseous composition of the air. This has led to an increase in the temperature of the earth. This increase in the earth's temperature is known as global warming. This has resulted in the melting of glaciers and an increase in sea levels.

Acid Rain

The burning of fossil fuels releases harmful gases such as nitrogen oxides and sulphur oxides in the air. The water droplets combine with these pollutants, become acidic and fall as acid rain which damages human, animal and plant life.

Ozone Layer Depletion

The release of chlorofluorocarbons, halons, and hydro chlorofluorocarbons in the atmosphere is the major cause of the depletion of the ozone layer. The depleting ozone layer does not prevent the harmful ultraviolet rays coming from the sun and causes skin diseases and eye problems among individuals.

Effect on Animals

The air pollutants suspend in the water bodies affect aquatic life. Pollution also forces the animals to leave their habitat and shift to a new place. This led to the extinction of a large number of animal species.

Smog

It is air pollution that is a result of the interaction of sunlight with certain chemicals in the atmosphere. One of the primary components of photochemical smog is ozone. The ozone in the stratosphere protects the earth from harmful UV radiation and the ozone on the ground is hazardous to human health.

Ground-level ozone is formed when vehicle emissions containing nitrogen oxides (primarily from vehicle exhaust) and volatile organic compounds (from paints, solvents, printing inks, petroleum products, vehicles, etc.) interact in the presence of sunlight.

Smog refers to hazy air that causes difficult breathing conditions. It is a combination of various gases with water vapour and dust. Its occurrences are often linked to heavy traffic, high temperatures, and calm winds. During the winter, wind speeds are low and cause the smoke and fog to stagnate near the ground therefore the pollution levels increase near ground level. Ground-level ozone is formed through a complex reaction involving hydrocarbons, nitrogen oxides, and sunlight. It is formed when pollutants released from gasoline, diesel-powered vehicles and oil-based solvents react with heat and sunlight. The effects of smog are:

- It hampers visibility and harms the environment.
- Causes the respiratory problems
- Problems relating to bronchial diseases.
- Heavy smog greatly decreases ultraviolet radiation. It also results in a decrease in natural vitamin D production leading to a rise in the cases of rickets.

5.3.3 Air Pollution Control Measures

The following are the measures for controlling air pollution:

Minimize the Use of Vehicles

People should avoid using vehicles for shorter distances. Rather, they should prefer public modes of transport to travel from one place to another. This not only prevents pollution but also conserves energy.

Energy Conservation

A large number of fossil fuels are burnt to generate electricity. Switch off the electrical appliances when not in use to save the environment at the individual level. The use of energy-efficient devices such as CFLs also controls pollution to a greater level.

Use of Clean Energy Resources

The use of solar, wind and geothermal energies reduces air pollution. It is an important step towards a cleaner environment.

Other air pollution control measures include:

1. By minimizing and reducing the use of fire and fire products.
2. 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 their 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.
3. 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 fueled vehicles.
4. The industries can modify and maintain existing equipment so that the emission of pollutants is minimized.
5. In some cases, controlling pollutants at the source is not possible. In that case, the process control equipment to control the pollution can be used.
6. A very effective way of controlling air pollution is by diluting the air pollutants.
7. The plantation of trees reduces the large number of pollutants in the air.

Control of Industrial Emissions

- Conversion of the industry to CNG/PNG from coal, furnace oil & pet coke.
- Conversion of natural draft brick kilns to induced draft.
- Demonstration of cost-effective energy efficient & cleaner technologies.
- Capacity building on better fuel preparation & firing practices.
- Action against non-complying industrial units.

Control of Vehicular Emissions

- Extensive drive against polluting vehicles.
- Remote sensor-based PUC system.
- Promotion of E- vehicles.
- Promotion of CNG & biofuels.
- Introduce intelligent traffic systems.
- Check fuel adulteration.

Burning of Garbage, Agriculture & other Biomass

- Construction of composting pits in different parks for collection of horticulture waste to avoid burning of biomass in the city.
- Burning of municipal solid wastes stands prohibited.
- Awareness among MC staff/Safai Sewak should be created.
- Create awareness among farmers regarding the health effects of residue burning.
- Identification of several fire incidents during harvesting season.
- Demonstration & dissemination of technology for in-situ and ex-situ utilization of agriculture residue.

Control of Road Dust Emissions

- Maintain potholes-free roads for free flow of traffic.
- Mechanical sweeping and water sprinkling of roads.
- Creation of green buffers along the roadsides.
- Greening of parks, open areas, community places, schools and housing societies.
- Water fountains at major traffic intersections.

Control of Construction & Demolition Activity

- Enforcement of Construction & Demolition Rules.
- Ensure carriage of construction material in closed/covered vehicles.

Control of Emissions from other measures

- Dissemination of information on Air Quality Index.

- Monitoring of DG sets and action against the violation.

Mitigation Measures for Controlling Air Pollution

- Conserve energy - at home, at work, everywhere.
- Look for the 'energy star' label when buying a home or office equipment.
- Carpool, use public transportation, bike, or walk whenever possible.
- Use of clean fuels like CNG and regular maintenance and checkup of vehicles.
- Mulch or compost leaves and yard waste.
- Avoid burning leaves, trash, and other materials.
- Install energy-efficient equipment in the industry.

Air Quality Related Standards

- National Ambient Air Quality Standards
- Vehicular Exhaust
- Bio-Medical Incineration
- Auto Fuel Quality
- Common Hazardous Waste Incinerators
- Generator Set Notifications & Guidelines
- Industry Specific Standards: Effluent/Emission & General Standards

5.4 WATER POLLUTION

Water is used for drinking, washing, cooking and several other human activities. Two-thirds of the earth's surface is water, but still, we face water scarcity problems. With the ever-increasing population and pollution, the water demand has increased and the quantity of usable water has decreased. Water pollution is the contamination of natural water bodies (e.g., lakes, rivers, sea, ocean, aquifers, groundwater etc.). This form of environmental degradation occurs when pollutants are directly or indirectly added to the water bodies without proper treatment to remove harmful compounds.

The substances which are responsible for causing water pollution are called water pollutants. One of the most severe pollutants is the disease-causing microorganisms called pathogens. Pathogens are mostly bacteria, viruses, and protozoa. Although bacteria are considered harmless if not beneficial, there are a few pathogenic bacteria as well which enter the water bodies through sewers and sanitation systems. Water-borne pathogens cause several diseases such as diarrhoea, gastrointestinal illness, etc. Organic water pollutants include food waste, detergents, leaves, grass, etc. They originate from domestic sewage, discharged from food processing factories and farm wastes which reach the water sources through runoff and pollute them. It is a fact that bacteria decompose complex organic matter into simple organic matter. They consume oxygen which is dissolved in water. This adversely affects

aquatic life. Chemical pollutants include heavy metals such as mercury, lead, cadmium, etc., solvents from industries, pesticide run-offs, oil spills through ships, etc. They are poisonous to aquatic life forms and cause infertility and death. The metal wastes are dangerous to humans as well when they get absorbed in our bodies. They can damage the nervous system, kidneys, etc.

Based on source, water pollutants can be classified as follows:

1. Domestic wastes and sewage
2. Surface run-off
3. Industrial effluents
4. Thermal pollution
5. Marine pollution

1. Domestic wastes and sewage

Domestic waste and sewage is the biggest polluter of surface and groundwater sources in India. This is due to the gap between the amount of sewage generation and the facilities to dispose of it.

2. Surface run-off

The pollutants present on the surface of land, fertilizers, and pesticides added to the soils are washed down into natural water courses during rains. The flow of fertilizer-rich water into streams and lakes gives rise to eutrophication. Excess pesticides in water also adversely affect aquatic life.

3. Industrial effluents

Effluents generated from industries which are directly disposed of into the water streams without any treatment are a very important cause of water pollution. Several types of liquid effluents having toxic chemicals, acids and bases, etc. are also added into the rivers which kill fish and other aquatic life besides being toxic to human beings.

4. Thermal pollution

Temperature above the normal range is called thermal pollution or calefaction. Thermal pollution occurs as a result of the entry of heated water from industries and power generation plants. The immediate effect of an increase in temperature is a decrease in oxygen concentration. A temperature increase of 10°C will double the rate of many chemical reactions and so the decay of the organic matter, rusting of iron, and the solution rate of salts are also accelerated by calefaction. All organisms have a range of temperature tolerance beyond which they die.

5. Marine pollution

Marine pollution is the pollution of the water of oceans and seas through various sources. Industrial wastes, heavy metals, insecticides, urban and rural

sewage, farm and forest runoffs i.e., wastes of all kinds including those which are not biodegradable and even radioactive wastes are dumped into the sea. In marine water, the most serious pollutant is oil, particularly when afloat at sea. Due to oil spills from oil container vessels into the sea, a large number of useful aquatic life, as well as birds, are killed. Point sources of marine pollution are domestic sewage and industrial effluents. Non-point sources draining to coastal waters include surface run-off from agricultural areas, washout of agrochemicals, and transport of sediments due to coastal erosion.

5.4.1 Sources of Water Pollution

Direct sources of water pollution include effluent outfalls from factories, refineries, industries etc. that emit fluids of varying quality directly into water bodies. Indirect sources of water pollution include contaminants that enter the water supply from soils/groundwater systems and the atmosphere via rainwater. Soils and groundwater contain the residue of human agricultural practices (fertilizers, pesticides, etc.) and improperly disposed of industrial wastes. Atmospheric contaminants are also derived from human practices (such as gaseous emissions from automobiles, factories and even bakeries). If pollution comes from a single location, such as a discharge pipe attached to a factory, it is known as point-source pollution. If pollution comes from one single source but from many different scattered sources. This is called nonpoint-source pollution.

5.4.2 Effects of Water Pollution

Water pollution is a very serious problem as it affects all spheres of life of humans, animals, and plants. Water pollution affects human health, ecosystems, flora and fauna and the economy.

Effect on Human Health

People often get exposed to various water-borne diseases such as cholera, diarrhoea, etc. In severe cases, there may be an outbreak of diseases like Hepatitis, tuberculosis, malaria, encephalitis, etc. Industrial chemicals and agricultural pesticides that culminate in the aquatic environments can accumulate in fish that are later eaten by humans. Fish are easily poisoned with metals that are also later consumed by humans. Mercury has been found to interfere with the development of the nervous system.

Effect on Ecosystems

Nutrient pollution, sewage, fertilizer, and agricultural run-off contain organic materials that when discharged into waters, increase the growth of algae, which causes the depletion of oxygen. The excess growth of algae affects the fish and other aquatic organisms by absorbing and reducing their oxygen supply. The aquatic ecosystems are affected very adversely disturbing all the food chains. The natural ecological balance in rivers and lakes gets upset. Water pollution also causes flooding due to the accumulation of solid waste and soil erosion in streams and rivers.

Effects on Flora and Fauna

Animals, both aquatic and terrestrial, are prone to risks generated from the wastewater. Due to the oil spill, the death of many animals has been reported and there was a great loss to aquatic fauna. Animals are also affected by the solid waste thrown into the water bodies, as it harms them in many ways. Groundwater contamination from pesticides causes reproductive damage to wildlife in ecosystems.

Economic Loss

The increasing water pollution will lead to excessive pressure on the existing treatment plants as well as the establishment of new treatment plants. The fishing industry is also affected badly as the fishes die due to the depletion of oxygen. Recreational and tourism sectors are also affected negatively as lots of money needs to be spent to clean up the water from algae blooms etc.

5.4.3 Water Pollution Control Measures

Water pollution in natural water bodies can be identified and quantified based on various parameters, such as dissolved oxygen (DO), biochemical oxygen demand (BOD), coliform organisms, pH etc. Water pollution can be controlled by diluting the water pollutants in a reservoir. *The various methods for the control of water pollution can be summarized as follows:*

1. The sewage pollutants are required to be treated in sewage treatment plants before their discharge into natural water bodies. It changes them into non-toxic substances or makes them less toxic.
2. Water pollution due to organic insecticides and pesticides can be reduced by the use of very specific and less stable chemicals in the manufacture of insecticides/pesticides. Moreover, the use of bio-fertilizers should be promoted.
3. Oxidation ponds can be useful in removing a low level of radioactive waste.
4. Hot water should not be disposed of directly into the river, as it adversely affects the life of aquatic organisms.
5. Domestic and industrial wastewaters should be treated properly in wastewater treatment plants, before being discharged into the natural aquatic systems.
6. Strict implementation of legislation for water treatment should be done. Suitable strict legislation should be enacted to make it obligatory for the industries to treat the wastewater before being discharged into rivers or seas.
7. No solid waste should be dumped into water bodies.
8. Dead bodies of animals/humans should not be floated in water sources.

Bathing, washing of clothes, and idol immersion should be strictly restricted in natural water bodies. Water hyacinth popularly known as Jalkumbhi can purify water polluted by biological and chemical wastes. It can also filter out heavy metals like cadmium, mercury, lead and nickel as well as other toxic substances found in industrial wastewaters.

Polluted water can be reclaimed by proper sewage treatment plants and the same water can be reused in factories and even for irrigation. Such treated water being rich in phosphorus, potassium and nitrogen can make good fertilizer. Thermal pollution can be reduced by employing techniques through cooling ponds, evaporative or wet cooling towers and dry cooling towers.

5.5 THE WATER (PREVENTION AND CONTROL OF POLLUTION) ACT, 1974

After the Stockholm conference on Human Environment in June 1972, it was considered to have uniform law all over the country for the main Environment problems endangering the health and safety of people as well as of our flora and fauna. The Water (Prevention & Control of Pollution) Act, 1974 is the first enactment by the Parliament in this direction. This is also the first specific and comprehensive legislation institutionalizing simultaneously the regulatory agencies for controlling water pollution. The Pollution Control Board at the Centre and in the State came into being in terms of this Act. Water Act is enacted to prevent and control Water Pollution in India.

This Act aims to establish the Central and State Pollution Control Board at the central level and also at the state level for each state and give powers to the members to enable them to carry out the purposes of the Act. The Board is having 17 members to carry out the said purposes. The functions of the Board include the following:

a) To plan a comprehensive programme for the prevention, control or abatement of pollution of streams and wells.

b) To advise the State Government on any matters concerning the prevention, control or abatement of water pollution.

c) To collect and disseminate information relating to water pollution and prevention, control or abatement thereof.

d) To encourage, conduct and participate in investigations and research relating to problems of water pollution, prevention, control or abatement of water pollution.

e) To inspect sewage or trade effluents, works and plants for the treatment of sewage and trade effluents and to review plans, specifications or other data relating to plant set up for the treatment of water, works for the purification thereof and the system for the disposal of sewage or trade effluents or in connection with the grant of any consent as required by this act.

f) Lay down, modify or annul effluent standards for the sewage and trade effluents.

g) To evolve economical and reliable methods of treatment of sewage and trade effluents, having regard to the peculiar conditions of soils, climate and water resources of different regions and more especially the prevailing flow characteristics of water in streams and wells, which render it impossible to attain even the minimum degree of dilution and other such functions.

Section 25/26 of the Water Act says that no industry or operator process or any treatment and disposal system can be established without the previous consent of the State Board and no industry or process can discharge sewage or trade effluent into a stream or well or sewer or land above the standards & without the consent of the Board. Whoever contravenes the provisions of section 25 or section 26 of the Water Act shall be punishable with imprisonment for a term which shall not be less than one and half years but which may extend to six years with a fine under section 43/44 of the Water Act. The industry can appeal if aggrieved against the orders of the Board under section 28 of the Water Act. The Board can issue directions for closure of industry & disconnection of electricity in case of persistent defiance by any polluting industry under section 33-A of the Water Act.

5.6 NATIONAL WATER QUALITY MONITORING PROGRAMME (NWMP)

Water is the ultimate source required for the survival of organisms including human beings. Proper monitoring of the water quality and quantity in the freshwater bodies (rivers, lakes, ponds, underground, etc.) are also good indicators of the sustainability of the ecosystem and environment.

Central Pollution Control Board (CPCB) in collaboration with State Pollution Control Boards (SPCBs) in the States and Pollution Control Committees (PCCs) in Union Territories has established a National Water Quality Monitoring Network to assess the status of water quality and to facilitate for prevention and control of pollution in water bodies. Monitoring is carried out with a frequency on a monthly, quarterly, half-yearly and yearly basis. Water samples are analyzed for 9 core, 19 general parameters,9 trace metals and a set of pesticides as per the Guidelines on Water Quality Monitoring, 2017 issued by the Ministry of Environment, Forest and Climate Change (MoEF & CC). Analyzed water quality parameters are compared with the designated best use water quality criteria recommended by CPCB or primary water quality criteria for outdoor bathing notified under Environment (Protection) Rules, 1986 or BIS Drinking Water Specification i.e., IS:10500-2012 or water quality standards for coastal water depending on the use of water bodies.

The outcome of the National Monitoring Programme

- Every year a compendium of water quality statistics is published and circulated to various scientific institutes and processed data is put on the website for easy access.
- Basin/sub-basin Inventory of water pollution is prepared and published for all the major river basins in the country.
- A water quality atlas is prepared to assess the fitness of river water for desired uses in the country.
- Water quality data is used for the Identification of Polluted Water Bodies based on violation of desired water quality criteria for designated uses.
- Water quality data formed the basis for the formulation of the River Action Plan and Identification of Pollution Sources in 157 cities for interception and diversion of municipal wastewater and stricter surveillance of industrial sources.
- Water quality data is used for Query Response i.e. to reply to Parliament Questions, VIP reference, Public Queries, Public Interest Litigation filed in Supreme Court and Various High Courts and to fulfil the requirement of Non-Governmental organizations, Students, and Researchers.

Achievement of Monitoring Programme

Water quality data is used for the identification of polluted water bodies, identification of pollution sources in cities for the formulation of River Action Plans including interception, diversion and treatment of municipal wastewater, waste management and stricter surveillance of industrial pollution sources. Water quality data is also used for dissemination of information i.e., to reply to Parliament Questions, references, Public Queries, for filing replies in Supreme Court, High Courts and in NGT.

5.7 AIR (PREVENTION AND CONTROL OF POLLUTION) ACT, 1981

Environmental policies of the Government of India include legislation related to the environment. In the Directive Principles of State Policy, Article 48(a) reads that "the state shall endeavour to protect and improve the environment and to safeguard the forests and wildlife of the country"; Article 51-A states that "it shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers, and wildlife and to have compassion for living creatures."

It is innovative legislation that lets the State regulate the standard for emission of air pollutants. The Act empowers the State to inspect any factory and check any control equipment and manufacturing process. It further allows the State to take the necessary steps to control air pollution. No industry can operate without meeting the requirements mentioned in this act.

The Air Act was enacted on 29th March 1981. The main objective of this Act was the prevention, control and abatement of air pollution through the Air Pollution Control Boards, constituted at the National Level. The powers and functions of the Board are given below:

i) To declare any area as an air pollution control area.

ii) To fix up the emission levels from automobiles.

iii) Location of the industry from the point of view of pollution.

iv) To approach the court against any polluter.

v) To inspect any factory premises to assess pollution being caused by it.

vi) To obtain any information from industry with regard to pollution.

vii) To take samples from the concerned unit.

Violation of various Sections of the Act attracts punishment of varying degrees which may be imprisonment of up to three months and/or a fine of up to Rs. 10,000.

5.8 CENTRAL POLLUTION CONTROL BOARD AND STATE POLLUTION CONTROL BOARD

The constitution of central and state boards and the powers and functions of both the boards are under The Water (Prevention and Control of Pollution) Act, 1974.

Constitution of Central Board

According to Section 3, the Central Board shall consist of the following members:

- A full-time Chairman (to be nominated by the Central Government) having knowledge or practical experience in matters related to environmental protection or having knowledge and experience in administration of institutions dealing with aforesaid matters.
- Not more than five officials are nominated by the Central Government.
- No more than five persons are nominated by the Central Government from amongst the members of State Boards.
- Not more than three non-officials were nominated by the government to represent interests of agriculture, fishery, agriculture-trade etc.
- Two persons are nominated by the government to represent the companies or corporations owned by the Central Government.
- One full-time Member-Secretary (to be appointed by the Central Govt.) having knowledge and experience of scientific engineering or management aspects of pollution control.

Constitution of State Boards

According to Section 4 of the Water Act, the State Pollution Control Board may be constituted having the same constitution as the Central Board.

Terms and Service Conditions of the Members of the Board

- Terms and service conditions of the Member Secretary and Chairman shall be as prescribed by the Government.
- The rest of the members shall hold office for a term of three years.
- A member shall be eligible for renomination.
- Central or State Government may remove a member of the Central or State Board at any time by giving him reasonable notice and opportunity.
- The Chairman may resign by addressing his resignation to the government and a member may resign by addressing his resignation to the Chairman.
- In the case of insolvency, unsound mind, a conviction for the offence under this Act, conviction for the offence involving moral turpitude, inability to attend three consecutive meetings, abusing position as a member of the Board, partnership with anybody dealing with sewage or trade effluent etc., are some conditions for disqualification of the member. The seat of the disqualified member shall fall vacant and a person nominated to fill such a vacancy shall hold office for the remaining term.

Functions of the Central Board

According to Section 16, the following are the functions of the Central Board:

- To promote the cleanliness of streams and wells in different areas of the state.
- To advise the Central Government, on matters concerning the prevention and control of water pollution.
- To coordinate the actions of the State Board and resolve disputes among them.
- To provide technical assistance and guidance to the State Boards to carry out research in the prevention and control of water pollution problems.
- To organize training of persons engaged in pollution control.
- To organize a comprehensive programme for pollution control through mass media.
- To lay down standards for streams or wells.

- To prepare manuals, codes or guides for the treatment and disposal of sewage and trade effluents.
- To establish or recognize laboratories for analysis of water samples from any stream, well or trade effluents.

Functions of the State Board

According to Section 17, the following are the functions of the State Board:

- Planning a comprehensive programme for prevention, control and abatement of pollution of streams and wells.
- Advising the State Government regarding water pollution control or location of industries.
- Conducting and encouraging investigations and research relating to different aspects of water pollution.
- To collaborate with the Central Board for training personnel for handling water pollution programmes and organizing related mass education programmes.
- Inspecting trade effluents and wastewater treatment plants.
- Prescribing effluent standards for the sewage and trade effluents.
- Evolving economical and reliable methods of disposal, treatment and reuse of wastewater (in agriculture).
- Laying down the standards of treatment of sewage and trade effluents to be discharged into any stream.
- Making, varying or revoking any order for preservation or control of discharge of waste into streams and wells or construction of systems for disposal of effluents.
- Establishing or recognizing laboratories for analysis of samples.
- Performing such functions as may be entrusted by Central Board or State governments.

Directions

According to Section-18, the Central Board shall be bound by directions given by the Central Government, whereas the State Board shall be bound by directions given by the Central Board or the State Government.

5.9 NATIONAL AIR QUALITY MONITORING PROGRAMME (NAMP)

The network consists of 804 operating stations covering 344 cities/towns in 28 states and 6 Union Territories of the country. The objectives of the NAMP are:

- To determine the status and trends of ambient air quality.
- To ascertain whether the prescribed ambient air quality standards are violated and to identify non-attainment cities.
- To obtain the knowledge and understanding necessary for developing preventive and corrective measures and to understand the natural cleansing process undergoing in the environment through pollution dilution, dispersion, wind-based movement, dry deposition, precipitation and chemical transformation of pollutants generated.
- Under NAMP, four air pollutants viz., Sulphur Dioxide, Oxides of Nitrogen, Respirable Suspended Particulate Matter (RSPM/PM10) and Fine Particulate Matter (PM2.5) have been identified for regular monitoring at all the locations. The monitoring of meteorological parameters such as wind speed and wind direction, relative humidity (RH) and temperature were also integrated with the monitoring of air quality.
- The monitoring of pollutants is carried out for 24 hours (4-hourly sampling for gaseous pollutants and 8-hourly sampling for particulate matter) with a frequency of twice a week, to have one hundred and four (104) observations in a year. The monitoring is being carried out with the help of the Central Pollution Control Board; State Pollution Control Boards; Pollution Control Committees; National Environmental Engineering Research Institute (NEERI), Nagpur. CPCB coordinates with these agencies to ensure the uniformity, and consistency of air quality data and provides technical and financial support to them for operating the monitoring stations. NAMP is being operated through various monitoring agencies.

Ambient Air Quality Monitoring

Ambient air quality monitoring is the organized, long-term assessment of pollutant levels by measuring the quantity of certain pollutants in the surrounding and outdoor air. It is an integral part of an effective air quality management system. Data collected from monitoring stations helps to:

- Assess the extent of the pollution level
- Provide air pollution data to the public on time
- Support implementation of air quality standards
- Evaluate the effectiveness of action plans for pollution control
- Provide information on air quality trends
- Support research on long-term studies of the health effects of air pollution.

5.10 NATIONAL AIR QUALITY INDEX

The Air quality index (AQI) is a tool for the effective communication of air quality status to people in terms, which are easy to understand. It transforms complex air quality data of various pollutants into a single number (index value), nomenclature and colour.

There are six AQI categories, namely, good, satisfactory, moderately polluted, poor, very poor, and severe. Each of these categories is decided based on the ambient concentration values of air pollutants and their likely health impacts. The index is calculated using the ambient concentrations of six pollutants - particulates less than 10 μm in diameter (PM10), particulates less than 2.5 μm in diameter (PM2.5), Sulphur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), and ozone for which short-term (up to 24-hours) National Ambient Air Quality Standards are prescribed. Based on the measured ambient concentrations of a pollutant, a sub-index is calculated using standard formulae developed by EPA Environmental Protection Agency. The worst sub-index determines the overall AQI. The AQI categories and associated health impacts are given in the following table 5.2.

Table 5.2 The AQI categories and associated health impacts

AQI	Category	Associated Health Impact
0 to 50	Good	Minimal impact.
51 to 100	Satisfactory	May cause minor breathing discomfort to sensitive people.
101 to 200	Moderate	May cause breathing discomfort to people with lung diseases such as asthma and discomfort to people with heart disease, children and older adults.
201 to 300	Poor	May cause breathing discomfort to people on prolonged exposure and discomfort to people with heart disease.
301 to 400	Very Poor	May cause respiratory illness to the people on prolonged exposure. The effect may be more pronounced in people with lung and heart diseases.
401 to 500	Severe	May cause respiratory effects even on healthy people and serious health impact on people with lung/heart diseases. The health impact may be experienced even during light physical activity.

Sameer App

It is an app that provides hourly updates on the National Air Quality Index (AQI) published by CPCB. Air Quality Index is a tool for effective communication of air quality in a single number, nomenclature and colour. The public can post complaints with pictures and provide valuable suggestions through the APP.

5.11 AIR AND WATER QUALITY STANDARDS

Air quality standards seek to establish the concentrations of air pollutants to which the public can be exposed without significant adverse effects. The ambient air quality refers to the condition or quality of air surrounding us in the outdoors. National Ambient Air Quality Standards are the standards for ambient air quality set by the Central Pollution Control Board (CPCB) that is applicable nationwide. The CPCB has been conferred this power by the Air (Prevention and Control of Pollution) Act, 1981.

Table 5.3 National Ambient Air Quality Standards

S. No.	Pollutant	Time Weighted Average	Concentration in Ambient Air		
			Industrial, Residential, Rural and Other Area	Ecologically Sensitive Area (notified by Central Government)	Methods of Measurement
(1)	(2)	(3)	(4)	(5)	(6)
1	Sulphur Dioxide (SO2), µg/m^3	Annual*	50	20	a. Improved West and Gaeke b. Ultraviolet fluorescence
		24 hours**	80	80	
2	Nitrogen Dioxide (NO2), µg/m^3	Annual*	40	30	a. Modified Jacob & Hochheiser (Na- Arsenite) b. Chemiluminescence
		24 hours**	80	80	
3	Particulate Matter (size less than 10µm) or PM10 µg/m^3	Annual*	60	60	a.Gravimetric b.TOEM c.Beta attenuation
		24 hours**	100	100	

4	Particulate Matter (size less than 2.5µm) or PM2.5 µg/m^3	Annual*	40	40	a.Gravimetric b.TOEM c.Beta attenuation
		24 hours**	60	60	
5	Ozone (O3) µg/m^3	8 hours**	100	100	a. UV photometric b. Chemiluminescence c. Chemical Method
		1 hour**	180	180	
6	Lead (Pb) µg/m^3	Annual*	0.50	0.50	a.AAS/ICP method after sampling on EPM 2000 or equivalent filter paper b.ED-XRF using Teflon filter
		24 hours**	1.0	1.0	
7	Carbon Monoxide (CO)mg/m^3	8 hours**	02	02	a.Non-Dispersive Infra-Red (NDIR) spectroscopy
		1 hour**	04	04	
8	Ammonia (NH3)µg/m^3	Annual*	100	100	a.Chemiluminescence b.Indophenol blue method
		24 hours**	400	400	
9	Benzene (C6H6) µg/m^3	Annual*	05	05	a.Gas chromatography-based continuous analyzer b.Adsorption and Desorption followed by GC analysis
10	Benzo(a)Pyrene (BaP) - particulate phase only, ng/m^3	Annual*	01	01	a.Solvent extraction followed by HPLC/GC analysis

11	Arsenic (As), ng/m^3	Annual*	06	06	a.AAS /ICP method after sampling on EPM 2000 or equivalent filter paper
12	Nickel (Ni), ng/m^3	Annual*	20	20	a.AAS /ICP method after sampling on EPM 2000 or equivalent filter paper

Note: *Annual arithmetic means of minimum 104 measurements in a year at a particular site taken twice aweek 24 hourly at uniform intervals.

**24 hourly or 08 hourly or 01 hourly monitored values, as applicable, shall be complied with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive daysof monitoring.

Water Quality Criteria

Water quality refers to specific levels of water quality desired for identified uses, including drinking, recreation, farming, fish production, other aquatic life, and agricultural and industrial processes.

Table 5.4 Water Quality Criteria

Designated-Best-Use	Class of water	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	• Total Coliforms Organism MPN/100ml shall be 50 or less; • pH between 6.5 and 8.5; • Dissolved Oxygen 6mg/l or more; • Biochemical Oxygen Demand (5 days 20°C) 2mg/l or less
Outdoor bathing (Organized)	B	• Total Coliforms Organism MPN/100ml shall be 500 or less; • pH between 6.5 and 8.5; • Dissolved Oxygen 5mg/l or more; • Biochemical Oxygen Demand (5 days 20°C) 3mg/l or less
Drinking water source after conventional treatment and	C	• Total Coliforms Organism MPN/100ml shall be 5000 or less; • pH between 6 to 9;

disinfection		• Dissolved Oxygen 4mg/l or more; • Biochemical Oxygen Demand (5 days 20°C) 3mg/l or less
Propagation of Wildlife and Fisheries	D	• pH between 6.5 to 8.5; • Dissolved Oxygen 4mg/l or more; • Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	• pH between 6.0 to 8.5; • Electrical Conductivity at 25°C micromhos/cm Max.2250 • Sodium absorption Ratio Max. 26; • Boron Max. 2mg/l
•	Below-E	Not Meeting A, B, C, D & E Criteria

WHO Drinking Water Specifications

WHO has given the international norms on water quality and human health in the form of guidelines that are used as the basis for regulation and standard setting in developing and developed countries.

Table 5.5 WHO Drinking Water Specifications

PARAMETER	UNIT	LIMIT
Aluminium	mg Al/l	0.2
Arsenic	mg As/l	0.05
Barium	mg Ba/l	0.05
Beryllium	ug Be/l	0.2
Cadmium	ug Cd/l	5.0
Calcium	mg Ca/l	200.0
Chromium	mg Cr/l	0.05
Copper	mg Cu/l	1.0
Iron Total	mg Fe/l	0.3
Lead	mg Pb/l	0.01
Magnesium	mg Mg/l	150.0
Manganese	mg Mn/l	0.1
Mercury	ug Hg/l	1.0
Selenium	mg Se/l	0.01
Sodium	mg Na/l	200.0
Zinc	mg Zn/l	5.0

Chlorides	mg Cl/l	250.0
Cyanide	mg Cn/l	0.1
Fluorides	mg F/l	1.5
Nitrates	mg NO_3/l	10.0
Nitrites	mg NO_2/l	-
Sulphates	mg SO_4/l	400.0
Sulphides	mg H_2S/l	0
TOTAL "drins"	ug/l	0.03
TOTAL "ddt"	ug/l	1.0
Hydrocarbons	mg/l	0.1
Anionic Detergents	mg/l	0
pH		9.2
Total dissolved solids	mg/l	1500
Total hardness	mg/l	500
Alkalinity	mg/l	500
MICROBIOLOGICAL PARAMETERS		
Total Bacteria	Count/ml	100
Coliform	Count/100ml	0
E. Coli	Count/100ml	0
Salmonella	Count/100ml	0

ug = microgram or ppb

mg = milligram or ppm

Safe Drinking Water Must Have BIS Water Quality Standards

Drinking water is defined as water used for human consumption for drinking and cooking purposes from any source. It includes water (treated or untreated) supplied by any means for human consumption.

The quality standards for drinking water in India are prescribed by the Bureau of Indian Standards (BIS) laid down IS 10500: 2012. The Bureau of Indian Standards initially published the Indian standard for drinking water IS 10500 (Drinking Water-Specification) in the year 1983. Since then, the standard has undergone a few revisions. The 2012 revision was undertaken to upgrade the requirements of the standard to align them with the international specifications for drinking water.

In an ideal situation all samples of water taken from the water distribution system which includes consumers' locations, should be free from coliform

and other biological organisms and bacteriological quality must be as per BIS standards. Bacteriological quality of drinking water includes the absence of E.coli in 100 ml sample. A biological examination is also required for determining the causes of unpleasant tastes and odours in water. The drinking water must be free from microscopic organisms such as algae, zooplanktons, flagellates, parasites and toxin-producing organisms to be safe for drinking, cooking and processing of foods.

The 2012 revision in BIS standards has laid down the specifications for virological requirements. MS2 phages are indicators of viral contamination in drinking water and for water to be safe for drinking MS2 phages shall be absent in 1 litre of water. The standard clearly states that all samples taken from the distribution system including consumer premises should be free from viruses.

According to Central Ground Water Board, BIS IS 10500:2012 the quality of water has standards with two limits "acceptable limits" and "permissible" limits. If any parameter exceeds the limits set by BIS then the water is considered unfit for human consumption. If the water is bacteriology contaminated by E-coli or viruses or if chemical contamination exceeds the maximum permissible it is considered unfit for drinking.

Check Your Progress 1

Note: i) Use the space given below for your answers.

ii) Check your answers with those given at the end of the unit.

1. Write a short note on the Water (Prevention and Control of Pollution) Act, 1974.

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2. Write a short note on the Air (Prevention and Control of Pollution) Act, 1981.

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3. Write a short note on National Water Quality Monitoring Programme.

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4. Write a short note on National Air Quality Monitoring Programme.

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5. Explain the functions of the Central Pollution Control Board.

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5.12 LET US SUM UP

In this unit, we have discussed the features of the Water (Prevention and Control of Pollution) Act, 1974 and the Air (Prevention and Control of Pollution) Act, 1981. We have also discussed the National Water Quality Monitoring Programme (NWMP) and National Air Quality Monitoring Programme (NWMP). Further, we have discussed the air and water quality standards.

5.13 KEY WORDS

Air Quality: The cleanliness of the air.

Smog: A form of air pollution that is or looks like a mixture of smoke and fog.

Water Pollution: Water pollution is the contamination of natural water bodies such as lakes, rivers, seas, oceans, aquifers, groundwater, etc.

5.14 SUGGESTED FURTHER READING/REFERENCES

Central Pollution Control Board. (2011). Air quality monitoring, emission inventory and source apportionment study for Indian cities—National summary report. CPCB, Ministry of Environment, Forest and Climate Change, Government of India.

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Vallero, D. (2014). Fundamentals of Air Pollution. 5th edition. Academic Press.

Web Links

https://moef.gov.in/wp-content/uploads/2019/05/NCAP_Report.pdf

https://cpcb.nic.in/7thEditionPollutionControlLawSeries2021.pdf

5.15 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

1. Please refer to section 5.5
2. Please refer to section 5.7
3. Please refer to section 5.6
4. Please refer to section 5.9
5. Please refer to section 5.8