

A Textbook of
**Environmental
Chemistry
and
Pollution Control**



S.S. DARA

S. CHAND

Contents

Chapter	Pages
1. Environmental Chemistry	1-23
Environmental segments-Lithosphere, Hydrosphere, Biosphere, Atmosphere, Composition of the atmosphere, Atmospheric structure-Troposphere, Stratosphere, Mesosphere, Thermosphere ; Radiation balance of the earth, chemical species and particulates present in the atmosphere - ions, radicals, particles, reactions in atmosphere, oxidation of sulfur dioxide, photochemical smog, oxidation of organic compounds, formation of ozone in the stratosphere; lapse rate and temperature inversion ; Radionuclides in the environment; El Nino Phenomenon and its Effect.	
2. Air Pollution	24-64
Introduction, classification of air pollutants, air pollutants and their effects, acid rain, photochemical smog, particulates, Characteristics and biochemical effects of some air pollutants, sources of some important air pollutants and their effects. Effects of air pollutants on man and environment, interdependence of human activities, meteorology and air pollution, wind speed and wind direction, atmospheric stability and temperature inversion, plume characteristics under different lapse conditions, precipitation and humidity, air quality standards, air monitoring, atmospheric sampling and analysis, analytical and instrumental techniques used in the estimation of atmospheric pollutants, air pollutants from industrial and other sources, air pollution from automobiles, air pollution control.	
3. Water Pollution	65-109
Introduction, classification of water pollutants - organic wastes - oxygen demanding wastes, disease causing wastes, synthetic organic compounds, sewage and agricultural runoff, oil; inorganic pollutants, suspended solids and sedi-	

ments, radioactive materials, heat/characterisation of wastewaters - physical characteristics, chemical characteristics, biological characteristics, methods and equipment used in waste-water treatment - preliminary treatment, primary treatment - sedimentation, coagulation, equalization, neutralization, secondary treatment- aerobic treatment - aerated lagoons, trickling filters, activated sludge process, oxidation ditch process, oxidation pond, anaerobic treatment - anaerobic sludge digestion, sludge treatment and disposal; Tertiary treatment - evaporation, ion-exchange, adsorption, chemical precipitation, Electro dialysis, Electrolytic recovery, Reverse osmosis, Wastewaters from some typical industries - Sources, characteristics, effects and treatment options: Textile industry, Paper and Pulp industry, Electro - plating industry : Leather tanning industry, Fertiliser industry, Dairy, Rubber, Soap, and Detergent industries, Cane sugar, Edible oil refining and oil refinery. Water for municipal purposes, sewage treatment, Eutrophication.

4. Solid Wastes - Pollution, Treatment and Disposal 110-122

Introduction, classification and origin, magnitude of the problem, characteristics of solid wastes, objectives and considerations in solid waste management, methods of solid waste treatment and disposal, microbiology involved in solid waste disposal, Methods of solid waste disposal - composting, sanitary landfilling- economic, aesthetic and environmental problems, thermal processes -incineration, pyrolysis, recycling and reuse of solid wastes, co-disposal, bioconversion.

5. Hazardous Wastes 123-138

Introduction, classification, radioactive wastes, effects of radiation on living cells, environmental problems and management of nuclear wastes, bio-medical wastes, chemical wastes-environment effects, love canal episode, toxic chemicals, identification of hazardous wastes, management of hazardous wastes, treatment and disposal of hazardous chemical wastes-physical, chemical and biological processes, off-site hazardous waste disposal, co-disposal, security landfill.

6. Noise Pollution 149-176

Introduction, The decibel scale, effects of noise - physiological effects - acute and chronic, psychological effects, noise control programme in industries- measurement of noise levels, noise control criteria- annoyance, interference with communication, hearing loss criteria, permissible exposure

limits, equipment used for noise measurement - different types of meters and analysers, approaches for noise control, noise control in industrial establishments - administrative controls and engineering controls, suppression at source, path control, sound absorption, sound insulation, vibration control, acoustic enclosures, noise barriers, mufflers or silencers, acoustic plenums, vibration isolation, damping, lagging, protection of the personnel - ear plugs, ear muffs, helmets, personnel isolation, acoustical absorptive materials, noise sources and control in industrial plants.

7. Trace Elements - Pollution & Control **177-216**

Introduction, Mechanism of distribution - primary, secondary and tertiary dispersion, Essential and non-essential trace elements, physiological role of trace metals, trace elements in marine environment, heavy metals, Industrial uses and pollution sources, Environmental levels, Ecological effects; Bio-chemical effects, Toxicology, environmental fate, control and treatment of the following trace elements : Mercury (Hg), Cadmium (Cd), Lead (Pb), Chromium (Cr), Zinc (Zn), Copper (Cu), Arsenic (As), Nickel (Ni), Selenium (Se), Tin (Sn), Antimony (Sb), Fluorine (F), Beryllium (Be), Cobalt (Co), and Manganese (Mn).

8. Bio-Technology and its Application in Environmental Protection **217-224**

Introduction, Bio-informatics, Bio-Technology and pollution control, Bioremediation, Biological de-odourisation, Biological purification of contaminated air.

9. Energy and Environment **225-250**

Sources of energy, Fossil fuels, Nuclear fission and fusion, Solar energy, Use of solar energy in space heating and water heating, Production of electricity using solar energy, Solar trough collectors, Power tower, Solar pond, Solar energy for driving vehicles, Power from indirect solar energy - Hydro power, Wind power, Biomass energy, Production of ethanol from biomass, Production of methane from biomass, Photosynthesis, Photoelectrochemistry, Geothermal energy, Ocean thermal energy conversion (OTEC), Tidal power, Air energy, Conclusion

10. Environmental Management **251-273**

(A) Introduction, Objectives, Components, Environmental Impact assessment (EIA) - Historical background, Elements

of the EIA process, Participants in EIA Process, Contents of EIS, Design of EIA

(B) Some Important Environmental Laws

1. The Wildlife (Protection) Act, 1972 (Amended in 1983, 1986 and 1991)
2. The Forest Conservation Act, 1980
3. The Water (Prevention and Control of Pollution Cess) Act, 1974 (Amended in 1988)
4. The Water (Prevention and Control of Pollution Cess) Act, 1977 (Amended in 1991)
5. Air Prevention and Control of Pollution) Act, 1981 (Amended in 1987)
6. The Environment (Protection) Act, 1986.

(C) Environmental Quality Management Standard – ISO-14000 series

11. Soil Pollution

274-287

Composition of the earth's crust, Formation of soil, Composition of soil, Importance of soil to the biosphere, soil profile, Types of soil texture, Major types of soils in our Country, Accumulation of Salts in soils, Soil indicator plants, Plants as pollution indicators, sources of soil pollution, Effects of soil pollution -- Effects of modern agricultural practices, Synthetic fertilizers, Pesticides, Effects of Industrial effluents, Effects of urban wastes, Control of soil pollution.

12. Effects of Electric and Magnetic Fields in the Environment

288-307

Introduction, Regions in the electromagnetic spectrum, Health effects due to electromagnetic fields, Effect of exposure to extremely low frequencies (ELF) on humans and animals, Occupational exposure, ELF magnetic and electric fields on experimental animals, Radio frequency (RF) and Microwave radiation (MR) and their biological effects, EMR and Cancer, Epidemiological studies, Studies on animals, "in-vitro" studies, Control measures, Conclusion, Biological effects of ultraviolet radiation, Biological effects of laser radiation, Sources of electric and magnetic fields, Electromagnetic fields – Quasistatics and Electro-dynamics, Fields from power lines, Electric railways, Radiation fields, Field concentration, Power frequency fields and the body, Typical standards, Limits of exposure to electric and magnetic fields as per IRPA/INIRC, Guidelines for exposure limits at Radio and Microwave-Fre-

quencies, Conclusion.

13. Genetic and Plant Biodiversity

308-326

Introduction, Environment and Ecology, Biotic and abiotic environment, Organisation of Ecosystem – producers, consumers, decomposers; Biodiversity, Assessment of biological diversity, Importance of biodiversity; Loss of Biodiversity - Major causes responsible for reduction in Biodiversity – Natural upheavals, environmental pollution, Invasion by exotic species, over-exploitation of selected species; Conservation of Biological Diversity – Biodiversity inventories, Conserving Biodiversity in protected habitats, “Ex-situ” conservation, “In-situ” conservation, conserving biodiversity in seed-banks, gene-banks, and germ-plasm banks, Restoration of Biodiversity, Imparting Environmental Education; Enacting, Strengthening and Enforcing Environmental Legislations; Population control; Reviewing the agricultural practices, controlling urbanisation.

14. Sustainable Development : New Approaches

327-351

Pollution prevention, Design for Environment, Industrial ecology, Green chemistry, Emerging technologies, Total quality management (TQM), Life cycle analysis (LCA), Preventive environmental management (PEM), IS 15001 : 2000 Regulations on occupational safety and health (OSH), Energy utilization : Introduction, Basic principles, Heat engines, Heat engine efficiency, combined cycle power plants, Heat pumps, Geothermal heat pumps, Cogeneration, Entropy and chemical energy, Fuel cells, proton exchange membrane (PEM) fuel cell, Electricity storage, Hydrogen economy, Dematerialization, Conclusion.

15. Green Chemistry for Clean Technology

352-375

Introduction, Goals of Green Chemistry, Significance of Green Chemistry, Basic Components of Green Chemistry Research, Alternative feedstocks or starting materials, Alternative reagents or transformations, Alternative reaction conditions, Alternative products or target molecules, Atom economy, Functional group approaches to green Chemistry, Structure-Activity relationship, Elimination of toxic functional group, Reducing the bio-availability, Optimization of Frameworks for the Design of Greener Systematic Pathways, Industrial Applications of Green Chemistry, Products from natural materials, Green solvents, Ionic liquids, Green fuels and E-Green propellents, Zeolites, Biocatalysis, Conclusion

Appendix-1. Rio–Declaration on Environment and Development (Earth Charter)	
Appendix-2 Drinking water standards	
Appendix-3. National Ambient Air Quality Standards,	
Appendix-4. Standards for noise levels.	
Appendix-5. standards for discharge of Industrial and Sewage Effluents.	
Appendix-6. Standards of Maharashtra Pollution Control Board for treated Waste water.	376-391
Bibliography	392-397
Index	398-403