

UNIT - II

CHAPTER 3

ENVIRONMENTAL POLLUTION

3.1 Introduction

Environmental pollution can be defined as “the unfavorable alteration of our surroundings”

3.1.1 Types of pollutants

1. Bio degradable pollutants - decompose rapidly by natural processes.
2. Non- degradable pollutants - do not decompose or slowly decompose in the environment.

3.1.2 Classification of Pollution

- ✓ Air pollution
- ✓ Water pollution
- ✓ Soil pollution
- ✓ Marine pollution
- ✓ Noise pollution
- ✓ Thermal pollution and
- ✓ Nuclear hazards

3.2 AIR POLLUTION

The presence of one or more contaminants like dust, smoke, mist and odor in the atmosphere which are injurious to human beings, plants and animals.

3.2.1 Sources of air pollution

- 🌋 Natural pollution - volcanic eruptions, forest fires, biological decay.
- 🏭 Man – made activities – Thermal power plants, agricultural activities.

3.2.2 Classification

- Primary pollutant – these are those emitted directly in the atmosphere in harmful form like CO, NO.
- Secondary pollutant – these may react with one another or with the basic components of air to form new pollutants.

3.2.3 Control Measures

1. Source control

- ❖ Use only unleaded petrol

- ❖ Use petroleum products and other fuels that have low sulphur and ash content
- ❖ Plant trees along busy streets because they remove particulates and carbon monoxide and absorb noise.
- ❖ Industries and waste disposal sites should be situated outside the city centre.
- ❖ Use catalytic converters to help control the emissions of carbon monoxide and hydrocarbons.

2. Control measures in Industrial centers

- ❖ Emission rates should be restricted to permissible levels
- ❖ Incorporation of air pollution control equipments in the design of the plant layout.

3.3 WATER POLLUTION

- It may be defined as “the alteration in physical, chemical and biological characteristics of water which may cause harmful effects on human and aquatic life.

3.3.1 Types, effects and sources of water pollution

1. Infectious agents: Bacteria, viruses, protozoa and parasitic worms.

Sources: Human and animal wastes.

Effects: Variety of diseases.

2. Oxygen demanding wastes: Animal manure and plant debris that can be decomposed by aerobic bacteria.

Sources: Sewage, paper mills, and food processing facilities.

Effects: Wastes can degrade quality by depleting water of dissolved oxygen.

3. Inorganic Chemicals: Water soluble inorganic chemicals. Compounds of toxic metals such as lead, arsenic and selenium. Salts such as NaCl in ocean water.

Effects: Genetic mutations, birth defects and certain cancers.

4. Thermal pollution (Heat)

Example: Excessive heat.

5. Human source

- Water cooling of electric power plants and some types of industrial plants. Almost all of all water withdrawn in United States for cooling electric power plants.

3.3.2 Effects

- ✓ Lowers dissolved oxygen levels and makes aquatic organisms more vulnerable to disease and toxic chemicals
- ✓ When a power plant first opens or shuts down for repair, fish and other organisms adapted to a particular temperature range can be killed by the abrupt change in water temperature known as thermal shock.

3.3.3 Control measures of water pollution

- The administration of water pollution should be in the hands of state or central government.
- Industrial plants should be based on recycling operations, because it will not only stop the discharge of industrial wastes into natural water sources but by products can be extracted from the wastes.
- Plants, trees and forests control pollution and they act as natural air conditioners.
- Highly qualified and experienced persons should be consulted from time to time for effective control of water pollution.
- Basic and applied research in public health engineering should be encouraged.

3.4 SOIL POLLUTION

It may be defined as “the contamination of soil by human and natural activities which may cause harmful effects on living beings”.

3.4.1 Types

1. Industrial wastes

Sources and effects: Pulp and paper mills, chemical industries, oil refineries, sugar factories. These pollutants affect and alter the chemical and biological properties of soil. As a result, hazardous chemicals can enter into human food chain from the soil; disturb the biochemical process and finally lead to serious effects.

2. Urban wastes

Sources and effects: Plastics, Glasses, metallic cans, fibers, papers, rubbers, street sweepings, and other discarded manufactured products. These are also dangerous.

3. Agricultural practices

Sources and effects: Huge quantities of fertilizers, pesticides, herbicides, and weedicides are added to increase the crop yield. Apart from these farm wastes, manure, slurry, are reported to cause soil pollution.

4. Radioactive pollutants

Sources and effects: These are resulting from explosions of nuclear dust and radio active wastes penetrate the soil and accumulate there by creating land pollution.

5. Biological agents

Sources and effects:

Soil gets large quantities of human, animal and birds excreta which constitute the major source of land pollution by biological agents.

3.4.2 Control measures of soil pollution

The pressure on intensification of farm activities increases for two reasons

- ✓ Population growth
- ✓ Decrease of the available farm land due to urbanization
- ✓ Forestry and farm practices
- ✓ Proper dumping of unwanted materials
- ✓ Production of natural fertilizers
- ✓ Proper Hygienic condition
- ✓ Public awareness
- ✓ Recycling and Reuse of wastes
- ✓ Ban on Toxic chemicals.

3.5 MARINE POLLUTION

It may be defined as “the discharge of waste substances into the sea resulting in harm to living resources hazards to human health, hindrance to fishery and impairment of quality for use of sea water”.

Source of marine pollution

The coastal zones contain rich heritage, coral reefs, wetlands, and sea grass beds.

3.5.1 Effects of marine pollutants

- The presence of heavy metals and organic pollutants cause more damage in birds as thinning of eggshell and tissue damage of egg.
- Oil spilling causes abnormally low body temperature in birds resulting in hypothermia.
- Oil films are able to retard significantly the rate of oxygen uptake by water.

3.5.2 Control measures of marine pollution

- ❖ Plants for conserving marine biodiversity must be taken into account of human needs.
- ❖ People should be educated about marine ecosystems and the benefits offered by them.

- ❖ Local communities must be involved in protecting and managing their coastal resources. Social and economic incentives must be offered for conserving and sustainable use of marine resources.
- ❖ Governments must manage their own water while extending cooperation to the neighboring states.

3.6 NOISE POLLUTION

It may be defined as “the unwanted, unpleasant or disagreeable sound that causes discomfort for all living beings”

3.6.1 Types of noise

- Industrial noise
- Transport noise
- Neighborhood noise

3.6.2 Effects of Noise pollution

- ✓ This affects human health, comfort and efficiency.
- ✓ It causes muscles to contract leading to nervous breakdown, tension.
- ✓ It affects health efficiency and behavior.
- ✓ In addition to serious loss of hearing due to excessive noise, impulsive noise also causes psychological and pathological disorders.
- ✓ Brain is also adversely affected by loud and sudden noise as that of jet and aero plane noise.

3.6.3 Control and preventing measures

- ❖ Source control – acoustic treatment to machine surface, design changes, limiting the operational timings.
- ❖ Transmission path intervention- the source inside a sound insulating enclosure, construction of a noise barrier or provision of sound absorbing materials.
- ❖ Oiling – Proper oiling will reduce the noise from the machines.

3.7 THERMAL POLLUTION

It may be defined as the “addition of excess of undesirable heat to water that makes it harmful to man, animal or aquatic life or otherwise causes significant departures from the normal activities of aquatic communities in water”

3.7.1 Sources of thermal pollution

- ✓ Nuclear power plants
- ✓ Coal fired power plants
- ✓ Industrial effluents
- ✓ Domestic sewage

- ✓ Hydro – electric power.

3.7.2 Effects of thermal pollution

- Reduction in dissolved oxygen
- Increase in Toxicity
- Interference with biological activities
- Interference with reproduction
- Direct mortality
- Food storage for fish.

3.7.3 Control measures of thermal pollution

- Cooling towers - This is used as a coolant wet cooling tower, dry cooling tower.
- Cooling ponds and spray ponds.
- Artificial lakes – The heated effluents can be discharged into the lake at one end and the water for cooling purposes from the other end.

3.8 NUCLEAR HAZARDS

The radiation hazard in the environment comes from ultraviolet, visible, cosmic rays and micro wave radiation which produces genetic mutation in man.

3.8.1 Sources of Nuclear Hazards

Natural Sources – This is in space which emits cosmic rays.

Man made Sources – (Anthropogenic sources) these are nuclear power plants, X-rays, nuclear accidents, nuclear bombs, diagnostic kits.

3.8.2 Effects of Nuclear Hazards

- ❖ Exposure of the brain and central nervous system of high doses of radiation causes delirium, convulsions and death within hours or days.
- ❖ The eye is vulnerable to radiation. As its cells die, they become opaque forming cataracts that impair sight.
- ❖ Acute radiation sickness is marked by vomiting; bleeding of gums and in severe cases mouth ulcers.
- ❖ Nausea and vomiting often begin a few hours after the gastrointestinal tract is exposed. Infection of the intestinal wall can kill weeks afterwards.
- ❖ Unborn children are vulnerable to brain damage or mental retardation, especially if irradiation occurs during formation of the central nervous system in early pregnancy.

3.8.3 Control measures

- ✚ Nuclear devices should never be exploded in air.
- ✚ In nuclear reactors, closed cycle coolant system with gaseous coolant may be used to prevent extraneous activation products.
- ✚ Containments may also be employed to decrease the radio active emissions.
- ✚ Extreme care should be exercised in the disposal of industrial wastes contaminated with radio nuclides.
- ✚ Use of high chimneys and ventilations at the working place where radioactive contamination is high. It seems to be an effective way for dispersing pollutants.

3.9 SOLID WASTE MANAGEMENT

Management of solid waste is very important in order to minimize the adverse effects of solid wastes.

3.9.1 Types of solid wastes

1. Urban wastes

Sources

- ✓ Domestic wastes – Food waste, Cloth, Waste paper.
- ✓ Commercial wastes – Packing material, cans, bottles, polythene.
- ✓ Construction Wastes – Wood, concrete debris.
- ✓ Bio medical wastes – Anatomical wastes, infectious wastes.

2. Industrial wastes

Sources

- ✓ Nuclear power plants – generates radioactive wastes
- ✓ Thermal power plants – produces fly ash in large quantities

3. Chemical industries

Produces large quantities of hazardous and toxic materials

3.9.2 Steps involved in solid waste management

- ✓ Reduce, Reuse and Recycle of materials – raw materials re usage should be reduced, reuse of waste materials should be reduced and recycling of the discarded materials into new useful products should also be reduced.
- ✓ Discarding wastes
- ✓ Land fill: Solid wastes are placed in sanitary landfill system in alternate layers of 80 cm thick refuse, covered with selected earth fill of 20cm thickness
- ✓ Incineration: It is a hygienic way of disposing the solid waste. It is a thermal process and is very effective for detoxification of all combustible pathogens
- ✓ Composting: It is another popular method practiced in many cities in our country. In this method, bulk organic waste is converted into fertilizing manure by biological action.

3.9.3 Role of an individual in prevention of pollution

- Plant more trees
- Help more in pollution prevention than pollution control
- Use water, energy and other resources efficiently
- Purchase recyclable, recycled and environmentally safe products
- Reduce deforestation
- Remove NO from motor vehicular exhaust
- Use of eco friendly products.

3.9.4 Case studies

- Effluents treatment at MRL, Chennai
- The Bhopal gas tragedy
- Arsenic pollution in ground water
- Soft drink bottling unit
- Mercury wastes
- Palar river pollution
- The miniamatta epidemic (marine pollution)

3.10 DISASTER MANAGEMENT

Hazard

It is a perceived natural event which threatens both life and property.

Disaster

- ✓ A disaster is the realization of this hazard
- ✓ It is defined as the geological process and it is an event concentrated in time and space in which a society or subdivision of a society undergoes severe danger and causes loss of its members and physical property.

Types

Natural disasters – refers to those disasters that are generated by natural phenomena.

Man made disasters – refers to the disasters resulting from man made hazards.

3.11 FLOODS

Whenever the magnitude of water flow exceeds the carrying capacity of the channel within its banks the excess of water overflows on the surroundings causes floods.

3.11.1 Causes of floods

- Heavy rain, rainfall during cyclone causes floods
- Sudden snow melt also raises the quantity of water in streams and causes flood
- Sudden and excess release of impounded water behind dams
- Clearing of forests for agriculture has also increased severity of floods.

3.11.2 Flood Management

- Encroachment of flood ways should be banned.
- Building walls prevent spilling out the flood water over flood plains.
- Diverting excess water through channels or canals to areas like lake, rivers where water is not sufficient.
- Optical and microwave data from IRS is also used for flood management.
- Flood forecasts and flood warning are also given by the central water commission.

3.12 CYCLONES

It is a meteorological process, intense depressions forming over the open oceans and moving towards the land.

Cyclone is measured by Saffir-Simpson scale.

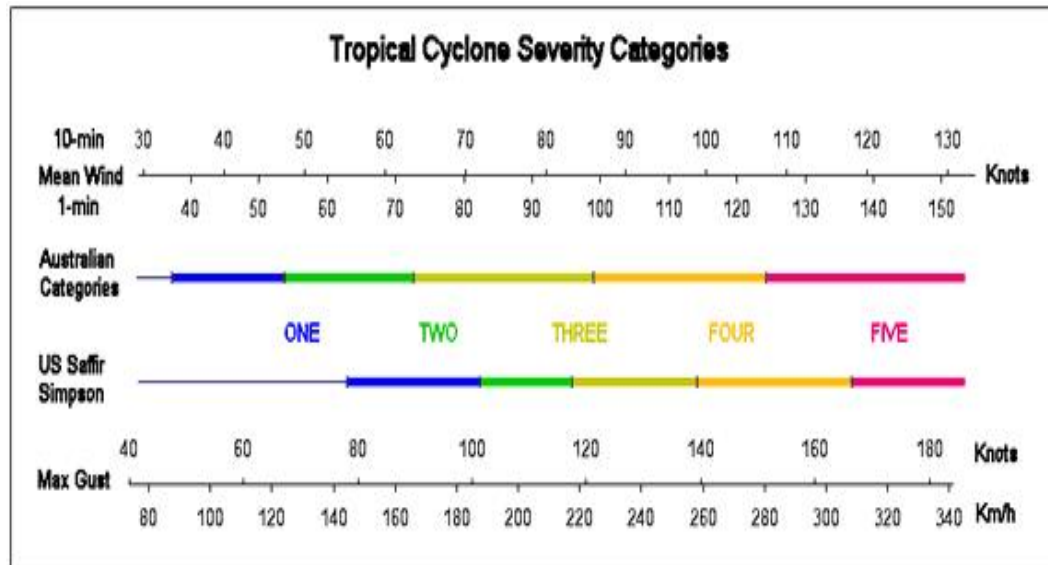


Fig.3.1 Saffir –Simpson scale

3.12.1 Effect

- ✓ The damage depends on the intensity of cyclone the damage to human life, crops, roads, transport, could be heavy.
- ✓ Cyclone occurrence slows down the developmental activities of the area.

Table 3.1 Classification of cyclones based on their speed

Category	Strongest Gust (km/h)	Typical Effects (indicative only)
1 (Tropical Cyclone)	Less than 125 (Gales)	Negligible house damage. Damage to some crops, trees and caravans. Craft may drag moorings.
2 (Tropical Cyclone)	125-169 (Destructive winds)	Minor house damage. Significant damage to signs, trees and caravans. Heavy damage to some crops. Risk of power failure. Small craft may break moorings.
3 (Severe Tropical Cyclone eg. Roma)	170-224 (Very destructive winds)	Some roof and structural damage. Some caravans destroyed. Power failure likely.
4 (Severe Tropical Cyclone eg. Tracy)	225-279 (Very destructive winds)	Significant roofing loss and structural damage. Many caravans destroyed and blown away. Dangerous airborne debris. Widespread power failures.
5 (Severe Tropical Cyclone eg. Vance)	More than 280 (Very destructive winds)	Extremely dangerous with widespread destruction.

3.12.2 Cyclone management

- Satellite images are used by meteorological departments for forecasting the weather conditions which reveal the strength and intensity of the storm.
- Radar system is used to detect the cyclone and is being used for cyclone warning.

3.12.3 Case studies

Cyclone in Orissa – 1999

- ✓ Two cyclones in Orissa occurred on 18th and 29th October 1999. In the coastal area of Orissa, a powerful cyclone storm hit with a wind velocity of about 260 km/hr. Nearly 14-30 districts of Orissa were in severe damage.
- ✓ It has been reported that nearly 15 millions of people were affected and 90-95% of the crop yield was affected. About 11,500 local schools have been damaged.

3.13 LAND SLIDES

The movement of earthy materials like coherent rock, mud, soil and debris from higher to lower region to gravitational pull is called land slides.

3.13.1 Causes

- ❖ Movement of heavy vehicles on the unstable sloppy regions.

- ❖ Earthquake, shocks, vibrations and cyclone.

3.13.2 Effects of landslides

1. Block roads and diverts the passage.
2. Soil erosion increases.
3. Causes damages to houses, crops and live stock.

3.14 EARTH QUAKES

An earthquake is a sudden vibration caused on earth surface with the sudden release of tremendous energy stored in rocks under the earth's crust.

3.14.1 Causes

1. Disequilibrium in any part of the earth crust
2. Underground nuclear testing
3. Decrease of underground water level.

3.14.2 Severity of an earthquake: Generally it is measured by its magnitude on Richter scale.

Richter Scale	Severity of earthquake
Less than 4	Insignificant
4- 4.9	Minor
5- 5.9	Damaging
6- 6.9	Destructive
7- 7.9	Major
More than 8	Great

3.14.3 Effect

- Damage the settlements and transport systems
- Collapses houses and their structures
- Deformation of ground surface
- Tsunami

3.14.4 Earthquake Management

- ✓ Constructing earthquake resistant building
- ✓ Wooden houses are preferred
- ✓ Seismic hazard map should give the information about the magnitude of intensity of anticipated earthquakes.

3.15 TSUNAMI

A tsunami is a large wave that is generated in a water body when the seafloor is deformed by seismic activity. This activity displaces the overlying water in the ocean.

3.15.1 Causes of tsunami

- ❖ Seismic activities like earthquakes, landslides, volcanic eruptions, explosions, can generate tsunami.
- ❖ Deformation of the sea floor due to the movement of plates.

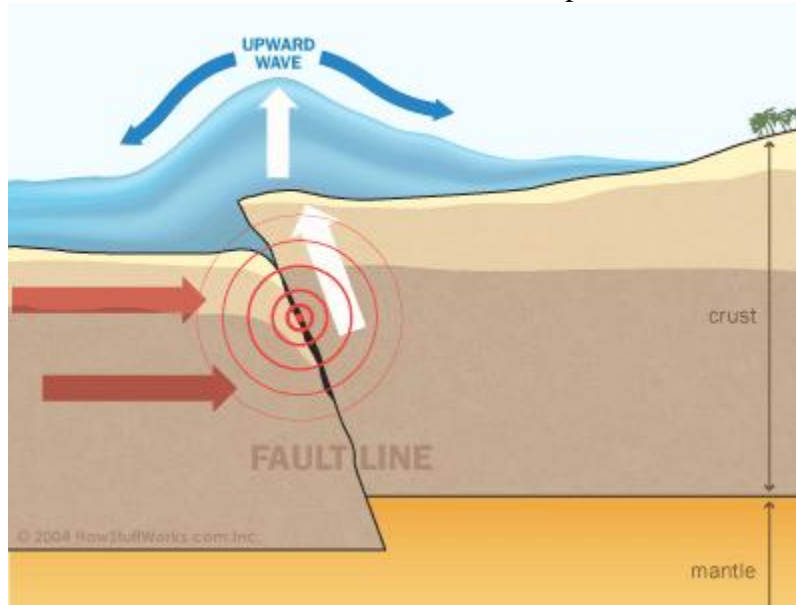


Fig.3.1 Formation of Tsunami

3.15.2 Concept of Tsunami

A tsunami is not a single wave but a series of waves like the ordinary waves which we see on seas.

3.15.3 Effects on Tsunami

- Tsunami attacks mostly the coastlines, causing devastating property, damage and loss of life.
- Tsunami can kill lot of human beings, livestock's.
- Tsunami may also spread lot of water borne diseases.

3.15.4 Tsunami Management

- ✓ Earthquakes under the water are monitored by sensors on the floor of the sea.
- ✓ The sensors send the information of floating buoys on the surface, whenever they detect any changes in pressure of the sea.
- ✓ The information is then relayed to satellites, which passes it on to the earth stations.
- ✓ Finally the country make the people alert through the media to take all necessary precautions.

3.15.5 Case studies

Tsunami- Japan 2011, India 2004.

Review questions

1. Give any three methods of air pollution control equipment.

- Catalytic converters
- Cyclone collectors
- Electrostatic precipitators

2. What is smog?

It is a mixture of smoke and fog which forms droplets that remain suspended in the air.

3. What is point source of water pollution?

Point source is discharge pollutants at specific locations through pipes, ditches into bodies of surface waters.

4. When a sound causes noise pollution?

Noise beyond 120 dB

5. What are the types of solid waste?

- Municipal waste
- Industrial waste
- Hazardous waste

What is waste minimization? Industrial manufacturing system the primary concern should be reducing the quantities of waste materials produced. This avoids the necessity to threat and disposal off such materials.

6. Name the chemical constituent of gas that caused death in Bhopal gas tragedy in India.

Methyl iso cyaide.

7. Define the term Tsunami.

It is a large wave that are generated in a water body where the sea floor deformed by seismic activity. This activity displaces the overlying water in the ocean