

ENVIRONMENTAL POLLUTION AND CONTROL TECHNIQUES: Definition, Types of pollution:

Air pollution :

causes, effects, control measures control measures of air pollution
and prevention techniques.

Water pollution causes, effects, control measures and
techniques, impact of modern agriculture, degradation of soil

Pollutants: composition gets changed by addition of harmful substances, the environment is called polluted environment and the substances polluting it are called pollutants.

- ▶ Environmental pollution can, therefore, be defined as any undesirable change in the physical, chemical or biological characteristics of any component of the environment (air, water, soil), which can cause harmful effects on various forms of life or property.

Air pollution It is an atmospheric condition in which certain substances (including the normal constituents in excess) are present in concentrations which can cause undesirable effects on man and his **environment**.

- ▶ These substances include gases, particulate matter, radioactive substances etc.
- ▶ Gaseous pollutants include oxides of sulphur (mostly SO_2 , SO_3) oxides of nitrogen (mostly NO and NO_2 or NO_x), carbon monoxide (CO), volatile organic compounds (mostly hydrocarbons) etc.
- ▶ Particulate pollutants include smoke, dust, soot, fumes, aerosols, liquid droplets, pollen grains et

Causes:

The sources of air pollution are natural and man-made (anthropogenic).

Natural Sources: The natural sources of air pollution are volcanic eruptions, forest fires, sea salt sprays, biological decay, pollen grains of flowers, spores etc.
Man-made:

Man made sources include thermal power plants, industrial units, vehicular emissions, fossil fuel burning, agricultural activities etc.

- ▶ The most important indoor air pollutant is radon gas.
- ▶ Radon can be emitted from building materials like bricks, concrete, tiles etc. which are derived from soil containing radium.
- ▶ Many houses in the under-developed and developing countries including India use fuels like coal, dung-cakes, wood and kerosene in their kitchens.
- ▶ Complete combustion of fuel produces carbon dioxide which may not be toxic. However, incomplete combustion produces the toxic gas carbon monoxide.
- ▶ Coal contains varying amounts of sulphur which on burning produces sulphur dioxide.
- ▶ Fossil fuel burning produces black soot.
- ▶ These pollutants i.e. CO, SO₂, soot and many others like formaldehyde, benzo-(a) pyrene (BAP) are toxic and harmful for health.
- ▶ A house wife using wood as fuel for cooking inhales BAP.

Effects:

- ▶ Air pollution has adverse effects on living organisms and materials.
- ▶ **Effects on Human Health:** Oxides of nitrogen especially NO₂ can irritate the lungs and cause conditions like chronic bronchitis and emphysema. Carbon monoxide (CO) reaches lungs and combines with hemoglobin of blood to form carboxyhaemoglobin.
- ▶ CO has affinity for hemoglobin 210 times more than oxygen.
- ▶ Hemoglobin is, therefore, unable to transport oxygen to various parts of the body. This causes suffocation.
- ▶ Long exposure to CO may cause dizziness, unconsciousness and even death.
- ▶ Many other air pollutants like benzene (from unleaded petrol), formaldehyde and particulates like polychlorinated biphenyls (PCBs) toxic metals and dioxins (from burning of polythene) can cause mutations, reproductive problems or even cancer.

► **Effects on Plants:**

- Air pollutants affect plants by entering through stomata (leaf pores through which gases diffuse), destroy chlorophyll and affect photosynthesis.
- The damage can result in death of the plant.

► **Effects on aquatic life:**

- Air pollutants mixing up with rain can cause high acidity (lower pH) in fresh water lakes.
- This affects aquatic life especially fish.
- Some of the freshwater lakes have experienced total fish death.

► **Effects on materials:** Because of their corrosiveness, particulates can cause damage to exposed surfaces.

- Presence of SO₂ and moisture can accelerate corrosion of metallic surfaces.
- SO₂ can affect fabric, leather, paint, paper, marble and limestone.
- Ozone in the atmosphere can cause cracking of rubber.
- Oxides of nitrogen can also cause fading of cotton and rayon fibres

► Control of Air Pollution

- Air pollution can be minimized by the following methods:
- 1. Siting of industries after proper Environmental Impact Assessment studies.
- 2. Using low sulphur coal in industries
- 3. Removing sulphur from coal (by washing or with the help of bacteria)
- 4. Removing Nox during the combustion process.
- 5. Removing particulate from stack exhaust gases by employing electrostatic precipitators, bag-house filters, cyclone separators, scrubbers etc.
- 6. Vehicular pollution can be checked by regular tune-up of engines ; replacement of more polluting old vehicles; installing catalytic converters ; by engine modification to have fuel efficient (lean) mixtures to reduce CO and hydrocarbon emissions; and slow and cooler burning of fuels to reduce NOx emission.
- 7. Using mass transport system, bicycles etc.
- 8. Shifting to less polluting fuels (hydrogen gas).
- 9. Using non-conventional sources of energy.
- 10. Using biological filters and bio-scrub.

WATER POLLUTION Water pollution can be defined as alteration in physical, chemical or biological characteristics of water making it unsuitable for designated use in its natural state.

- ▶ **Sources of water pollution:**
- ▶ Water has the property to dissolve many substances in it, therefore, it can easily get polluted.
- ▶ Pollution of water can be caused by point sources or non-point sources.
- ▶ **Point sources** are specific sites near water which directly discharge effluents into them.
- ▶ Major point sources of water pollution are industries, power plants, underground coal mines, offshore oil wells etc.
- ▶ The discharge from non-point sources is not at any particular site, rather, these sources are scattered, which individually or collectively pollute water.
- ▶ Surface run-off from agricultural fields, overflowing small drains, rain water sweeping roads and fields, atmospheric deposition etc. are the non-point sources of water pollution

► **Ground water pollution:**

- There are a number of potential sources of ground water pollution.
- Septic tanks, industry (textile, chemical, tanneries), mining etc.
- They are mainly responsible for ground water pollution, which is irreversible.
- Ground water pollution with arsenic, fluoride and nitrate are posing serious health hazards.

► **Surface water pollution:** The major sources of surface water pollution are:

- **Sewage:** Pouring the drains and sewers in fresh water bodies causes water pollution.
- The problem is severe in cities.
- **Industrial effluents:** Industrial wastes containing toxic chemicals, acids, alkalis, metallic salts, phenols, cyanides, ammonia, radioactive substances, etc. are sources of water pollution.
- They also cause thermal (heat) pollution of water.
- **Synthetic detergents:** Synthetic detergents used in washing and cleaning produce foam and pollute water. •
- **Agrochemicals:** Agrochemicals like fertilizers (containing nitrates and phosphates) and pesticides (insecticides, fungicides, herbicides etc.) washed by rain-water and surface run-off pollute water.
- **Oil:** Oil spillage into sea-water during drilling and shipment pollute it.

► Effects of Water Pollution

Following are some important effects of various types of water pollutants:

► Oxygen demanding wastes:

- Organic matter which reaches water bodies is decomposed by micro-organisms present in water. For this degradation oxygen dissolved in water is consumed.
- Dissolved oxygen (DO) is the amount of oxygen dissolved in a given quantity of water at a particular temperature and atmospheric pressure.
- Amount of dissolved oxygen depends on aeration, photosynthetic activity in water, respiration of animals and plants at ambient temperature.
- Lower DO may be harmful to animals especially fish population.
- Oxygen depletion (deoxygenation) results in release of phosphates from bottom sediments and causes eutrophication
- Nitrogen and Phosphorus Compounds (Nutrients):
- Addition of compounds containing nitrogen and phosphorus helps in the growth of algae and other plants which when die and decay consume oxygen of water.
- Under anaerobic conditions foul smelling gases are produced.

- ▶ Pathogens: Many wastewaters especially sewage contain many pathogenic (disease causing) and non-pathogenic micro-organisms and many viruses.
- ▶ Water borne diseases like cholera, dysentery, typhoid, jaundice etc. are spread by water contaminated with sewage.
- ▶ Toxic Compounds: Pollutants such as heavy metals, pesticides, cyanides and many other organic and inorganic compounds are harmful to aquatic organisms
- ▶ The demand of (dissolved oxygen) DO increases with addition of biodegradable organic matter which is expressed as biological oxygen demand (BOD).
- ▶ BOD is defined as the amount of DO required to aerobically decompose biodegradable organic matter of a given volume of water over a duration of 5 days at 20° C.
- ▶ More BOD values of any water sample are associated with poor water quality.
- ▶ The non-biodegradable toxic compounds bio magnify in the food chain and cause toxic effects at various levels of food chain.
- ▶ Some of these substances like pesticides, methyl mercury etc. move into the bodies of organisms from the medium in which these organisms live.
- ▶ Substances like DDT are not water soluble and have affinity for body lipids.
- ▶ These substances tend to accumulate in the organisms body.
- ▶ This process is called bioaccumulation.
- ▶ The concentration of these toxic substances builds up at successive levels of food chain. This process is called bio magnification.

- ▶ Some heavy metals like lead, mercury and cadmium cause various types of diseases.
- ▶ Mercury dumped into water is transformed into water soluble methyl mercury by bacterial action.
- ▶ Methyl mercury accumulates in fish.
- ▶ In 1953, people in Japan suffered from numbness of body parts, vision and hearing problems and abnormal mental behavior.
- ▶ This disease called Minamata disease occurred due to consumption of methyl mercury contaminated fish caught from Minamata bay in Japan.
- ▶ The disease claimed 50 lives and permanently paralyzed over 700 persons.
- ▶ Pollution by another heavy metal cadmium had caused the disease called Itai-itai in the people of Japan. The disease was caused by cadmium contaminated rice.
- ▶ The rice fields were irrigated with effluents of zinc smelters and drainage water from mines.
- ▶ In this disease bones, liver, kidney, lungs, pancreas and thyroid are affected.
- ▶ Arsenic pollution of ground water in Bangladesh and West Bengal is causing various types of abnormalities.

- ▶ Nitrate when present in excess in drinking water causes blue baby syndrome or methaemoglobinemia.
- ▶ The disease develops when a part of haemoglobin is converted into non-functional oxidized form.
- ▶ Nitrate in stomach partly gets changed into nitrites which can produce cancer-causing products in the stomach.
- ▶ Excess of fluoride in drinking water causes defects in teeth and bones called fluorosis.
- ▶ Pesticides in drinking water ultimately reach humans and are known to cause various health problems.
- ▶ DDT, aldrin, dieldrin etc. have therefore, been banned. Recently, in Andhra Pradesh, people suffered from various abnormalities due to consumption of endosulphan contaminated cashew nuts

▶ **Control of Water Pollution**

- ▶ It is easy to reduce water pollution from point sources by legislation. However, due to absence of defined strategies it becomes difficult to prevent water pollution from non-point sources.
- ▶ The following points may help in reducing water pollution from non-point sources.
- ▶ Judicious use of agrochemicals like pesticides and fertilizers which will reduce their surface run-off and leaching.
- ▶ Use of nitrogen fixing plants to supplement the use of fertilizers.
- ▶ Adopting integrated pest management to reduce reliance on pesticides
- ▶ Prevent run-off of manure.
- ▶ Divert such run-off to basin for settlement.
- ▶ The nutrient rich water can be used as fertilizer in the fields.
- ▶ Separate drainage of sewage and rain water should be provided to prevent overflow of sewage with rainwater.
- ▶ Planting trees would reduce pollution by sediments and will also prevent soil erosion

- ▶ For controlling water pollution from point sources, treatment of wastewaters is essential before being discharged.
- ▶ Parameters which are considered for reduction in such water are Total solids, biological oxygen demand (BOD), chemical oxygen demand (COD), nitrates and phosphates, oil and grease, toxic metals etc.
- ▶ Wastewaters should be properly treated by primary and secondary treatments to reduce the BOD, COD levels up to the permissible levels for discharge.
- ▶ Advanced treatment for removal of nitrates and phosphates will prevent eutrophication.
- ▶ Before the discharge of wastewater, it should be disinfected to kill the disease-causing organisms like bacteria.
- ▶ Proper chlorination should be done to prevent the formation of chlorinated hydrocarbons or disinfection should be done by ozone or ultraviolet radiations

Impact of modern agriculture, degradation of soil

- ▶ A) Impact related to High yielding varieties: encourage Monoculture - which on one infestation of pathogen can lead to large devastation.
- ▶ B) Fertilizer related problems:
 - ▶ 1. **Micronutrient imbalance** focusing more on macro nutrients (NPK fertilisers) which boost up crop growth.in turn leading to deficiency of micronutrients- further affecting the productivity of soil.
 - ▶ 2. **nitrate pollution:** Nitrogenous fertilisers leach into deep soil contaminating the ground water- (25mg/L) blue baby syndrome(methhaemoglobinemia)
 - ▶ 3. **eutrophication** overnourishment of water bodies due to NPK fertilisers further leads to algal blooms. And this further leads to deficiency of dissolved Oxygen affecting the aquatic life.

▶ C) Pesticide related problems:

- ▶ 1. Creating resistance in pests and producing new pests: about 20 sps of pests become immune to pesticides and are known as Super pests.
- ▶ 2. death of non - target organisms
- ▶ 3. biological magnification
- ▶ 4. irrigation related problems
 - ▶ water logging
 - ▶ salinity problems

Degradation of soil:

- ▶ Soil formation is slow process naturally, abt 2.5cm or one inch of top soil to form it will take abt 200 -1000years
- ▶ When rate of soil erosion is faster than rate of renewal then soil is non - renewable resource.
- ▶ Increasing population growth the demands for aerable land is also incresing