15 Pollution — A Rising Environmental Problem

Syllabus : *(i) Types of pollution – air, water (fresh and marine), soil, radiation and noise.* **Self explanatory.**
(ii) Sources of pollution and major pollutants.
(iii) Effects of pollution on climate, environment, human health and other organisms and its abatement. Greenhouse effect and global warming, Acid rain, Ozone layer depletion.
Meaning of the terms, causes, effect on life on earth, idea about setting standards - ***Euro/Bharat stage vehicular standards.***

Scope of Syllabus : Sources of pollution and major pollutants.
Air : Vehicular, industrial, burning garbage, brick kilns.
Water : Household detergents, sewage, industrial waste, oil spills, thermal pollution.
Soil : Industrial waste, urban commercial and domestic waste, chemical fertilizers, biomedical waste like needles, syringes, soiled bandages etc., biodegradable waste like paper vegetable peels, etc., non-biodegradable waste like plastics, glass, styrofoam, etc, pesticides like DDT etc.
Radiation : X-rays, radioactive fall out from nuclear plants.

Pollution is a serious problem of the modern times due to very rapid advancement in several areas such as industries, transport, agriculture, residential set-ups, thermal and nuclear power generation plants. It is causing deterioration and even poisoning of the environment including air, water and soil. It is posing a serious threat to human health as well as to almost all kinds of our surroundings.

15.1 POLLUTION

POLLUTION

Pollution is the addition of any such constituent to air, water or land which deteriorates the natural quality of the environment.

AND

Pollutant is any such constituent which causes pollution.

Types of pollution

There are *five* major types of pollution :

1. Air pollution
2. Water pollution
3. Soil pollution
4. Radiation
5. Noise

15.2 AIR POLLUTION

Air pollution means degradation of the air quality harmfully affecting the living organisms as well as certain objects.

Types of air pollution

The air pollution is basically of *two* types :

1. **Gaseous pollution :** Harmful gases given out from a variety of sources.
2. **Particulate pollution :** Particles such as those of dust, smoke, mining, stone drilling, wearing of rubber tyres of motor vehicles.

Sources of air pollution

1. **Natural sources**

Examples : Ash from burning volcanoes, dust from storms and forest fires.

These pollutions are beyond human control and will continue to occur.

2. **Man-made sources**

Examples : Vehicular (automobiles), industries, garbage, brick kilns. These are the four major sources which, to a great extent, are under human control and the methods for controlling them are being developed.

15.2.1 Vehicular Air Pollution

There are various kinds of vehicles — the motor cars, trucks, buses, scooters, tractors, motor cycles, railway engines, etc. They are mostly running on petrol and diesel. The exhaust given out contain three main **gaseous pollutants** : CO_2, SO_2 and CO. Simultaneously, there is the wearing of rubber tyres of the automobiles releasing **rubber particles** and furthermore, the speeding vehicles also raise the **road dust particles** into the air. You must have also experienced a lot of dust raised when the road cleaners sweep the roads every morning.

GASES (Exhaust)

TYRE PARTICULATE AND DUST

Fig. 15.1 Particulate and gaseous emissions from an automobile.

Control : Efficient engines, good quality automobile fuels, lead-free petrol, greater use of compressed natural gas (CNG).

15.2.2 Industrial Air Pollution

The whole world is undergoing extensive industrial revolution. It ranges from small scale pottery and carpet weaving units to huge sugar factories, cloth factories, metal factories, automobile manufacturing units, drug manufacturers, oil refineries and so on. They give out all kinds of pollutants.

The chief industrial **gaseous pollutants** again consist of CO_2, SO_2 and CO and also oxides of nitrogen.

The smoke released by the factory chimneys into the air contains lot of **particulate pollutants**.

Fig. 15.2 Smoke from factory chimneys

Stone drilling and mining (coal, metals, etc.) produce fine particles which pose serious health hazards to the labourers involved.

SMOG (Smoke plus Fog)

The smoke released from various sources may get mixed with dust particles and small drops of fog to produce what is called **smog**. Smog is harmful to plants and, if inhaled, may cause asthma and allergies is humans.

15.2.3 Burning Garbage

The garbage mainly consists of items such as peelings of vegetables and fruits, shells taken off from dry fruits, washings of pulses, rice, etc., and also the leftovers in food dishes. Such waste is either used in composting (making manure for agricultural use) or burnt in special enclosures. On **burning**, the garbage releases CO_2 and some other **harmful gases** too. The smoke given out adds to the **particulate** air pollution.

15.2.4 Brick Kilns

Brick kilns (**Hindi :** *"eenton ke bhatte"*)

The brick kilns are fire-heated enclosures for making construction bricks. Raw moist clay bricks are arranged in heaps with fire-wood in between and then covered by layer of some special mud mixture to contain the burning flames inside. This set-up is left for a few days. The smoke collecting inside is released through a hole. On opening, the original mud-coloured bricks are found to be red, and there is a huge quantity of ash. The wastes produced are large quantities of ash and broken brick bits. These are all pollutants, which are either somehow reused or just dumped. Lot of smoke and heat given out are the pollutants.

? *PROGRESS CHECK*

1. Mention whether the following statements are ***true*** (T) or ***false*** (F)
   (i) Pollution and pollutant are one and the same thing. (T/F)
   (ii) Rubber tyres of motor vehicles contribute to particulate pollution. (T/F)
   (iii) The chief gaseous air pollutants are CO_2 and SO_2. (T/F)
   (iv) Kitchen garbage and leftovers in food dishes can be used for making manure (compost). (T/F)
   (v) Brick kilns give out both gaseous and particulate pollutants. (T/F)

2. Name any *four* ways to control vehicular air pollution.
3. Name any *two* small scale industries that can be the source of particulate air pollution.
4. Give *two* examples of gaseous air pollutants.

15.3 WATER POLLUTION

Water pollution means any change in the water quality which makes it unsuitable for use by humans and by other living organisms.

Sources of water pollution

The five major sources of water pollution are as follows :

1. Household detergents
2. Sewage
3. Industrial wastes
4. Oil spills
5. Thermal pollution

15.3.1 Household Detergents

Every home uses some detergents (cleansing agents) to wash and clean the soiled or worn garments, crockery, utensils, etc. The dirty water flows down the drains.

15.3.2 Sewage

Sewage is the liquid waste from domestic activities. It consists of kitchen wastes, toilet and other household waste water. Most cities have sewage treatment plants to remove the dirty part and release the cleaned fluid water into nearby water bodies or rivers. Small towns and villages may still be releasing their fluid wastes directly into some nearby large water body (river/lake).

[At some places, people are still following the practice of disposing off the dead bodies into the rivers, specially in India. If not the dead bodies, the ashes after cremation are very commonly immersed into rivers like Ganga at many places. We like it or not, such practices are sources of water pollution].

15.3.3 Industrial Waste

A large number of industries (small scale as well as large scale) produce waste water which contains various types of chemical pollutants. Such wastes are commonly discharged into the rivers. Fish processing industries set up near sea coasts release toxic wastes into the sea causing pollution.

15.3.4 Oil Spills

Oil spills are the accidential discharges of petroleum in oceans or estuaries. The sources of spills are the overturned oil tankers, offshore oil mining, oil refineries. Oil pollution kills a lot of marine life (fish, birds, etc.). Fig. 15.3 below shows a duck coated with oil.

Fig. 15.3 Oil spill affected duck.

15.3.5 Thermal Pollution

Many industries (thermal power plants, oil refineries and even nuclear power plants) use water for cooling their machinery. This hot waste water may be 8–10°C warmer than the intake water, and is released into the nearby streams, rivers or the sea and causes warming. This warming of water harmfully affects the animals (even killing the fish), and harms the plant life growing in it.

? PROGRESS CHECK

1. Mention whether the following statements are ***true*** (T) or ***false*** (F)
   (i) Liquid kitchen waste alone constitutes the sewage. (T/F)
   (ii) Household detergents are safe and non-contributors to water pollution. (T/F)
   (iii) Industrial wastes mainly consist of chemical pollutants. (T/F)
   (iv) Thermal power plants give out a lot of hot waste water. (T/F)
   (v) Hot water discharged into water bodies hardly affects the fish and other aquatic life. (T/F)

15.4 SOIL POLLUTION

The soil pollution is largely localised whereas the air and water pollutions can spread to long distances. The major sources of soil pollution are :

1. Industrial wastes

2. Urban commercial and domestic waste
3. Chemical fertilizers
4. Biomedical waste
5. Pesticides

15.4.1 Industrial waste

In addition to releasing gaseous air pollutants and chemical-laden water, industries also give out much solid wastes. These wastes are in the form of **chemical residues, flyash, metallic ash,** etc.

15.4.2 Urban Commercial and Domestic Wastes ("Urban": Relating to Cities)

The cities and towns have a variety of markets — food grains, vegetables and fruits. They have tailors, restaurants, banquet halls giving out lot of solid waste in different forms. At home, we produce wastes in the form of plastic bags, glass bottles, electric bulbs, kitchen waste, paper-packaging, etc. All this is **solid waste**. It is collected by municipal workers and dumped for proper disposal — part of this can be converted into manure, and the rest can be dumped in sanitary landfills.

Sanitary landfills are the places where the wastes are dumped in a ground depression and covered with dirt every day.

15.4.3 Chemical Fertilizers

Chemical fertilizers (nitrates, phosphates, ammonium salts) help in faster and increased crop yield. But their excessive use is harmful. These fertilisers are slowly washed away by the rain water, to reach lakes and ponds. This leads to **faster growth of bacteria** which **consume lot of oxygen** in water resulting in the **death of fish and other water animals**.

15.4.4 Biomedical Waste

There are numerous items under this category:

- needles, syringes, dirty dressings, etc.
- unused discarded medicinal tablets and powders.
- discarded biological research materials carelessly disposed off in the municipal garbage.

Such waste often reaches the soil and may cause harm to soil organisms, and also to humans indirectly through some agents.

15.4.5 Pesticides

Several pesticides such as DDT were much used to kill pests in agricultural farms, godowns and even at homes. Most of these persisted (undegraded) in the environment as pollutants causing much harm to life indirectly. Presently, milder pesticides are being used, but even these are pollutants.

Pesticides such as DDT (dichloro-diphenyl-trichloroethane), used in agriculture to destroy pests alter the basic structure of soil, kill microorganisms in it and may even reach the human body through food grown in such soils. The killed microorganisms are mostly those that recycle the nutrients in the soil.

The wastes generated from the various sources described above can be categorised into two types :

(i) **Biodegradable waste.** Material which can be degraded (broken down) by microorganisms into relatively harmless compounds.
Examples : Paper, vegetable peels, food left-overs, sewage, cow dung, dried leaves, hay, etc.

(ii) **Non-biodegradable waste.** Material which cannot be degraded.
Examples : Plastic, glass, styrofoam (a kind of packing material) and pesticides like DDT.

PROGRESS CHECK

1. Mention whether the following statements are ***true*** (T) or ***false*** (F)
   (i) Soil pollution is largely localised. (T/F)
   (ii) Flyash and metallic ash are examples of urban domestic waste. (T/F)
   (iii) Chemical fertilisers may reach the rivers but do not harm the fish. (T/F)
   (iv) Biomedical waste may consist of both biodegradable and non-biodegradable waste. (T/F)
2. List any *two* degradable and any *two* non-degradable medical wastes released from hospitals.

15.5 RADIATION

Radiation is a form of energy consisting of high energy particles. It is being used extensively in the fields of **medicine** (X-rays, etc.) and in generating electricity in the **nuclear power plants**.

X-rays contain a great deal of energy (measured in **photons**, the units of energy). They damage the body cells. Too frequent and too many X-ray exposures may cause serious health hazards (damaged chromosomes, genetic variations, bone cancer, etc.). X-ray machine operators have to take very special care to avoid exposure as much as possible.

Nuclear power plants can be the sources of leak of nuclear radiations either through the negligent disposal of wastes or by any accidental explosion of the plant. Two very serious nuclear plant explosions have occurred — one in Chernobyl (Ukraine) in 1986 and the other in Japan (Fukushima Daiichi Nuclear Plant) on 11, March 2011. So many people died and many more suffered radiation exposure causing health problems such as haemorrhaging and even cancers. The chief radiation pollutant was **Iodine 131**, which raises the risk of thyroid cancer. Radiation even leaked into the sea and reached humans passively through sea food.

Fig. 15.4 Recording radioactivity levels at a village, about 40 km from the Fukushima Daiichi nuclear power plant in Japan

Carelessly discarded radioactive material may cause severe damage as it happened in Mayapuri Delhi in 2010. The radioactive waste (Cobalt 60) from a research centre somehow reached the market streets through "kabaris". Several exposed people are still suffering and had even died. A Delhi resident sufferer from nuclear (Cobalt 60) radiation had ignorantly kept Cobalt 60 pencils in his back pocket, and suffered serious burns (Fig. 15.5).

Fig. 15.5 A cobalt 60 radiation sufferer from Delhi.

15.6 NOISE POLLUTION

Noise is defined as any unpleasant/loud undesired sound interfering with one's hearing and concentration.

Major sources of noise are the industrial machines, workshops, trains, automobiles on the streets, jet aircrafts landing and taking off in the air, loud conversation and the radio or television inside houses, the loudspeakers and musical bands in public places, and so on.

— If you are reading something seriously or solving a mathematical problem, even a mild conversation in the room becomes noise.

— But, if you are doing some light reading in a running train, you may not get disturbed.

Fig. 15.6 Noise pollution

Harmful effects of noise pollution :

1. **Interferes in communication.**
2. **Interrupts concentration of thought** and disturbs peace of mind.
3. **Lowers efficiency** of work.
4. **Disturbs sleep** and leads to nervous **irritability.**
5. A sudden loud sound can **damage ear drum. Prolonged noise** can even **lead to deafness.**
6. **Bird life** gets **disturbed** by aircrafts landing or taking off from airports.

Measures to minimise noise pollution :

— Prohibiting blowing of horns.

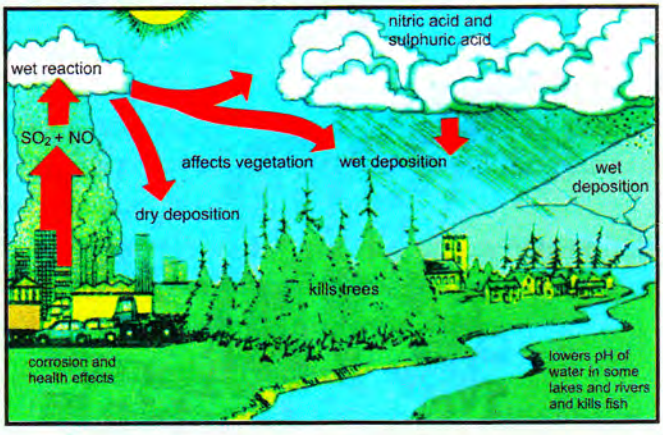
— Restriction on loud speakers, specially during night.

— Planting trees by the road side and keeping doors closed in the houses reduce noise reaching our ears.

— Not to burn fire crackers.

PROGRESS CHECK

1. Mention whether the following statements are ***true*** (T) or ***false*** (F)
   (i) X-rays are a potential source of radiation pollution. (T/F)
   (ii) Unwanted disturbing sound, even if it is music next door, is noise. (T/F)
   (iii) People routinely working in noisy places are not much affected by noise. (T/F)
2. List any *three* common places which are potentially major noise producers.
3. Can you make out the pollutions shown below ?



15.7 EFFECTS OF VARIOUS TYPES OF POLLUTION

Pollution affects the environment, humans and other life in numerous ways. The more significant ones are as follows :

A. Effects on human health

- *Air pollution* causes respiratory problems, lung disorders. **Particulate lead** may cause blood cell shortage. **Smog** (smoke + fog) leads to asthma and poor visibility. The **exhaust gas SO_2** causes serious damage to the air passages in lungs (the disease bronchitis).
- *Water pollution* may lead to several diseases like cholera, jaundice and typhoid.
- *Soil pollution* may indirectly affect human health. The pesticides used in agricultural farming may cause health problems.

B. Effects on climate and environment

Pollution affects the climate and environment in several ways but the three most significant ones are : *(i)* Acid rain, *(ii)* Greenhouse effect and global warming and *(iii)* Ozone layer deplection

1. Acid rain

Normally the clean rain is only slightly acidic (pH of about 6) because of some CO_2 naturally present in the atmosphere. Due to increasing industrialisation there is lot of emission of CO_2, and sulphur dioxide (SO_2) and oxides of nitrogen which get dissolved in the rain drops falling on earth as rain. This is the **acid rain**.

Harmful effects of acid rain :

- Damage to vegetation by pollution of the soil.
- Decay of building material and paints.
- Erosion of ancient monuments, statues and sculpture by the acid reacting with the calcium.
- The fine particles (sulphates, nitrates) degrade visibility and harm the human health.
- Fish and other aquatic animals are harmed due to increased acidity of the water in such lakes/ rivers, *etc.*

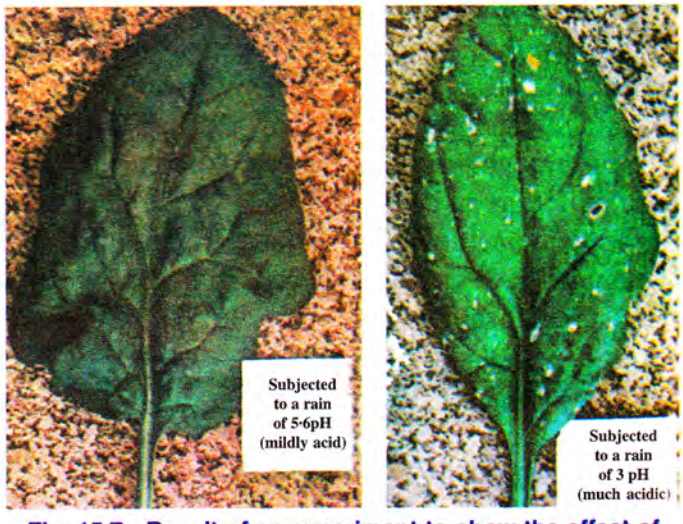


Fig. 15.7 : Result of an experiment to show the effect of acid rain on spinach leaves

2. Greenhouse effect and global warming

- *What is a greenhouse.* Greenhouses are small glass houses specially constructed to grow plants particularly during cold winters. The glass panel all around lets the sunlight enter but *does not*

allow the heat to escape. (You experience the same thing inside a car parked in sun for a few hours).

- Certain gases *specially* CO_2 and methane (CH_4) accumulating in the atmosphere prevent the escape of heat, thus *warming the air* (Greenhouse effect).
- With increased industrialisation, burning of fuels in homes, and rising population **more CO_2 is released**. On the other hand, the decreasing vegetation and deforestation is leading to **less CO_2 utilisation in photosynthesis**. Thus overall rise in CO_2 is leading to greater retention of the solar radiation in the atmosphere causing **global warming**.

  During the last three decades the temperature of the Earth atmosphere has increased by about 0·5°C. This is causing melting of snow caps, rise in sea level, as well as decline in food production in agricultural fields and in fishery resources in the oceans.

3. Ozone layer depletion

Ozone (O_3) is an allotropic form of oxygen (O_2). It forms a sort of sunscreen high up in the atmosphere. It prevents the harmful type of ultra-violet rays (UV-B) coming down from the sun. Certain gaseous compounds such as CFCs (chlorofluorocarbons) released from refrigerators, aerosol-sprayers and packing material styrofoam, rise into the atmosphere. There they break down into chlorine atoms which in turn breakdown **ozone** (O_3) **into oxygen** (O_2) and O. The reduced ozone cannot prevent the entry or harmful UV-B rays to the earth, which cause sun burn, genetic disorders, skin cancers and reduced productivity of forests and sea.

INTERNATIONAL OZONE DAY
September 16
[Do not disturb ozone layer].

15.8 ABATEMENT OF POLLUTION (*abatement : diminishing or nullifying*)

Pollution cannot be totally stopped but several steps can be taken to curtail it.

- Use of unleaded petrol and of CNG (Compressed Natural Gas) in automobiles.
- Switching of the automobile engines at red lights and when not in use.
- Installation of tall chimneys in factories, and fitting them with filters and, electrostatic precipitators.
- Treating industrial effluents before discharging them into water bodies.
- Not to throw food wastes into open ground or in the drains.
- Setting up of **sewage treatment plants** in larger habitations, and **septic tanks** in houses.
- Greater use of compost (organic matter) instead of chemical fertilisers, and judicious use of pesticides.
- Recycling of plastic, metal and glass material and incineration (burning) of non-recyclable waste.
- Planting of trees along roadside, waste land and mountainous slopes reduces soil erosion as well as improves the air quality (reduction of the amount of CO_2 in the atmosphere).

VEHICULAR STANDARDS :

Certain norms have been laid down under the title **Euro/Bharat norms** which are applicable to all automobiles, on the levels of emissions given out — stricter controls to be maintained in most large cities. Government of India has adopted auto fuel policy to effectively **cut down sulphur and nitrogen oxides** in the automobile exhausts.

? *PROGRESS CHECK*

1. Mention whether the following statements are ***true*** (T) or ***false*** (F)
   (i) Diseases like cholera and jaundice are the results of **soil pollution**. (T/F)
   (ii) CO_2 and methane are **directly** contributing to global warming. (T/F)
   (iii) Erosion of ancient monuments and statues is caused by acid rain which itself is the result of gaseous pollution. (T/F)
   (iv) Use of unleaded petrol and compressed Natural Gas (CNG) in automobiles is one of the methods of abatement of gaseous and particulate air pollution. (T/F)

REVIEW QUESTIONS

A. MULTIPLE CHOICE TYPE

(Select the most appropriate option in each case)

1. Which one the following is an example of **pollutant** ?
   (a) A rat entering your kitchen.
   (b) CO_2 given out by the respiring organisms.
   (c) The heat given out while cooking food.
   (d) The dust raised during road-cleaning
2. Which one of the following is a "dirty" practice contributing to pollution and seriously needs stoppage by educating the public ?
   (a) Too loud marriage musical bands
   (b) Disposing of corpses in rivers
   (c) Floating lighted earthen lamps ("deeyas") in rivers
   (d) Wearing scented/perfumed clothes
3. One of the examples of radiation pollutants is
   (a) Sulphur dioxide
   (b) Ozone
   (c) Iodine – 131
   (d) Discarded fused electric bulbs

B. VERY SHORT ANSWER TYPE

1. Name the following pollutants :
   (i) A pollutant which is mainly responsible for causing acid rain
   (ii) Any two chemicals leading to the formation of ozone holes.
   (iii) The chemical element which caused minimata disease in Japan.
2. Match the items in column I with the closely related ones in column II.

Column I	Column II
(i) Chlorofluocarbons (CFCs)	(a) Global warming
(ii) Flyash	(b) Biodegradable
(iii) Cow dung	(c) Nuclear radiation pollutant
(iv) CO_2 and methane	(d) Acid rain
(v) Sulphur dioxide	(e) Industrial waste
(vi) Iodine – 131	(f) Ozone depletion

3. Fill in the blanks :
   (i) Rubber particles and dust raised by running motor vehicles are examples of ..... pollutants.
   (ii) Too frequent exposure to ..... in a medical diagnostic technique may damage chromosomes.
   (iii) Thermal power plants give out a lot of ..... waste water.
   (iv) Sewage is a liquid waste from ..... .

C. SHORT ANSWER TYPE

1. List two major harmful effects of each of the following :
   (i) Rivers contaminated with sewage.
   (ii) Too much gaseous exhausts containing CO_2 and SO_2.
   (iii) Pesticides such as DDT used in agriculture.
   (iv) Prolonged noise such as the one produced by crackers throughout night.
2. List the three major constituents of sewage.
3. What are the common sources of oil spills, and how do they affect sea life.
4. Mention any two measures to minimise noise pollution.

D. STRUCTURED/APPLICATION/SKILL TYPE

1. A lot of fish are dying near a sea shore. Describe any two possible causes.
2. Look at a cartoonist's presentation of a kind of pollution given below.
   (i) Name the kind of pollution.
   (ii) List the sources of pollution.
   (iii) Mention any two harmful effects of this pollution.