

Unit

5

Environmental Pollution

For normal and healthy living a conducive environment is required by all the living beings, including humans, livestock, plants, micro-organisms and the wildlife. The favourable unpolluted environment has a specific composition. When this 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.** Environmental pollution could be of various types:

■ 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 etc.

Radioactive pollutants include radon-222, iodine-131, strontium-90, plutonium-239 etc.

Sources of Air Pollution

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, photochemical oxidation of terpenes, marshes, extra terrestrial bodies, pollen grains of flowers, spores etc. Radioactive minerals present in the earth crust are the sources of radioactivity in the atmosphere.

Man-made: Man made sources include thermal power plants, industrial units, vehicular emissions, fossil fuel burning, agricultural activities etc. Thermal power plants have become the major sources for generating electricity in India as the nuclear power plants couldn't be installed as planned. The main pollutants emitted are fly ash and SO_2 . Metallurgical plants also consume coal and produce similar pollutants. Fertilizer plants, smelters, textile mills, tanneries, refineries, chemical industries, paper and pulp mills are other sources of air pollution.

Automobile exhaust is another major source of air pollution. Automobiles release gases such as carbon monoxide (about 77%), oxides of nitrogen (about 8%) and hydrocarbons (about 14%). Heavy duty diesel vehicles spew more NO_x and suspended particulate matter (SPM) than petrol vehicles which produce more carbon monoxide and hydrocarbons.

Indoor Air Pollution

The most important indoor air pollutant is radon gas. Radon gas and its radioactive daughters are responsible for a large number of lung cancer deaths each year. Radon can be emitted from building materials like bricks, concrete, tiles etc. which are derived from soil containing radium. Radon is also present in groundwater and natural gas and is emitted indoors while using them.

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 , SO_2 , soot and many others like formaldehyde, benzo- (a) pyrene (BAP) are toxic and harmful for health. BAP is also found in cigarette smoke and is considered to cause cancer. A house wife using wood as fuel for cooking inhales BAP equivalent to 20 packets of cigarette a day.

Effects of air pollution: Air pollution has adverse effects on living organisms and materials.

Effects on Human Health: Human respiratory system has a number of mechanisms for protection from air pollution. Bigger particles ($> 10 \mu\text{m}$) can be trapped by the hairs and sticky mucus in the lining of the nose. Smaller particles can reach tracheobronchial system and there get trapped in mucus. They are sent back to throat by beating of hair like cilia from where they can be removed by spitting or

swallowing. Years of exposure to air pollutants (including cigarette smoke) adversely affect these natural defenses and can result in lung cancer, asthma, chronic bronchitis and emphysema (damage to air sacs leading to loss of lung elasticity and acute shortness of breath). Suspended particulates can cause damage to lung tissues and diseases like asthma, bronchitis and cancer especially when they bring with them cancer causing or toxic pollutants attached on their surface. Sulphur dioxide (SO_2) causes constriction of respiratory passage and can cause bronchitis like conditions. In the presence of suspended particulates, SO_2 can form acid sulphate particles, which can go deep into the lungs and affect them severely.

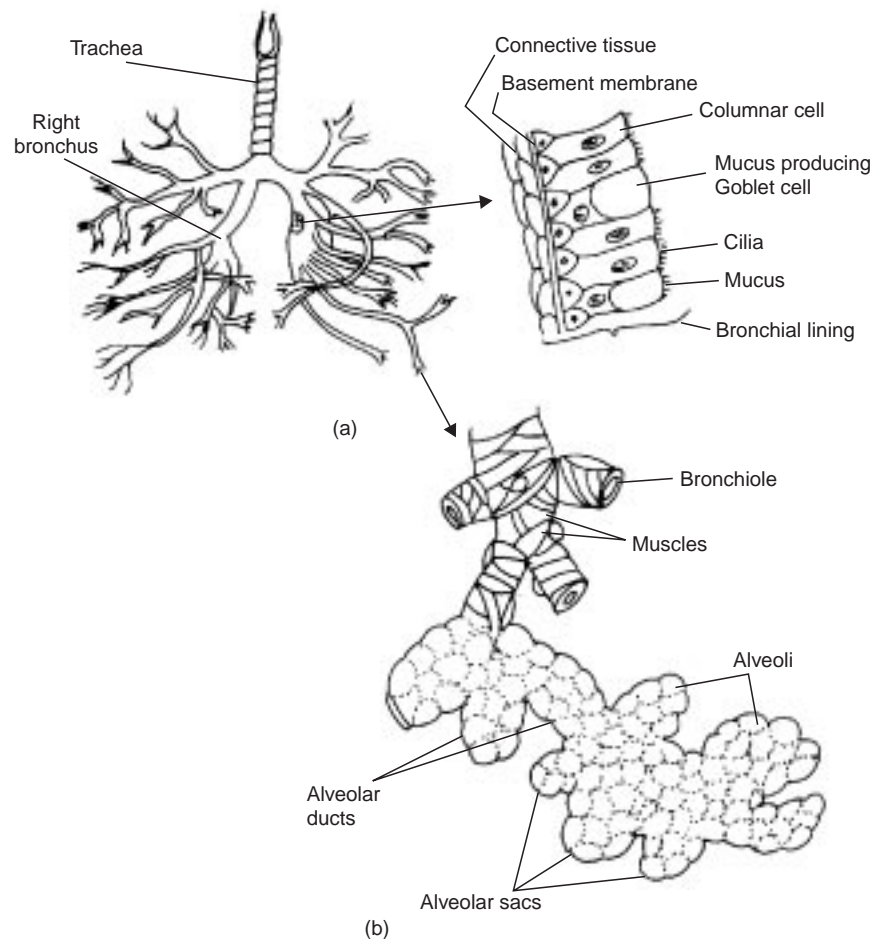


Fig. 5.1. Lower respiratory system of human beings (a and b) and cross section of bronchial lining showing cilia and goblet cells.

Oxides of nitrogen especially NO_2 can irritate the lungs and cause conditions like chronic bronchitis and emphysema. Carbon monoxide (CO) reaches lungs and combines with haemoglobin of blood to form carboxyhaemoglobin. CO has affinity for haemoglobin 210 times more than oxygen. Haemoglobin 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. Pollutants also erode waxy coating of the leaves called cuticle. Cuticle prevents excessive water loss and damage from diseases, pests, drought and frost. Damage to leaf structure causes *necrosis* (dead areas of leaf), *chlorosis* (loss or reduction of chlorophyll causing yellowing of leaf) or *epinasty* (downward curling of leaf), and *abscission* (dropping of leaves). Particulates deposited on leaves can form encrustations and plug the stomata. 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 SO_2 and moisture can accelerate corrosion of metallic surfaces. SO_2 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:

- Siting of industries after proper Environmental Impact Assessment studies.
- Using low sulphur coal in industries
- Removing sulphur from coal (by washing or with the help of bacteria)
- Removing NO_x during the combustion process.