

POLLUTION

“Environment is the representative of physical components of the earth wherein Man is the important factor influencing his environment”.

Difference between Environment Degradation and Pollution?

The most of the people thinks that environmental degradation and pollution are synonym as both are concerned with the lowering of the quality of the environment.

But there is Distinction between these two.

- ❖ **Environment Pollution** means lowering of the quality of the environment at the local scale caused exclusively by human activities.
- ❖ **Environmental Degradation** means lowering of environmental quality at local regional and global scales by both natural processes and human activities.

For Example: Volcanic eruptions, earthquakes, atmospheric storms like cyclones, forest fires, Hailstorms, geological erosion avalanches etc. are the natural factors which caused the environmental degradation but natural processes absorb them and keep the ecosystem in balance.

The adverse changes in the environmental quality caused by human activities as referred to above and thus lowering of environmental quality caused by human activities at local level is generally called Pollution .But sometimes the effects of human activities are so immense that the environment is degraded at global level as well .

POLLUTANTS: Any form of energy or matter or action that causes non-equilibrium state from equilibrium state in any existing natural ecosystem. Pollutants are divided on different bases into various types as follows:

1) On the basis of Source of Genesis

- I.Natural
- II.Man-made pollutants

Natural pollutants are manageable because of the laws of cybernetics or homeostatic mechanism, but unfortunately man is not making any permanent arrangement for pollutants made by him.

2) Pollutants are divided on the basis of Visibility into the following two types.

- I.Visible Pollutants
- II.Invisible Pollutants

Visible Pollutants include smoke gases, Dusts coming out of ‘human Volcanoes; waste water or sewage water coming out from factories and urban areas, animal and human waste etc. whereas Invisible pollutants include several types of bacteria, toxic chemicals mixed with water and soil etc.

3) Pollutants may be classified on the basis of their state as follows:

- I.Solid Particulate: Pollutants (aerosols, industrial wastes such as lead, mercury, tailings, asbestos etc)
- II.Gaseous Pollutants: (Chlorofluoro carbons, CO₂, Sulphur dioxide, nitrogen oxide, Carbon monoxides, methane etc.)
- III.Liquid Pollutants: (Oil slicks, dissolved solids, ammonia, urea, nitrate, chloride, fluoride, Carbonates, pesticides and insecticides etc –all in dissolved form oil and greases etc)

4) Pollutants may also be divided on the basis of areas polluted by specific pollutant and group of pollutants into 3 types.

I. Air Pollution: (Particulate matter, gases, smokes, soots etc)

II. Water Pollution: (Dissolve and suspended solids. Different types of ions, pesticides and insecticides residues, toxic metals such as lead, mercury and cadmium radioactive wastes etc)

III. Land Pollutants: Human and animal excreta, garbage, pesticide, insecticides and chemical fertilizers, machines and tools radioactive substances etc.

SOURCES OF POLLUTION

Two Categories:

1) Natural Source

- ❖ Volcanic ashes and dusts from volcanic eruptions (Volcanic dust in the air reduce air temp)
 - a. Undesirable substances brought to the surface because of fracture and faults caused by seismic events.
- ❖ Flood water in low lying area causes disease etc.

2) Anthropogenic Source

- ❖ Industrial Source
- ❖ Urban Source
- ❖ Agricultural Source
- ❖ Population Source

Industrial Source: Gaseous pollutants (Sulphur dioxide, nitrogen oxide, Carbon monoxides, methane and numerous toxic gases) solid pollutants dissolved and suspended solids, waste water having numerous chemical ingredients, heat etc.

Urban Source: Sewage water, solid waste, gaseous exhaust, liquid effluents, pollutants coming out of chimneys of factories located within the urban centers etc.

Agricultural Source: Chemical fertilizer, pesticides and insecticides

Human Pollution: Human pollution is the most important source of pollution because all forms of anthropogenic pollution are the creation of human activities. The ever increasing population in the developing countries is posing as much problem as in developed countries through industrial growth and urban expansion. Poverty and under development are yet another sources of pollution.

TYPES OF POLLUTION

1) AIR POLLUTION

Air is very important for all types of life in the biosphere. Human life is not possible without air because man can live for few days without water or for a few weeks without food but cannot survive even for few minutes without air.

It may be pointed out that air is never pure because some gases such as sulphur dioxide, hydrogen sulphide, carbon monoxide, emissions from volcanoes and swamps, windblown dusts, salt spray, pollen from plants etc. are continuously added to the air by the natural process. Thus the air becomes polluted whenever the natural composition is disturbed either by natural or man-made sources or both.

Air Pollution is generally accomplished through the pollutants of gases and solid and liquid particles of both organic and inorganic chemical classification important being CO₂, fluorocarbons,

nitrogen oxides, sulphur compounds, waste heat, water vapour, ammonia, Hydrocarbons, mechanic, Peroxyacetylnitrates, methyl bromide, krypton-85, aerosol etc.

➤ **SOURCES AND TYPES OF AIR POLLUTION**

- 1) **Natural Source:** (Volcanic eruptions, deflation of sands and dusts, forest fires etc.)
- 2) **Anthropogenic Sources:** Industries, urban centers, automobiles, aircrafts, agriculture, power plants etc.

NATURE OF AIR POLLUTANTS: Like source of air pollutants and pollution, air pollution is also divided on the basis of sources into the following two broad categories:

(1) **Natural Pollutants**

- (a) From volcanic eruptions, dusts, ashes, smoke, carbon dioxide and other gases.
- (b) From extra terrestrial bodies, cosmic dusts, dusts produced due to collision of asteroids, meteors, comets etc with the earth.
- (c) From green plants vapour through evapotranspiration, pollen from plant flowers, carbon dioxide from bacteria.
- (d) From fungi, fungal spores, viruses etc.
- (e) From land surfaces salt sprays from seas and lakes dust and soil particles from ground surface.

(2) **Anthropogenic Pollutants**

- (a) gases from kitchen and domestic heating, industries, incineration of municipal and domestic garbage's, automobiles, diesels locomotives of railways, aircrafts etc.
- (b) Particulate matter from industries, mines and urban centers mostly from automobiles
- (c) Radioactive substances from nuclear plants nuclear fuel releases, nuclear tests etc.
- (d) Heat from industries, domestic kitchens and room heating, thermal power plants etc.

➤ **Air pollution is also divided on the basis of the nature of pollutants into following two broad categories:**

(i) **Gaseous air pollutants**

- (a) Carbon Dioxide (CO₂), Carbon Monoxide (CO) from combustion of fossil fuels, transportation sectors, industrial processes and garbage disposal.
- (b) Hydrocarbons (carbons and hydrogen containing compounds in oxygenated hydrocarbons) for incomplete combustion of fuels.
- (c) Fluorocarbons, from aerosol cans and refrigeration systems.
- (d) Sulphur compounds SO and SO₃, H₂S (Hydrogen sulphide) and H₂SO₄ (sulphuric acids) from the burning of sulphur containing fossil fuels.
- (e) Nitrogen oxide and other nitrogenous compounds such as NO₂ (Nitrogen Dioxide), N₂O (nitrous oxides), NO (nitric oxide) and NO₃ (nitrogen Trioxide) from high flying aircrafts, combustion of fossil fuels and from chemical fertilizers.
- (f) Aldehydes from thermal decomposition of fats, oils or glycerol and
- (g) Chlorine from bleaching cotton clothes and flours and many other chemical processes.

(ii) **Particulate Air Pollutants**

(a) **aerosols** : are those fine particles which are round , one micron to 10 microns in size , these are added to the atmosphere by industries , thermal power generation , automobiles, space heating , agricultural activities etc.

(b) Dusts include those solid particles which are larger than aerosols in size; these are added to the air from all types of combustions and agriculture.

Particulate pollutants are also divided into the following two types:

(i) **Visible or living particulate matter**

E.g. bacteria, pollen grains, fungal and other spores all of which belong to category of natural air pollutants.

(ii) **Non-Living Particulate Matter**

E.g. all of the pollutants whether gaseous or particulate from anthropogenic sources as referred to above.

➤ **TYPES OF AIR POLLUTION**

Air pollution may be dividing on two bases as follows:

(1) On the basis of types of air pollutants, air pollution is divided in two major types

- (i) Gaseous air pollution
- (ii) Particulate air pollution

(2) On the basis of sources of air pollutants air pollution is divided into following types:

- (i) Automobiles air pollution
- (ii) Industrial in pollution
- (iii) Thermal air pollution
- (iv) Urban air pollution
- (v) Rural air pollution
- (vi) Nuclear air pollution

Carbon Monoxide and Air Pollution: The major source of the production of carbon monoxide (CO) is in incomplete burning of fossil fuels like coal, petroleum and wood charcoal. The automobiles using diesel and petroleum are the major sources of carbon monoxide. Besides, carbon monoxides are also produced from oil refineries, metallurgical operations and numerous combustion engines. It is apparent that urban area and industrial centers are the most significant contributors of carbon monoxide because they account for the largest number of automobiles and industries. Thus carbon monoxide contributes about 50 percent of the total air pollutants. The USA alone produces about 65 million tons of carbon monoxide per year. It may be mentioned that carbon monoxides not toxic to plants but it causes respiratory problem and suffocation when inhaled, in the human bodies. In spite of the presence of oxygen in sufficient amount in the room with burning coal carbon monoxide causes suffocation and if the room is closed, it causes death.

Carbon Dioxide and Air Pollution: Carbon Dioxide gas is one of the natural gaseous components of the atmosphere and in itself it is not harmful to human health rather it is a resource because plants manufacture their food through the process of photosynthesis by using carbon dioxide in the presence of sunlight and it is the food manufactured by green plants upon which depend all organisms including man. The content of CO₂ in the atmosphere is increasing at an alarming rate because of two major factors

- (i) Release of CO₂ due to burning of fossil fuels t ever-increasing rate

(ii) Gradual decrease in the consumption of CO₂ because of shrinking forest covers due to rapid rate of deforestation.

The higher concentration of carbon dioxide in the atmosphere increases the green house effect of the atmosphere and thus increases the temperature of the earth's surface because carbon dioxide is more or less transparent to incoming shortwave solar radiation and thus allows the radiation to pass through the atmosphere and reach the earth's surface but stops the outgoing long wave terrestrial radiation from escaping to the space. In other words atmospheric carbon dioxide together with other green houses trap the outgoing heat radiation waves of the earth and thus warms up the air which results in gradual increase in the temperature of the earth's surface and the lower atmosphere.

The increasing content of atmospheric carbon dioxide from anthropogenic carbon dioxide from anthropogenic sources is expected to have far reaching effects on global climate through gradual rise in temperature as given below:

- ❖ There may be substantial decrease in precipitation and soil moisture content in the most developed agricultural region in the world.
- ❖ There would be gradual increase in organic salinity which would decrease biological productivity of marine ecosystem which would change the Albedo of the ocean surface.
- ❖ There would be melting of continental and mountain glaciers and consequent rise in sea level and resultant flooding of coastal low lands.

Chlorofluorocarbon and ozone Depletion:

- ✓ The Chlorofluorocarbons, popularly known as CFCs, belonging to the category of chemical synthesized by man for use in several kinds of industries including refrigeration, are relatively simple compounds of the elements chlorine, fluorine and carbon and are initially stable compounds which do not have any toxic effect on life processes in the biosphere at the ground level.
- ✓ These synthetic chemicals are widely used as propellants in spray can dispensers, as fluids in air conditioners and refrigerators, as blowing agents in insulation foams and as industrial solvents.
- ✓ It is estimated that about 25 percent of the total world production of Chlorofluorocarbon is used to propel "personal care products" such as deodorants, hair spray, shaving cream and numerous other cosmetic products. The most important of Chlorofluorocarbon hydrocarbons are the trichlorofluoromethane and dichlorofluoromethane.
- ✓ The emissions of Chlorofluorocarbons (CFCs) in aerosol and non- aerosol forms from aerosol spray cans, air conditioners and refrigerators, foam plastics etc. into the troposphere and their transport to the stratosphere increase the concentration of Chlorofluorocarbon because these keep on accumulating in the stratosphere as they do not degrade for long period of time .
- ✓ The Chlorofluorocarbon (CFCs) ,after being broken by the ultra-violet solar radiation , destroy the strong ozone which act as a protective cover for all biotic communities of the biosphere because ozone layer absorbs ultraviolet solar radiation and this protect the earth from becoming too hot.
- ✓ It may be pointed out that the air is being increasingly polluted due to release of CFCs in the atmosphere. The atmospheric concentration of CFCs increasingly rapid at the rate of 13 to 28 percent per annum. Thus the depletion of ozone due to increased concentration of Chlorofluorocarbons is one of the most dangerous forms of air pollution.
- ✓ Thus the ozone depletion caused by increased concentration of Chlorofluorocarbon would adversely affect the global climate, biotic communities and human beings. The substantial

increase in the surface temperature of the earth would cause climate changes at regional and global level.

- ✓ The overall warming of the environment would cause melting of continental glaciers and ice caps such as those of Greenland and Antarctica. This would in turn cause rise in sea level and consequent submergence of coastal areas of low-lying countries.
- ✓ The increased surface temperature and exposure of human bodies to increase ultra-violet solar radiation would cause skin cancer mainly among the white population. Increased exposure of human bodies to ultra-violet solar radiation would decrease immunity of human bodies against infectious diseases.
- ✓ Thirdly, increase ultra – violet radiation and consequent increase photochemical processes would cause poisonous smog Fourthly human beings will face food shortage because very severe adverse effects of increased ultra-violet solar radiation on agricultural crops , vegetation communities and fishes in the fresh water and marine aquatic ecosystem.

Methane and Air Pollution:

- ✓ The major sources of production of methane (CH₄) which belongs to the category of green house gases are biological processes such as enteric fermentation in cattle, sheep and other animals, anaerobic situation in wetlands and rice fields and anthropogenic activities, such as biomass and fossil fuels.
- ✓ Concentration of methane gas in the stratosphere increases water vapour there and thus increases water vapour together with other factors intensities in green house effect of the atmosphere which cause rise in the temperature of earth's surface.

Sulphur Dioxide and Air Pollution:

- ✓ Sulphur dioxide gas (SO₂) is produced by both natural and man-made sources. After monoxide (CO), sulphur dioxide is the second important contributor of air pollutants as it accounts for about—29 percent of the total weight of all pollutants.
- ✓ It may be pointed- out that sulphur is essential element for both plants and animals only in trace amount but when the concentration of increases in the atmosphere, it becomes injurious to both plants and animals because increased concentration of sulphur increases the acidity of water and lowers the pH of water significantly.
- ✓ The major man-made sources of sulphur dioxide are thermal power plants (where huge amount of coal is burnt to generate power), crude oil refineries and automobiles which together account for 50% of total SO₂ pollution from man-originated source.
- ✓ Sulphur dioxide (SO₂) through the chemical reactions with atmospheric oxygen and with water films on suspended path produces sulphuric acids (H₂SO₄) which is highly corrosive and leading culprit to human health and wealth. Sulphuric acids coming down with rainfall cause acid rain having very low pH value ranging between 5 and 2.5.
- ✓ Acid rain is very dangerous hazard as it causes irreparable damage to agricultural crops, forests, aquatic life and human bodies. It corrodes buildings pollutes drinking water storage sources, and degrades soil biological process. The sulphur dioxide (SO₂) after combining with smoke over urban and industrial areas form poisonous smog which causes respiratory diseases in human and some time causes death.

Oxides of Nitrogen and Air Pollution:

- ✓ A few oxides of nitrogen such as nitric oxide (NO), nitrogen dioxide (NO₂) etc are important air pollutants. Nitrogen oxides are formed through natural processes as well as through man - induced process.
- ✓ The main sources of man originated nitrogen oxide are thermal power stations factories, automobiles and aircraft. In other words, nitrogen oxides are released to the atmosphere through the burning of coal and petroleum.
- ✓ High concentration of nitric oxide causes several diseases in human bodies such as gum inflammation, internal bleeding oxygen deficiency, Pneumonia lung cancer etc. Nitrogen oxides released from the exhausts of large fleets of supersonic jet aircrafts (travelling at more than double the speed of sound and at a height more 15,000 m, where ozone has its maximum concentration) of ozone by 30 percent.

Thermal Air Pollution: Heat energy released from industrial processes space heating and cooling, power generations stations into the atmosphere is expected to upset the balance between solar energy input and absorption of solar energy at the earth's surface which may lead to some changes in general atmospheric conditions.

Domestic Air Pollution: Domestic air pollution includes pollution of air due to pollutants emitted from the houses and offices in both rural and urban areas. The major domestic pollutants are smokes from cigarettes, biri, cigars and other tobacco smokes, burning of coal, firewood, cowdung cakes, kerosene oil and liquefied gases. Thus there are three major sources of domestic air pollution e.g. (i) several forms of tobacco smokes, (ii) kitchen smokes, and (iii) coal. The most widespread and serious domestic air pollutant is kitchen smoke mostly in the rural areas and slums of the urban areas in the developing countries. Most of the populations of rural India burn wood, twigs, leaf litters, cow dung cakes, coal and kerosene oil in the kitchens to cook food.

- **Adverse Effects of Air Pollution:** The effects of air pollution on environment and human society may be grouped into the following 3 categories:

(1) Effects on Weather on Climate

- (i) Depletion of Ozone
- (ii) Increased concentration of carbon dioxide and other green house gases in the atmosphere would intensify greenhouse effect on the atmosphere and thus the temperature of the earth's surface would increase which would cause climatic changes and would effect melting of continental glaciers and ice caps resulting into submergence of low coastal areas.
- (iii) Smog
- (iv) Acid rain

(2) Effects of Human Health

- ❖ Carbon monoxide is major pollutant for man community because it combines with hemoglobin molecules of human blood much faster than oxygen (about 200 times faster than oxygen does) and thus causes suffocation in spite of the presence of sufficient amount of oxygen in the air.
- ❖ Depletion of ozone due to chlorofluorocarbons (CFCs) is expected to cause skin cancer mainly among white people because of increased exposure of human bodies to more ultra-violet solar radiation.
- ❖ Sulphur dioxide after combining with water films on suspended particulates forms poisonous fogs known as urban smog over cities and industrial areas. Thus sulphur dioxide-originated

smog blocks the respiratory systems of human bodies and cause deaths of human beings. The ordeal of disastrous smog of Donora (Pennsylvania, U.S. Meuse Valley (Belgium, 1930) and London (1952)

- ❖ SO₂ (sulphur dioxide) pollution also causes disease of eyes, throat and lungs. SO₂ causes instantaneous irritation of nose and throat.
- ❖ SO₂ pollution also causes acid rains which pollute the surface and subsurface water storage source and thus adversely affects the heal persons who depend on such polluted water.
- ❖ Nitric oxide (NO) in high concentration air, when inhaled combines with hemoglobin thousands of times faster than oxygen with hemoglobin and thus causes respiratory problem, gum inflammation, internal bleeding, oxygen deficiency, pneumonia and lung cancer.
- ❖ Numerous suspended particular matters (SPM) emitted from factories and automobiles during the combustion of fossil fuels (coal petroleum and natural gas) and from other industrial processes, such as lead, dusts, etc. cause several deadly diseases human bodies. Lead poisoning and asbestosis the deadly diseases caused by particulate air pollution.

The BHOPAL GAS TRAGEDY (Bhopal, India) of **December 1984** is a burning example of one of the deadliest disasters caused by human negligence in the maintenance of deadly gases such as **MIC gas (methyl iso-cynate)**. The leakage of MIC gas from the Union Carbide Factory at Bhopal on the wintry night of **December 2/3, 1984** caused the single biggest air pollution tragedy which, according to official sources, claimed 2500 human lives in the early, hours of **December 3, 1984**, whereas nongovernmental sources put the figure beyond 5000. Methyl isocynate gas is produced at Bhopal based Union Carbide Factory of the USA to manufacture pesticides.