

CHAPTER 05

ENVIRONMENTAL POLLUTION

DEFINATION OF ENVIRONMENTAL POLLUTION

- It means adding impurities to the environment.
- It is an undesirable change in chemical, physical, and biological characteristics of air, water and soil, which causes the health problem to all the living beings.

TYPES OF POLLUTION

▣ These are categorised as :

- ▣ Air pollution
- ▣ Water pollution
- ▣ Soil pollution
- ▣ Sound / noise pollution
- ▣ Nuclear pollution
- ▣ E-waste

Further it may be

Indoor pollution / outdoor pollution

CLASSIFICATION OF POLLUTANTS

- The pollutants may be classified as
 - Degradable or non-persistent pollutants:- these can be broken down rapidly by the natural process e.g. Domestic waste, garbage and sewage.
 - Slowly degradable or persistent pollutants:- these remains in environment for a very long period of time, in unchanged condition, may be for few decades e.g. Pesticides, aerosole
 - Non-degradable pollutants:- these are pollutants never get degraded by any natural process. E.g. Toxic elements like lead, mercury, nuclear waste.

DIFFERENT POLLUTANTS

Pollutants	Examples
Gases	No_x , SO_x , Co_x ,
Industrial waste	Soot, smoke, tar, dust
Metal waste	Mercury, lead, zinc, nickel, cadmium. Chromium
Acids	H_2SO_4 , MNO_3
Agro pesticides	Herbicides, fungicides, bactericides, weedcides
Domestic waste	Garbage, rubbish
Radioactive waste	Nuclear ash from atomic reactors
E-waste	From IT sector

AIR POLLUTION

- Definition:- it can be defined as addition of any contaminant to the air which causes harm to the health of living organisms.

SOURCES OF AIR POLLUTION

- It can be classified as
 - Air pollution by natural and manmade sources
 - Air pollution by human activities

Air Pollution classification

Primary pollutants

Released directly in
to the air

- Ash
- Salt particles
- Pollen and spores
- Smoke
- Wind blown dust

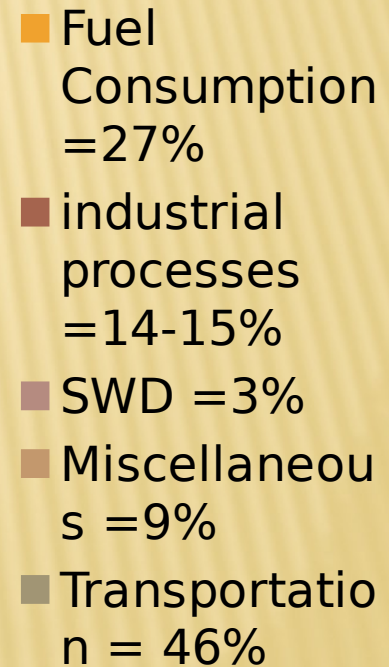
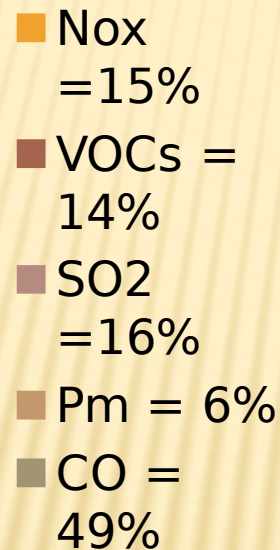
Secondary pollutants

Added after they are formed as
a chemical reaction in the air
between primary pollutants

- Smog = sunlight + NO_x
- Acid rain
- Pollen and spores
- Smoke
- Wind blown dust

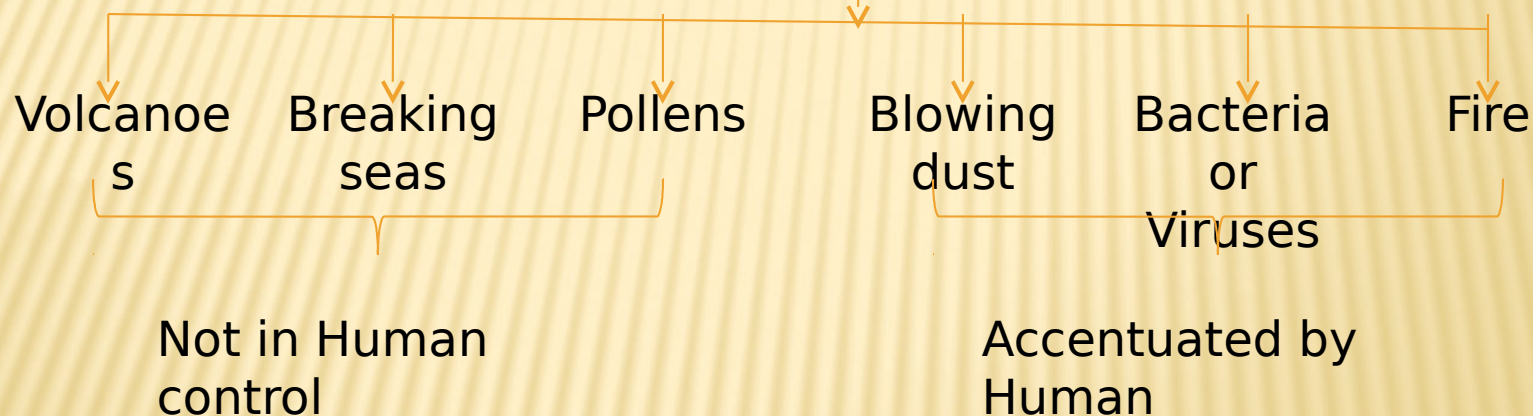
Primary pollutants

Sources of Primary pollutants



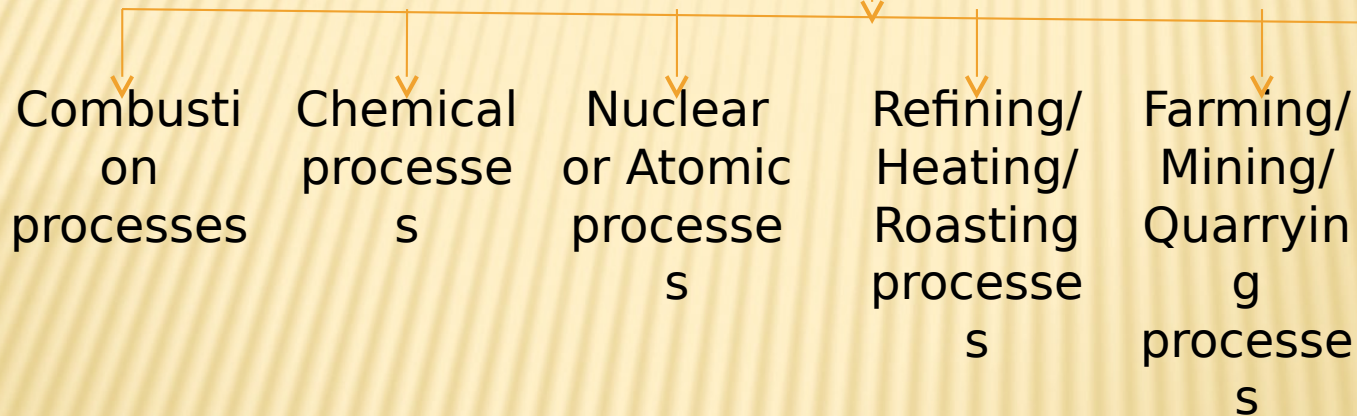
SOURCES OF AIR POLLUTION

Source of primary pollutants created by nature



SOURCES OF AIR POLLUTION

Source of primary pollutants created by human activities



Secondary pollutants : Atmospheric H_2SO_4 formed by reaction of moisture or water + SO_2 / SO_3

SECONDARY POLLUTANTS

- ▣ **Acid rain:** Atmospheric H_2SO_4 formed by reaction of moisture or water + SO_2 / SO_3
- ▣ **Photochemical smog:-** it is harmful mixture formed by gases of nitrogen and particulated matter due to photochemical reactions under influence of strong sunlight.
- ▣ Ozone contributes majorly to photochemical smog

MAJOR AIR POLLUTANTS

- ▣ Carbon compounds: CO_2 is released by complete combustion of fossil fuels and CO , a very toxic gas is released by automobile exhausts.
- ▣ Sulphur compounds : through the thermal power plants, using coal and from the oil refineries, SO_2 , H_2S , H_2SO_4 , are released.
- ▣ Nitrogen Oxides:- these oxides like NO , NO_2 , HNO_3 are released by automobiles, power plants and industries

- Ozone: due to cooling industries the CFC is released which has affected the O_3 in the atmosphere.
- Fluorides: they are produced by the industrial and insecticide spary.
- Hydrocarbons:- they are released by the automobiles e.g. Benzene, Benzpyrene etc.
- Metals: the metal such as lead, nickel, tin, beryllium, titanium are present in to form of solid particles produced by metallurgical processes.
- Photochemical matter: the product such as PAN, PB_2N are the photochemical smog produced by automobile.

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- Particulate matter: the suspended particulated matter (SPM) is released into the air by the stone crushing industries and dust and the ash from the thermal power plants.
 - Biological particulate : they are mainly the bacterial cells, fungal spores and pollens.

EFFECT OF AIR POLLUTION

- ▣ Effect on living things
- ▣ Effect on non-living things

EFFECTS ON LIVING THINGS

- ▣ **Air pollution and human health:**
 - ▣ Irritation of eyes, throat, nose and respiratory system
 - ▣ Respiratory damage through tobacco smoke
 - ▣ Convulsions, coma due to lead poisoning
 - ▣ Cigarette smoking cause cardiovascular diseases, due to cadmium particulates
 - ▣ Radioactive dust causes genetic effects on the next generation
 - ▣ The mercury from combustion of fossil fuel affects the nerves, brain and kidney

▫ Air pollution and vegetation:

- The direct use of pesticides affect the growth of metabolic activities by destroying chlorophyll and also by disrupting photosynthesis.
- Rise of ozone causes Necrosis i.e. Damaging the leaves
- The rise of NO_2 causes Abscission i.e. Premature fall of leaves - results in reduction in crop production
- Rise in SO_2 causes chlorosis i.e. Yellowing of the leaves
- Thus the air pollution has qualitative and quantitative effects on the plants

□ Air pollution and animals:

- When the animals during grazing consume the particulate coated plants mainly with fluorine, lead, arsenic they get affected, resulting into illness or poisoning or even death.
- The pets also suffer due to the lung diseases
- When animals are fed with oil cakes or grass, the remains of insecticides/ pesticides settled on vegetation, harm the digestive system very severely.

EFFECT ON NON-LIVINGS

- ▣ Effect on metals:
 - ▣ Corrosion or abrasion of metals
 - ▣ The acid gases like O_3 , SO_2 , NO_2 , affect the strength of the textile
 - ▣ The building material gets affected by SO_2 and acid rains.
 - ▣ SO_2 and acid gases affect the quality of paper and leather
 - ▣ The paints get decoloured by SO_2 and H_2S

Effect on climate:

- Carbon cycle is broken (as forests are cut consumption of CO₂)
- CO₂ is heavy gas and has capacity to absorb the heat. Rise of CO₂ has caused the global warming
- The release of CFC gases have made an impact on ozone layer due to the ozone depletion, cosmic rays reaches to earth increasing temperature of earth

PREVENTION OF AIR POLLUTION

- There are various air pollution control technologies and land use planning strategies available to reduce air pollution
- Following are the commonly used pollution control devices by industry or transportation devices
 - They can either destroy contaminants or remove them from an exhaust stream before it is emitted into the atmosphere

□ Particulate control:-

- Mechanical collectors (dust cyclones, multi-cyclones) – electrostatic precipitators or electrostatic air cleaner is a particulate collection device that removes particles from a flowing air/gas using force of an induced electrostatic charge.
- It is highly efficient filtration devices which can easily remove fine particulate matter such as dust and smoke from the air stream.
- Particulate scrubber / wet scrubber is a form of pollution control technology in which polluted gas stream is brought in contact with the scrubbing liquid by spraying it with the liquid by forcing it through a pool of liquid or by some other contact method so as to remove the pollutants.

▣ Scrubbers:-

- ▣ Baffle spray scrubber
- ▣ Cyclonic spray scrubber
- ▣ Ejector venturi scrubber
- ▣ Mechanically aided scrubber
- ▣ Spray tower
- ▣ Wet scrubber

□ Nox control:

- ~~Low NOx burner~~

- Selective catalytic reduction (SCR)

- Selective non-catalytic reduction (SNCR)

- NOx scrubbers

- Exhaust gas recirculation (EGR)

- Catalytic converter (also for VOC control)

□ Acid gas / SO₂ control:

- Wet scrubbers

- Dry scrubbers

- Flue-gas desulfurization

▣ VOC Abatement:-

▣ Adsorption systems, such as activated carbon

▣ Flares

▣ Thermal oxidizers

▣ Catalytic converters

▣ Biofilteres

▣ Absorption (scrubbing)

▣ Cryogenic condensers

▣ Vapor recovery systems

▣ Mercury control:-

▣ Sorbent injection technology

▣ Electro-catalytic oxidation (ECO)

▣ K-fuel

WATER POLLUTION

▣ Definition:-

It can be defined as “the presence of impurities and foreign substance in water in such a quantity that lowers its quality and makes it unfit for consumption and causes health hazard.

OR

“ Any physical, biological or chemical change in water quality that adversely affects living organism can be considered pollution”

CLASSIFICATION OF WATER POLLUTION

- ▣ Surface water pollution:- ocean, rivers, lakes get polluted in number of ways
- ▣ Ground water pollution:- is often caused by pesticide contaminations from soil
- ▣ Oxygen depleting:- when biodegradable material is added to water the number of micro-organisms increases rapidly consuming available oxygen. When this happens harmless aerobic micro-organisms die and anaerobic micro-organisms produce harmful toxins such as ammonia and sulfides

- Nutrients and their effect on water:- nutrients are essential for plant growth and development. Many nutrients are found in waste water & fertilizers, if these are in excess it can cause weed and algae growth.
 - This can contaminate drinking water and clog filters
 - This can damage other aquatic organisms as algae use up the oxygen in the water
- Microbiological water pollution:- it is natural way of water pollution form by micro-organisms.
 - Harmful bacteria, viruses, protozoa causes

- Suspended matter:- some pollutants do not dissolve in water as their molecules are too big to mix between water molecules called as suspended matter.
- These particles settle down forming thick sludge at the bottom, thus harmful to marine life that lives on floor
- Biodegradable substances often suspended in water causing problem as high number of anaerobic micro-organisms presents.
- Toxic chemicals suspended in water can be harmful to the development and survival of aquatic life

- Chemical water pollution:- industrial and agricultural work involves the use of many different chemicals that can run-off into water and pollute it
 - Metals and solvents from industrial work pollute water causing loss to aquatic life
 - Pesticides use in farming causes water pollution putting threat to aquatic life, birds, humans and other animals.
 - Petroleum contaminate the water through oil spill when ship ruptures. This have only localised effect on wildlife, it can cause death of many fishes and stick to feather of seabirds causing them to loose the ability to fly.

CAUSES OF WATER POLLUTION

- ▣ The water gets polluted by various causes and at various sources which are divided as:
- ▣ Point source – Source is identifiable (if pollution comes from single source such as oil spill it is called point source)
- ▣ Non-point source – Source is not identifiable. (if pollution comes from many sources is called non-point source)

Point source – Water pollution through industrial discharges:-

- Industrial effluents have wide variety of organic and inorganic pollutants, e.g. Breweries, tanneries, paper and pulp mills, dyeing textile industries are main source of industrial water pollution
- The fertilizers and chemical industries have also made problem of water pollution a serious environmental issue
- The heavy metal discharged from the industries such as Na, Cu, Cr, Hg, Pb etc. have serious effect on the living organisms
- Their main source is incinerators, coal burning power plants. Also mine drainage and leaching

Non- point source – Water pollution through Agricultural discharge:-

- The modern agricultural uses chemical fertilizers, chemical pesticides, herbicides, and weedicides, which gets dissolved in water making them polluted
- It alters pH value of water affecting aquatic animals as these animals are sensitive to pH of water thereby threatening the aquatic ecosystem
- Phosphates and nitrates in the fertilizers make water rich with nutrients and it becomes more producing – is called as Eutrophication.
- This reduces the oxygen level in water thereby increasing CO₂ level. This change kills the aquatic life which further makes water more polluted

▣ Water pollution through the solid waste of the industries

- ▣ Lead and mercury are the main toxic solid substances which comes out of the industrial waste and get mixed with nearby water pool
- ▣ Consumption of this water makes direct impact on the human health e.g. Damage to liver and kidney, reduction in haemoglobin formation, lead may affect the central nervous system which leads to coma or death
- ▣ Source of lead to water is effluents from lead processing industrial plants, paper and pulp industries, fluorescent light tubes, high intensity street lamps, batteries, thermometers.
- ▣ Mercury compounds enter in water body get converted into methyl mercury compounds due to anaerobic microbes. Finally it enters in the aqua food chain and disturbs the entire aqua ecosystem of pond or lake

EFFECT OF WATER POLLUTION

- Fertilizers and detergents act as nutrients and helps to grow algae which consumes dissolved oxygen and biological oxygen demand increases thus kills aqua life.
- Domestic and commercial effluents provide more nutrients to micro-organisms thus biological oxygen demand increases, killing aquatic life.
- Non-biodegradable pesticides travel through food chain and enters into the human body and affect the nervous system

EFFECT OF WATER POLLUTION

- Oil pollutants spill through oil tankers get spread over the water creating thin layer over the water surface. This affect the water cycle and leads to death of water birds and fishes.
- From mining Radio-active pollutants like uranium, thorium enters the human bodies through food and water which get accumulated in blood thyroid glands, liver, bones and muscles causing serious illness and death also
- Excess amount of fluorides causes dental and intestinal problems.
- In general consumption of polluted water causes diseases like typhoid, dysentery, cholera.

MEASURES TO CONTROL WATER POLLUTION

- Through the natural water cycle the water itself gets converted into pure water
- Disinfection of water, in this process harmful bacteria are killed making water safe for drinking. This is done by chlorination by using bleaching powder
- Sedimentation, in this process suspended materials are removed from water. For this sedimentation tanks are used these may be circular tanks having either radial or circumferential flow, rectangular tank and hopper bottom tank.

MEASURES TO CONTROL WATER POLLUTION

- Filtration, in this process water is allowed to pass through a bed of coarser and fine sand. It removes colour, taste, odour and also bacteria. These filters may be pressure filters and gravity filters.
- Softening of water, it is used to remove the hardness of water, two methods are used – by boiling water the hardness is removed or by adding lime in the water the hardness can be removed

SOIL POLLUTION

- Definition:- soil pollution is defined as contamination caused by chemicals and other substance resulting in the loss of the fertility or the productivity of soil.
- The productivity of soil is measured in terms of the yields of grains per unit of land.
- The indirect effect of soil contamination is observed through the crop contamination.
- When such contaminated grains are consumed by the human beings they affect the human health.

SOURCES OF SOIL POLLUTION

- ▣ Polluted water discharged from factories
- ▣ Oil and petroleum leaks from vehicles washed off the road by the rain into the surrounding habitat.
- ▣ Chemicals fertilizer runoff from farms and crops.
- ▣ Acid rain (fumes from factories mixing with rain)
- ▣ Sewage discharged into rivers instead of being treated properly
- ▣ Over application of pesticides and fertilizers
- ▣ Purposeful injection into groundwater as disposal method

- Interconnections between aquifers during drilling
- Septic tank seepage
- Lagoon seepage
- Sanitary / hazardous landfill seepage
- Cemeteries
- Scrap yards
- Leaks from sanitary sewers

EFFECTS OF SOIL POLLUTION

▣ Agriculture:-

- ▣ Reduced soil fertility
- ▣ Reduced nitrogen fixation
- ▣ Increased erodiability
- ▣ Larger loss of soil and nutrients
- ▣ Deposition of slit in tanks and reservoirs
- ▣ Reduced crop yield
- ▣ Imbalance in soil fauna and flora

▣ Industrial:-

- ▣ Dangerous chemicals entering underground water
- ▣ Ecological imbalance
- ▣ Release of pollutant gases
- ▣ Release of radioactive rays causing health problems
- ▣ Increased salinity
- ▣ Reduced vegetation

▣ Urban:-

- ▣ Clogging of drains
- ▣ Public health problems
- ▣ Pollution of drinking water sources
- ▣ Foul smell and release of gases
- ▣ Waste management problems

PREVENTION OF SOIL POLLUTION

- ▣ Reducing fertilizer and pesticide use – using bio-fertilizers and manures
- ▣ Reusing of materials – materials such as glass containers, plastic bags, paper, cloths can be reused at domestic level rather than being disposed thus reducing solid waste pollution
- ▣ Recycling and recovery of materials –papers, plastic and glass can be recycled
- ▣ Reforesting – control of land loss and soil erosion can be possible through restoring forests

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- Solid waste treatment – proper method should be adopted for management of solid waste disposal. Industrial waste can be treated physically, chemically and biologically until they are less hazardous.
 - Acidic and alkaline waste shall be first neutralised before disposed
 - Incineration of other waste is expensive and leaves a huge residue and adds to air pollution. Pyrolysis is a process of combustion in absence of oxygen or the material burnt under the controlled atmosphere of oxygen

NOISE POLLUTION

- ▣ Definition :-
- ▣ Noise is unpleasant, high intensity sound
- ▣ Noise which pollute calmness of society is called noise pollution

- ▣ Measurement of intensity of sound:-
 - ▣ The unit is dB (decibel), the range extend between 1 to 140 dB. When it is less than 1dB we can not hear it and when it is more than 140 dB we can not stand to it.
 - ▣ Normal talk sound intensity is 40 dB and shouting 60 dB. Whispering 30 db
 - ▣ Industrial machines 90 dB, traffic busy road with high speed vehicles 70 dB,
 - ▣ Thunder storm with lightening 120 dB, near Airports it is 150 dB, Rocket engines 190 dB

IMPORTANT SOURCES OF NOISE POLLUTION

- ▣ Industrial activities:- pneumatic industries, textile industries, steel rolling industries, wood cutting mills
- ▣ Transport activities:- automobiles, railways, aeroplanes
- ▣ Domestic activities:- T.V., Radio, tape recorder, mixers, grinders
- ▣ Cultural activities:- Festivals, religious programmes, marriage functions, public speeches

- ▣ Agricultural activity: tractors, threshers
- ▣ Defence activity: tanks, gunfire, aeroplanes, bombs, army exercises
- ▣ Mining activities:- blasting
- ▣ Other activities:- stone crushing, construction of dams, tunnels, roads, landslides, and earthquakes are the natural sources of noise pollution

EFFECTS OF NOISE POLLUTION

- ▣ The noise pollution creates temporary as well as permanent problems to the human beings, the noise pollution can have physical, physiological and psychological effects
- ▣ **Physical effects:-**
 - ▣ Temporary hearing problems
 - ▣ Permanent deafness
 - ▣ Damage to tympanic membrane

▣ **Physiological effects:-**

- ▣ Headache
- ▣ Pains in the heart
- ▣ Reduction in the vision
- ▣ Rise in blood pressure
- ▣ Loss of memory

▣ **Psychological effects:-**

- ▣ Depression
- ▣ Fatigue
- ▣ Emotional disturbance
- ▣ Frustration
- ▣ irritation

PREVENTION AND CONTROL OF NOISE POLLUTION

- Using earplugs, ear muffs, noise helmets, head phones
- Reducing the noise pollution at source
- Heavy vehicles should not be allowed into narrow streets
- Heavy traffic on the residential streets must be reduced
- Use of air pressure horns should be prohibited
- Laws regarding noise pollution must be followed
- Areas like schools, hospitals must be kept silence zone

- Social awareness program should be taken up to educate the public about the causes and effects of noise pollution
- Planting bushes, trees in and around sound generating source is an effective solution for noise pollution
- Regular servicing and tuning of vehicles can effectively reduce noise pollution
- Buildings can be designed with suitable noise absorbing material for walls, windows, and ceilings.
- Soundproof doors, and windows can be installed to block unwanted sound
- Factories and industries should be located far from the residential area