Unit-2

Environmental Pollution

Environmental segments

The environment consist of four segments

Atmosphere

It is the blanket of gases surrounding the earth.

Hydrosphere

It is composed of various water bodies on the earth. It includes the ocenes, lakes, river, etc.

Lithosphere

It contains various types of soil and rocks on earth.

Biosphere

It is composed of all living organisms and their interaction with the environment, viz atmosphere, lithosphere, and hydrosphere. The biosphere is earth's zone of air, soil, and water that is capable of life. It is a zone which is reaching about 10 km into the atmosphere and down to the deepest ocean floor. Thus biosphere is the global sum of all ecosystems.

Structure and composition of atmosphere

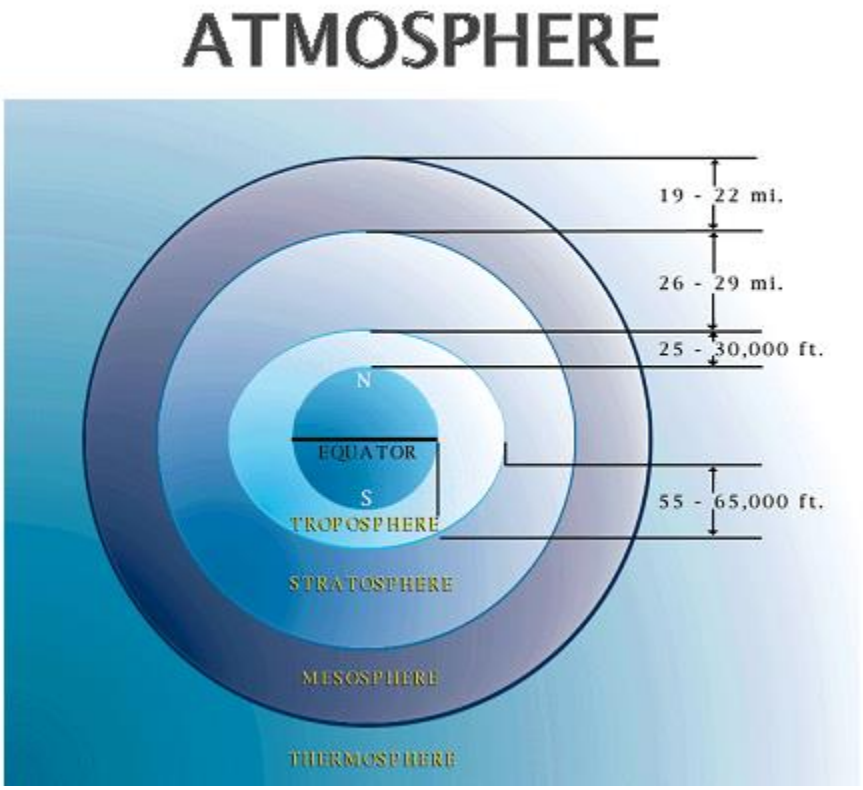
The atmosphere's gases are molecular nitrogen (N_2, 78%) and oxygen (O_2, 21%) ; argon (Ar, <1%); water vapor (H_2O, < 1% generally); carbon dioxide (CO2, <400 ppm); and a variety of ppm lower traces gases such as helium, neon, Krypton, molecular hydrogen, methane, CFC, ozone, and various oxides of nitrogen. Of these, the space/time distributions of water vapor and ozone have important implications for both weather and climate.

Molecules with three or more atoms exhibit highly complex electromagnetic absorption and emission spectra. This complex includes a variety of energetic frequencies as these molecules absorb and emit radiation, generally called "spectral bands". When temporal and spatial variability is added to this spectral complexity, the atmospheric heating and cooling associated with absorption of solar energy, and both absorption and emission of thermal energy, becomes significant and complicated.

In the clear (i.e., aerosol-free) atmosphere, most of the absorption of solar energy is associated with stratospheric ozone, while absorption and emission of thermal energy occurs throughout the atmosphere column by the socalled “greenhouse gases”.

Ozone is conveniently and appropriately discussed in two separate context : tropospheric ozone, a pollutant, and stratospheric ozone, a natural layer of the gas that is critical for life on earth as we know it and for the maintenance of climate as well.

Because the atmosphere is relatively transparent to sunlight, it is heated mainly from below. Sunlight heats the earth’s surface, which is absorbed by the greenhouse gases and re-radiated. In addition via conduction and convection, the surface also transfers energy to the atmosphere by mechanical means.



Pollutions

Addition of undesirable substance or unwanted foreign matters into the environment is known as **pollution**. It alters the natural qualities of the environment and cause damage to human, plant, and animals.

Air pollutants	Sources	Effects
CO	Incomplete combustion of fossil fuels, motor vehicle exhaust, cigarette smoking	React with hemoglobin reduce oxygen carrying to body cells and tissues. Headache, anemia, high levels cause coma, irreversible brain cell damages death, fertility problems etc.
CO_2	Smoke, combustion of fossil fuels, automobile exhausts, flue gases from industries	Corrosive under moist condition, Toxic at high concentration
SO_2	Combustion of fossil fuels containing sulphur, burning coal in power plants, H_2SO_4 plants, sulphide over roasting plants.	Respiratory disease, cardiac disease, dangerous to agriculture, eye irritation, throat troubles, corrosion of metals, in plants cell membrane damage, chlorophyll destruction, metabolic inhibition.
SO_3	Oxidation of SO_2	Breathing problem, irritation to the respiratory tracks, acid rain.
H_2S	Decomposition of sewage waste organic matters, various industries petroleum refinery.	Blaken lead paints, and causes corrosion of metals
NO_x	Combustion of fossil fuels, industrial power plants	Lung irritation and damage, acid deposition, damage trees, soils, aquatics, corrode metals, affects stone buildings, damage fabrics.

Particulate air pollution

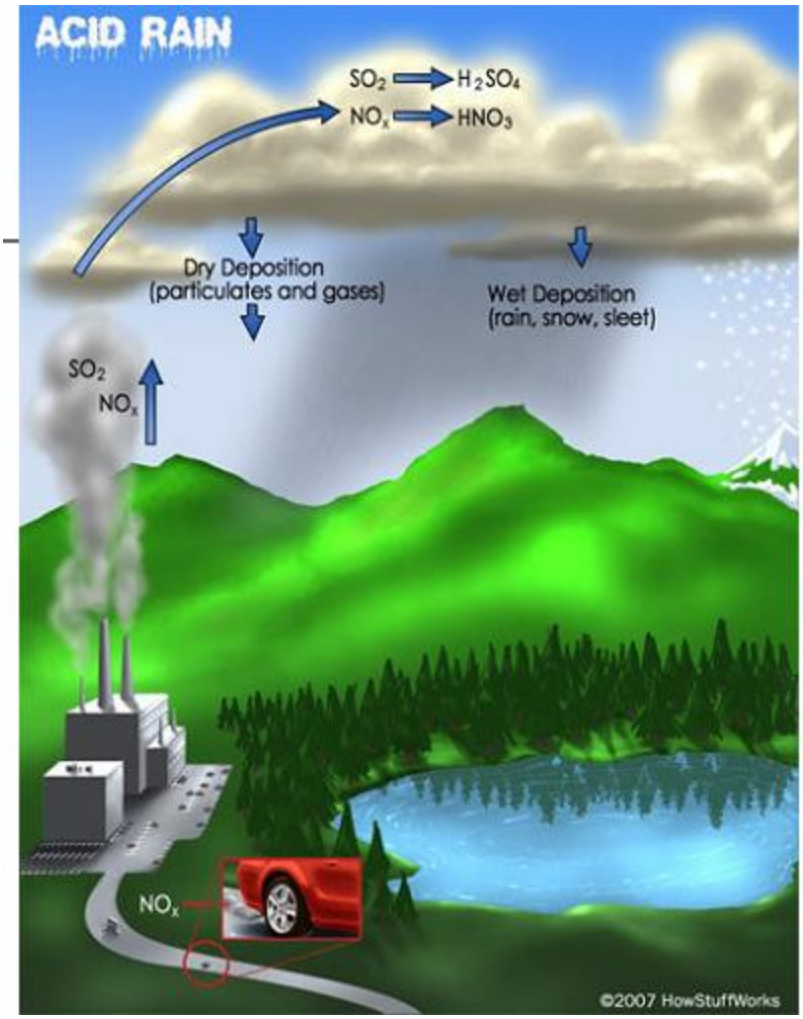
Particulate	Sources	Effects
Dust (small solid particles)	Cement and asbestos	Causes allergic and respiratory diseases
Lead dust	Automobile exhausts, lead batteries	Causes lead poisoning also damage liver and kidney
Smoke	In complete combustion of fuels, automobiles, diesels engines, etc	Skin diseases

Acid rain

The term acid rain means any form of precipitation like rain, fog, snow, or hail that contains harmful substances such as nitrogen and sulphur oxides.

It is a precipitation that is very acidic pH<5 which has harmful effects on plants, aquatic animals and buildings.

Oxides of sulphur (SO_x) Oxides of nitrogen (NO_x) these are emitted primarily from automobiles and industries. It is due to fossil fuel burning which emits these dangerous air pollutants.



Effect of Pollutants

These pollutants coming down with rain is called wet deposition.

The same pollutants reaching the ground by gravity during dry intervals are called dry deposition. They are carried over thousands of km by wind and get deposited on soil, vegetation, water and property causing great damage.

$$SO_2 + H_2O \longrightarrow H_2SO_3$$

$$2SO_2 + O_2 + 2H_2O \longrightarrow 2H_2SO_4$$

$$4NO_2 + O_2 + 2H_2O \longrightarrow 4HNO_3$$

$$HCl + H_2O \longrightarrow HCl(aq)$$

- ✓ Affect the growth of aquatic life
- ✓ Retardation of terrestrial growth
- ✓ Contamination of air, water and food
- ✓ Corrosive to metals, buildings, limestone, marble, etc
- ✓ Increases acidity of the soil
- ✓ Accumulation of toxic elements

Ozone layer depletion

Ozone is a bluish gas that is formed by 3 atoms of oxygen. When found in the troposphere, it is a dangerous secondary pollutant when found in the troposphere. The highest region of the stratosphere contains about 90% of all ozone. The ozone layer found in the stratosphere protects the Earth from the UV rays sent down by the sun. It absorbs the sun's rays in the stratosphere and thus they do not reach the earth. The ozone layer protects both plant and animal life on the planet from the intense heat of the sun.

Ozone depletion refers to the slow, steady decline in the total volume of ozone in the Earth's stratosphere. The area in the stratosphere with the thinning ozone is called the OZONE HOLE. Ozone layer depletion was first discovered in the 1980s.

Dissociation of oxygen in the presence of light to give nascent oxygen. O_2

$$O_2 \longrightarrow O + O$$

$$O + O_2 \longrightarrow O_3$$

$$O_3 + O_2 \longrightarrow 2O_2$$

Thus the overall amount of ozone is balanced in the atmosphere.

- Production and emission of CFCs is the major cause.
- Chemicals found in spray aerosols used by many industries is another major cause.

- These aerosols contain the oxides of sulphur, nitrogen, etc and CFCs.

Ozone can be destroyed by free radicals like $OH^{\cdot}$,$NO^{\cdot}$, atomic Cl, atomic Br, etc.

$$O_3 + NO \longrightarrow NO_2 + O_2$$

$$O_3 + Cl \longrightarrow ClO + O_2$$

$$O_3 + ClO \longrightarrow 2O_2 + Cl$$

The overall effect is a decrease in the amount of ozone.

Both chlorine and bromine contribute significantly to the destruction of ozone.

CFCs are used in air conditioning or cooling units, etc

They do not occur naturally and their presence in the atmosphere is entirely due to human manufacture. When they reach the stratosphere, they dissociate to give chlorine atoms. These act as catalysts and can destroy thousands of ozone molecules before being removed from the atmosphere.

Effects of ozone depletion

Ozone depletion causes more UV light to reach the earth.

This causes skin cancer Genetic abnormalities

Eye irritations and cataract problems

Mutation

Other infectious diseases

Increase in temperature

More exposure to solar radiation

Formation of photochemical smog

Affects the food chain

Decreases crop yield

Solutions

Limit the use of CFCs

In the Montreal Protocol, 31 countries agreed to reduce usage of CFCs.

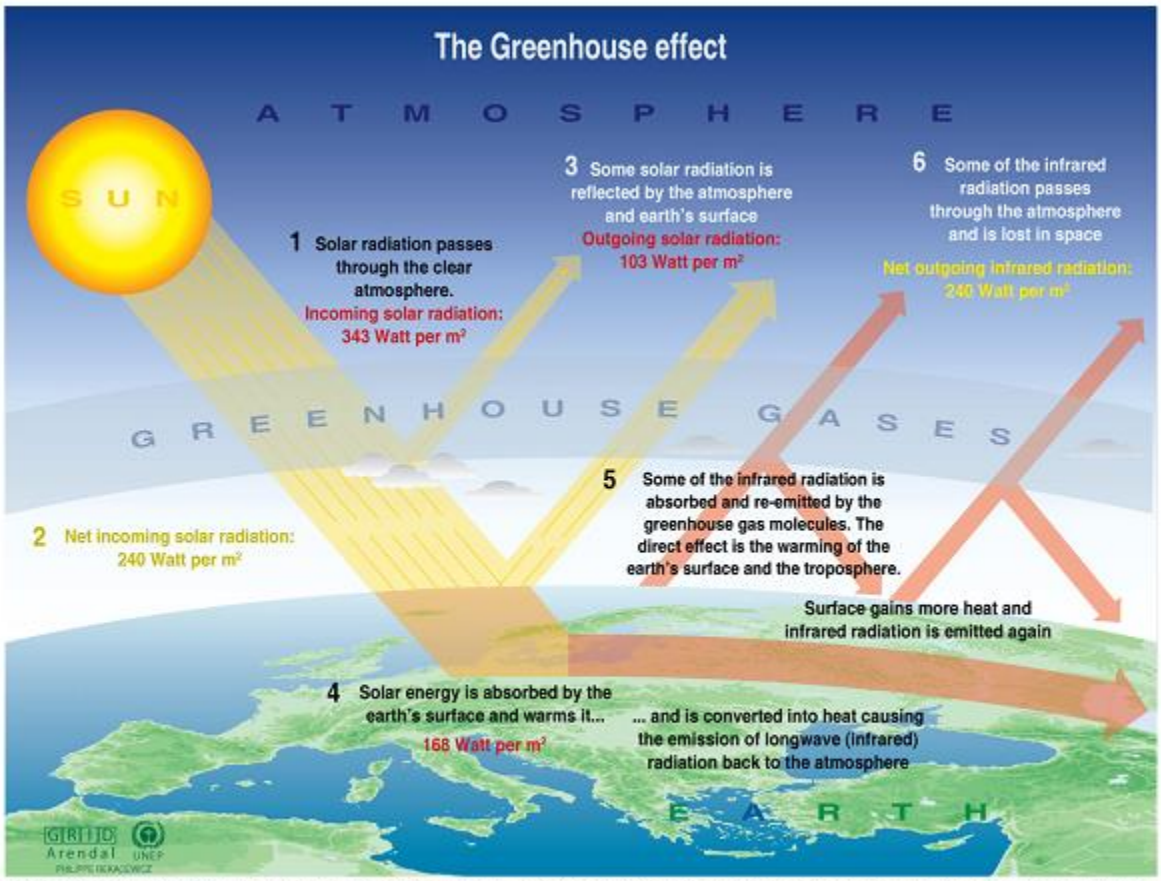
Use of alternate chemicals for cooling and air-conditioning units air-conditioning units

Grow plants to increase amount of oxygen

Use products labeled “Ozone friendly”

Greenhouse gases

Warming up of the earth’s surface due to greenhouse gases is called Greenhouse Effect. The increase in earth’s average temperature is called Global Warming Global Warming. Greenhouse is a building constructed mainly of glass to grow and protect plants. Glass allows visible light to pass through but not infra red rays. When light is absorbed into the greenhouse, it is converted to IR radiation which cannot escape.



Sources: Okanagan university college in Canada, Department of geography, University of Oxford, school of geography; United States Environmental Protection Agency (EPA), Washington; Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge university press, 1996.

Major Greenhouse gases are

Carbon dioxide (CO_2)

Methane (CH_4)

Chlorofluorocarbons (CFCs)

Chlorofluorocarbons (CFCs)

Hydro chlorofluorocarbons (HCFCs)

Ozone (O3)

Oxides of nitrogen (N2O, NO, NO2)

Carbon tetrachloride (CCl4)

Solar energy passes through the atmosphere and reaches the earth. About 50% of it is reflected back. The absorbed energy is converted to IR radiation and emitted upwards. This IR radiation is trapped by the greenhouse gases and thrown back onto the earth's surface. This warms up the earth's surface.

Effects of Green House Gases

Heat waves and periods of unusually warm weather.

Ocean warming, sea-level rise and coastal flooding.

Glaciers melting

Arctic and Antarctic warming

Unpredictable climatic changes

Spreading disease

Earlier spring arrival

Plant and animal range shifts and population changes Downpours, heavy snowfalls, and flooding

Droughts and fires

Solutions

Stop carbon emission

Reduce greenhouse gas emissions

Recycle, reduce and reuse

Eco-driving and car pooling

Eco-driving and car pooling

Save electricity

Grow plants

Use solar heating

Conserve natural resources

Water Pollution

Pollutants	**Sources**	**Effects**
Infectious agents, bacteria, virus, parasitic, worms	Human and animal waste	Variety of disease like dysentery, typhoid, cholera etc
Oxygen demand waste: organic organic waste such as animal manure plant debris	Sewage, paper mill, food processing facilities	Decrease the level of DO
Inorganic chemicals acid, toxic metal (Pb, As, Se) salt NaCl. Fluorides from soil	Surface run off industrial effluents, household cleaners	Make fresh water unsuitable for drinking, skin cancer, neck damage, nervous system, liver kidney damage
Organic chemical: oil, gasoline, plastics, pesticides, cleaning solvents	Industry, household, runoff water	Affect human health, cancer, harm to fish and wildlife.
Plant nutrients soluble NH_4, PO_4^{3-}, NO_4^{3-}	Sewage runoff, agriculture, urban fertilizer manure	Increase grouth of algae, aquatic plants, decrease DO, Kill aquatics, increase nitrates decrease oxygen carrying capacity of blood
Radioactive materials isotopes of uranium, I, Ra, Ce, Th	Nuclear power plants, mining, natural sources	Genetic mutation, birth defects, cancer
Heat or thermal pollutant	Water cooling of electric power plants, industrial plants	Decrease DO, disturbance in aquatic life, thermal shock (abrupt change of temperature)
Industrial effluent	Pharma, tannerles, fertilizer, metallurgical, paper, sugar, oil refinery, paint	Discharge of toxic chemicals, alcohols, cyanides, hazardous compounds are very dangerous to man and animals and other organisms

Agriculture discharge	Plant nutrient, pesticides, fertilizer, manure, slurry	Phosphate causes algae bloom, nitrate affect haemoglobin
Oil	Machine and automobile waste cleaning	Reduce light transmission through water, reduce photosynthesis by marine plants reduce DO in water causes damages for water birds and animals

Thermal Pollution

Thermal pollution is heat released to the environment during the generation of electricity in steam power plant. The heated water causes a lowering of dissolved oxygen (DO) in water bodies. This creates anaerobic conditions and disrupts the economical balance.

Sources of thermal pollution

Industrial effluents: Industries requires cooling water for heat removal and cooling purposes. This heated water discharged into the water system increases the temperature of water body.

Nuclear Power plants: Large quantity of heat and races of radioactive substances is emitted from nuclear power plant which increases the temperature of water bodies.

Coal-fired power plants: It is one of the major sources of thermal pollution.

Effects of thermal pollution:

Due to decrease in DO level there is suffocation of plants and animal species. The sudden change in the temperature harms to the aquatic organisms.

The heated water is used for irrigation purposes to extend plant growing seasons. The warm water also increases the metabolic rate of aquatic organism.

Less oxygen in the water can harm fish population. For example, it can increase the metabolic rate of fish and other aquatic animals so they consume more food in a shorter time then if their environment were not changed. This can lead to imbalance in food chain resulting in significant damage to many aquatic organisms.

Warm water can also lead to reproduction problem for many aquatic animals, and can cause huge bacteria and plant growth.

Radiation Pollution

Atmospheric radiation originates from both natural and man-made sources.

Natural sources

1. The earth's crust contains some radioactive nuclides which continually emit radiation . Uranium, thorium, radium are present in rocks, soil, and natural building materials.
2. Food crop grown in the earth and drinking water also contain some radioactive nuclides. They enter the human body through food chain.

Manmade sources

1. X-rays used in medicine and dentistry.
2. Radioactive fall-out resulting from nuclear weapon testing
3. Industrial emission from nuclear reactor and processing installations.

Effect of radiation:

Radiations are highly penetrating in nature, with sufficient energy to damage living organisms. When organisms are exposed to radiation, the complex molecule in organism get ionized and breakup. Radiation damages living system in the following ways.

Pathological damage: when the radiation produce permanent damage to the living organisms, even death may result.

Genetical damage: when the radiation affects the chromosomes of genetic cells, the genes in the productive cells are injured. This causes mutation, which passes from one generation to the next, leading to many diseases.

In addition, nuclear radiation may also reduce the efficiency of enzymes.

Protective methods:

1. Steps should be taken to prevent the leakage of the radioactive elements from nuclear reactors.
2. The radioactive wastages should be stored at such places, where they gradually decay to their stable firmly products.

3. Method have to be developed for the safe handling and diposal of radioactive meterials.

Methods of disposal of radioactive waste:

1. Ground disposal:

   It is cheapest and easy method, because soil absorbs radiation easily. It is safe only in area of low rain fall. Vacated coal mine can also use for waste. The wastes are disposed off in the salt heaps provided in the mines, because salt is a powerful radiation absorber.

2. Ocean disposal:

   Low radioactive waste is disposed off into ocean, otherwise activity of living species will be harmed. The soil waste should be encased into concrete block before dropping into ocean.

Determination of BOD

This is defined as the amount of free oxygen required for the biological oxidation of organic matter by suitable microorganism during a 5 days period. BOD is determined by finding the dissolved oxygen in the blank and polluted water. The oxygen dissolved in the sample reacts with manganese hydroxide and potassium iodide and the liberated iodine is titrated against sodium thiosulfate.

$$2Mn(OH)_2 + O_2 \longrightarrow 2H_2MnO_3$$

$$H_2MnO_3 + 2KI + 2H_2SO_4 \longrightarrow K_2SO_4 + MnSO_4 + H_2O + I_2$$

$$2I_2 + 2Na_2S_2O_3 \longrightarrow 4NaI + Na_2S_4O_6$$

Method

The sample, whose BOD is to be determined, has to be diluted with a special water. The diluted sample is incubated for 5 days at 20^{o}C. After the incubation period, the DO of the sample is determined. BOD is calculated by the following relationship.

BOD in ppm = $\frac{DO_b - DO_i}{P}$

Where DO_b = dissolved oxygen in the blank

DO_i = dissolved oxygen after the incubation in the sample

P = diffusion factor

DO is calculated using the following relationship

DO in ppm = $\frac{V \times N \times 8 \times 1000}{X}$

Where V = volume of sodium thio sulphate required to react with the iodine

X = volume of the sample used for titration

N = Normality of thio sulphate solution

Determination of COD

This is the total organic and inorganic matter that is oxidizable. The value is expressed in terms of ppm of oxygen. It is rapidly measurable parameter for stream and industrial waste studies and control of water treatment plants. This method is based on the chemical oxidation of the pollutant by $K_2Cr_2O_7$ in H_2SO_4 in the presence of a catalyst Ag_2SO_4.

Method

50 ml sample of polluted water is taken in a conical flask . 10 ml of 0.1 N $K_2Cr_2O_7$ in 18 N H_2SO_4 and 0.1 g Ag_2SO_4 are added. The contents are heated for about 3 hours. The unreacted dichromate is titrated against standard ferrous ammonium sulphate using ferroin as the indicator. The oxygen equivalent of $K_2Cr_2O_7$ consumed is taken as the value for COD.

$$(CH_2O)n + Cr_2O_7^{2-} + H^+ \longrightarrow Cr^{3+} + nCO_2 + nH_2O$$

For any given sample of polluted water, COD is determined by using the following relation.

$$\text{COD in ppm} = \frac{(X-Y)\ N\ 8000}{V}$$

Where X = Volume of FAS required in blank titration

Y = Volume of FAS required for sample

N = Normality of FAS

V = Volume of sample used

Total dissolved solids

Control of air pollution

1. Create awareness to public
2. Enforcing law and policies to prevent and control air pollution
3. Two stages of combustion process used to remove oxides of nitrogen
4. Growing more trees. Used to absorb CO2 and release O2 to air
5. Pollution control equipments
6. Microwave used to split toxic H2S into H2 and sends on.
7. Reaction with another gases

$$SO_2 + H_2S \longrightarrow S + H_2O$$

$$CaO + SO_3 \longrightarrow CaSO_4$$

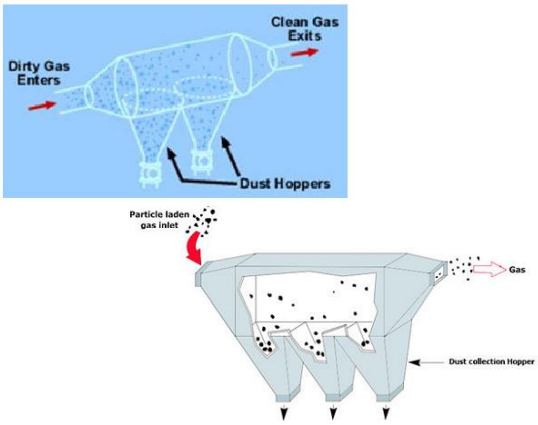
8. Industrial arrangements for pollution control.
9. Industries area should be located far away from residential area.
10. Use only unleaded petrol
11. Utilization of alternative energy like solar, wind, etc.
12. By changing the design of internal combustion engine.

Pollution control equipment

The removal of particulate matter from gas stream is an essential step for air pollution control.

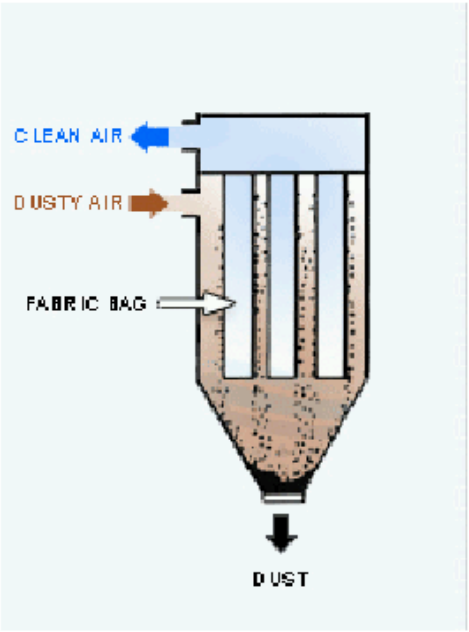
Gravity settling chamber:

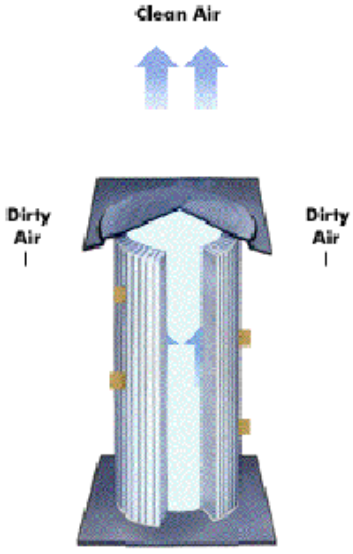
Settling chambers use the force of gravity to remove solid particles. The gas stream enters a chamber where the velocity of the gas is reduced. Large particles drop out of the gas and are recollected in hoppers.



Bag house filters

Dust particles are trapped by filters made of cloth, paper, etc. Particles are shaken or blown from the filters down into a hopper. Clean gas escapes from the top.





Electrostatic precipitator

Exhaust gases are passed between electrodes which are positively charged. This neutralizes the negative charge on the dust particles which are attracted to the dust particles which are attracted to the electrodes because of the opposite charges. Thus, the dust particles settle at the bottom of the chamber.

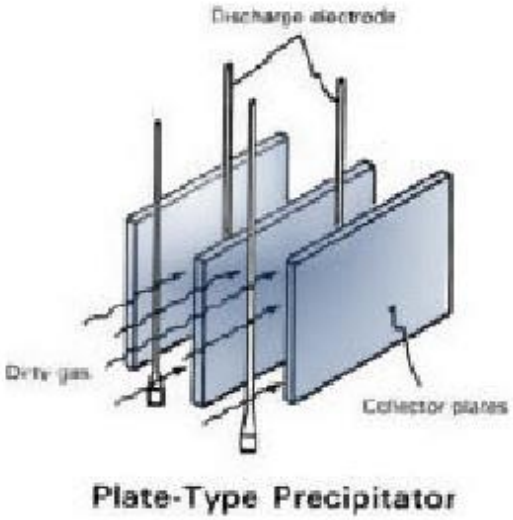
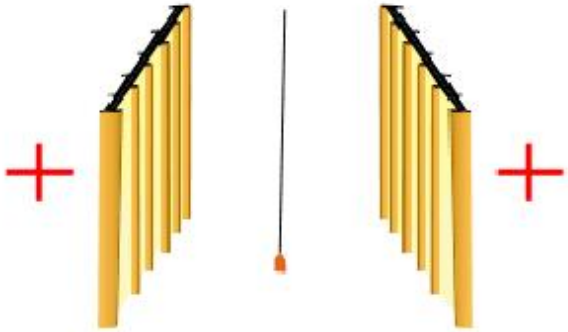


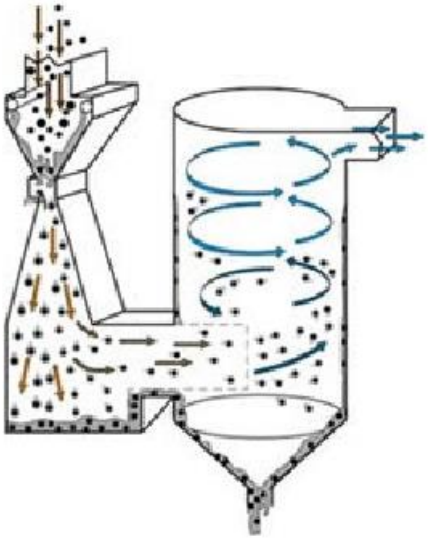
Plate-Type Precipitator



Electrostatic Precipitators

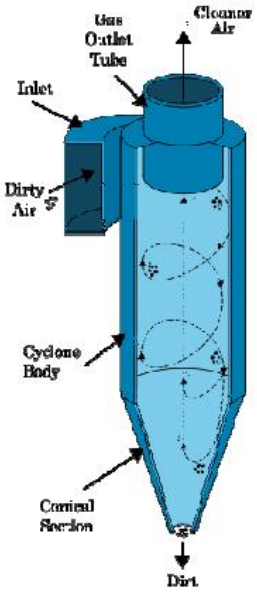
Wet scrubber

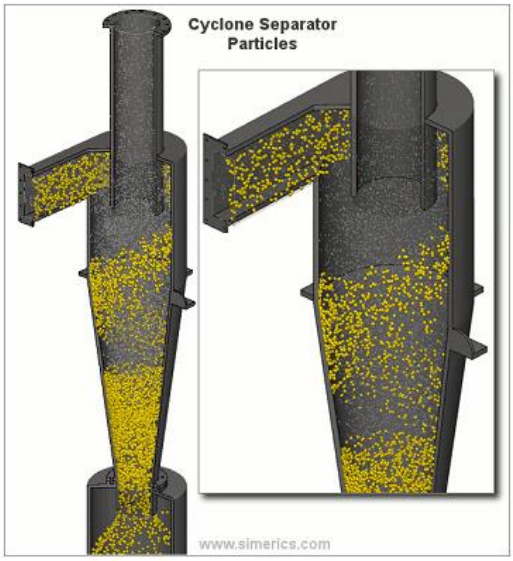
In the scrubber, the exhaust gases are controlled by passing the gas stream through a liquid solution. The liquid is sprayed onto the incoming gas and the dust particles are mopped up by the liquid. The cleaned gas is allowed to pass out. These are especially useful when the gases are combustible or require cooling before being let out into the atmosphere



Cyclone collector

Cyclone separators remove particulate matter by centrifugal force. Dust laden gas is forced into a chamber and the swirling motion creates centrifugal force. The swirling motion creates centrifugal force. This causes particles to be thrown against the walls and to drop down into a hopper. Clean air passes out from the top.





Control of water Pollution

1. Use of pesticides in agriculture should be limited and only standard quality pesticides should be used.
2. To protect water from microorganisms, potassium permanganate should be sprayed regularly.
3. Harmful compounds (Phosphorous, mercury, sodium, ammonium, radioactive substances can be removed by ion exchange method.)
4. Administration of water pollute on control should be in the hand of state and central government.
5. Recycling operation industry, stop the discharge of industrial waste into natural water.
6. Plantation, reforestation
7. Highly qualified and experienced person for monitoring and to control of water pollution
8. Create awareness to public through TV, Radio
9. Suitable laws, standards, practices should be framed
10. Basic and applied research in public health engineering should be encouraged.

Unit -3

Waste Management

Waste water treatment (OR) Sewage water treatment

The strength of waste water depends on the total amount of organic meterials and suspended solids. It is expected in terms of BOD and COD.

Objectives

Convert harmful substances to harmless

Destroy disease causing microorganisms

Eliminate offensive smell

Remove solid content of sewage

Steps involved in Sewage water treatment

- ✓ Preliminary
- ✓ Primary
- ✓ Secondary
- ✓ Tertiary and Solid disposal methods

Preliminary treatment:

Coarse solids and suspended impurities are removed by preliminary treatment. Through bar screen, mesh screen, rack screening, grit champers.

Screening: Metal bars are arranged like rack, in this method floating debrics, wood, cloth, bulky objects are settled at the top.

Grit removal: Suspended solid in sewage such as sand, tea dust, egg shell and some inert materials are removed.

Primary treatment: (sedimentation followed by coagulation)

In this method greater proportion of suspended inorganic and organic solids are removed by sedimentation and coagulation process. For quick settling coagulant like alum, ferrous sulphates are added.

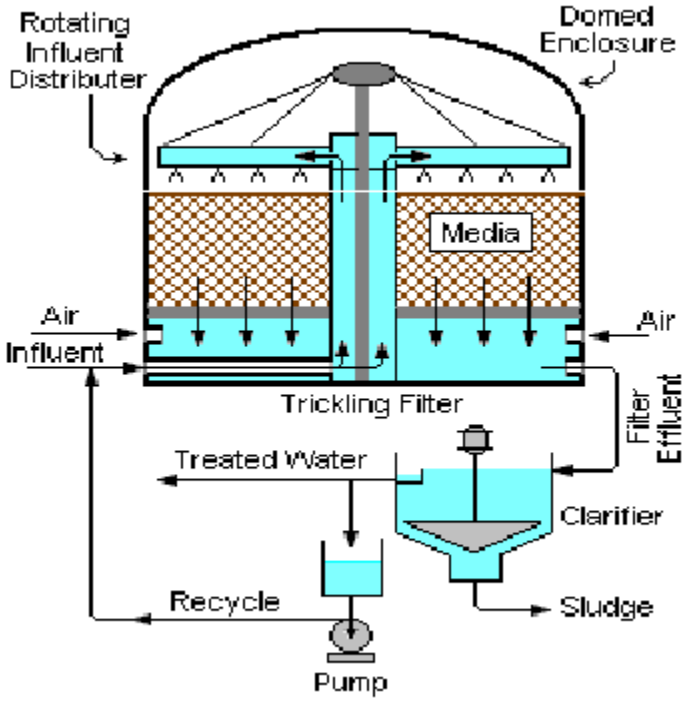
$$Al_2(SO_4)_3 + 6H_2O \longrightarrow 2Al(OH)_3 + H_2SO_4$$

Secondary treatment:

In this process biodegradable organic impurities are removed by aerobic bacteria. This method removes 90% of the oxygen demanding wastes. It is done by trickling filter or activated sludge process.

Trickling filter process:

A circular tank is fitted with coarse or crushed rocks containing microorganism in the form of bed. It is a fixed growth system. The sewage water is sprayed through the nozzles. Air is circulated through void spaces in the bed of stones provides oxygen for stabilization of organics by microbes. The microorganism present in the sewage grow on the surface of filtering media using organic material of sewages as food. After aerobic oxidation the treated sewage is taken to the settling tank and sludge is removed. This process removes about 80-85% of BOD.



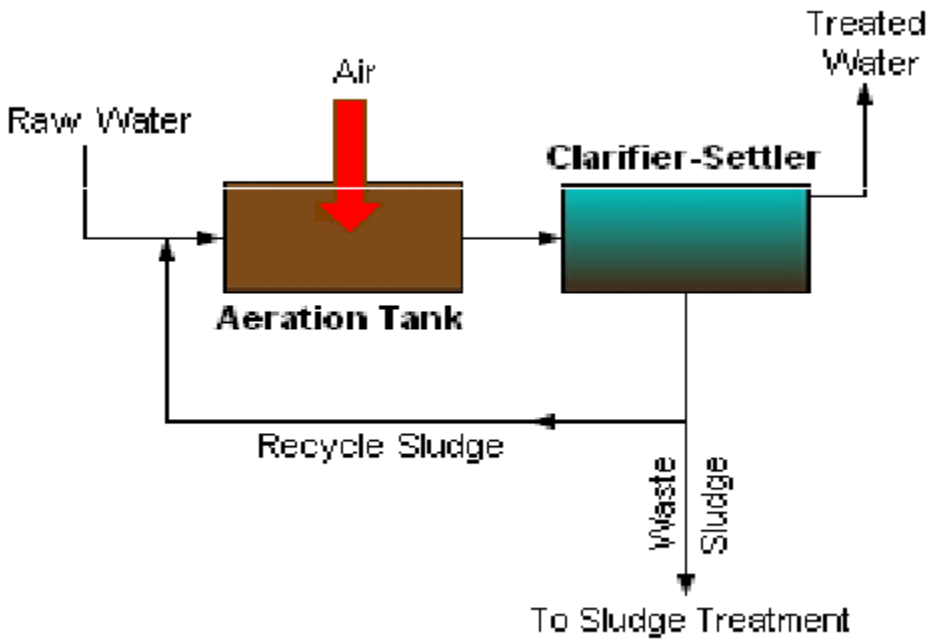
Fig

Activated sludge method:

Activated sludge is biologically active sewage and it has large number of aerobic bacteria which easily oxidize the organic impurities.

The treated sewage from primary treatment is mixed with the required amount of activated sludge. The mixture is aerated in the aeration tank.

Organic impurities of sewage get oxidized by microorganisms. This process removes about 90-95% of BOD.



Fig

Tertiary treatment:

In this tertiary treatment the effluent is introduced into flocculation tank where lime is added to remove phosphate, followed by ammonia stripping tower, where pH=11 and NH_4^+ is converted to ammonia gaseous. Then the effluent is allowed to pass through activated charcoal to remove coloring materials and finally it is treated with disinfectants.

Disposal of sludge

Sludge formed from the different stepa can be disposed by

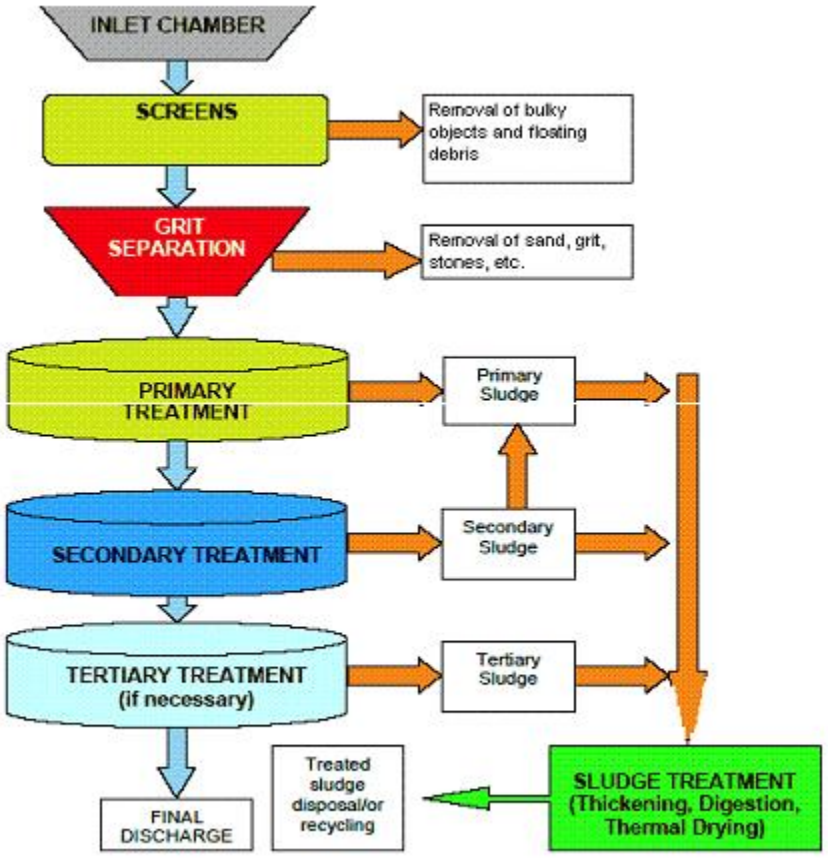
Dumping into low lying area

Burning of sludge

Dumping into the sea

Using as low grade fertilizer

Sludge is treated prior to ultimate disposal for volume reduction and stabilization of organics. Stabilized sludge does not have an offensive odour can be handled without causing health hazard.



Flow chart for sewage water treatment

Solid waste management

Classification

Garbage/food waste: produced during the preparation or storage of meat, fruits, vegetables, etc, spoiled food items etc.

Combustible waste: paper, wood, leather, etc.

Industrial wastes: chemicals, paints, sand, sewage treatment, sludge, toxic metal, etc.

Pathological waste: dead animal, human waste

Hazardous wastes: Waste which adversely affect human, plants, or animal life e.g radioactive wastes, toxic chemicals, explosive, hazardous biological waste from hospitals or research institute.

Process of Solid waste management

- Solid waste generation
- Collection of waste
- Transportation
- Storage
- Segregation of waste
- Disposal

Effects of solid waste

- Disease may spread rapidly
- Less comfortable environment for people
- Bad odour
- Ugly view
- Toxic substance may percolate into the ground and contaminate the ground water
- Waste disposal products produce foul smell, breeds various types of insects and spoil land value.
- Burning of industrial and domestic wastes (like cans, pesticides, plastics) produce furans, doxins, which are harmful to children and human being.

General disposal methods:

Open dumping:

Open dumping of solid waste is done in low lying areas and outskirts of the town and cities.

Advantages:

This method is cheap

Simple and economical

Require no planning

Segregation not required

The land filled areas can be reclaimed for other purpose

Disadvantages:

Large area is required

Transportation cost is heavy

Produce bad odour, if poor management

Causes fire hazardous due to formation of methane in wet weather

During rainy season it cause ground water pollution

Public health hazards are caused by the breeding of flies, mosquitoes, rats, and other pests.

Burning of these waste results air pollution

Closed dumping:

In this method the solid wastes are compacted and spread in thin layer (2m in depth) each layer being uniformly covered by a layer of soil. It should be 20 cm thickness to provide adequate covering.

The final layer is covered by a final cover about one meter of earth to prevent scattering. This is a biological method of waste treatment.

In this, aerobic and anaerobic bacteria's decomposes the waste into CO_2, CH_4, NH_3, and H_2O, which can be used as renewable source of energy.

Advantages:

Does not causes environmental damages, health hazards, as the refuse is covered and prevents breeding of pests and diseases.

No danger of air pollution

Reduce fire hazard

Simple and economical

Segregation is not required

Converting low-lying, marshy waste-land into useful area

Disadvantages:

Land fill has a limited life with increasing volumes of wastes, new land fill site have to be found.

Leaching of organic and inorganic matters of waste and the products of decomposition of waste by rain leads to ground water pollution.

To prevent ground water pollution from leaching, plastic membranes and other water light lining membrane on the base should be used.

Large area is required

Bad odour, if land fills are not properly managed

Cause fire hazard due to formation of methane in wet wethear.

Composting:

Composting needs separation of combustible matter such as egg-shell, tea bags, paper, cotton rags, grass etc from the total waste. For successful composting, the moisture content should be around 40-60% because excessive moisture make it difficult to maintain aerobic conditions.

The aerobic bacteria decompose organic matter into carbon dioxide and water, which raises the temperature to about 45^{o}C. Continuous oxidation leads further raise the temperature to about 60^{o}C. The waste should be periodically turned over to allow sufficient oxygen to go into the waste to support aerobic bacteria.

COMPOSTING TECHNIQUES

- Buhler Process: The non-composting materials are separated from the organic matter which is ground and decomposed in windrows.
- Dano Process: The waste is partially decomposed in rotating drums called bio-stabilizers. Then windrows are used.
- Tollemache Process: The waste is pulverized and decomposed in windrows for 3 weeks.
- Nu-soil Method: Waste is digested in a vertical digestor which consists of 7 sections. In each section, the waste is kept for a day. Process is complete in 7 days.

Advantages:

- ✓ Manure is added to soil, it increases the water retention and ion-exchange capacity of soil.
- ✓ Recycling occurs
- ✓ Manure be sold thereby reducing the cost of disposing of waste
- ✓ Industrial waste can be treated by this method

Disadvantages:

- ✓ The non combustibles have to be disposed separately
- ✓ Use of compost has not yet caught up with farmer and hence no assured market.

Incineration:

It is hygienic way of disposing solid waste. It is more suitable contain more hazardous waste and hospital waste. It is thermal process and is very effective for detoxification of all combustible pathogens.

In this method, the municipal solid wastes are burnt in a furnace called incinerators. The heat produced in the incinerators during the burning of waste is used in the form of steam power for generation of electricity throughout turbines.

The municipal waste is generally wet but has high calorific value. So it has to be dried up first before burning. The pre heated waste is allowed to furnace called destructors. Which can incinerate about 100-500 tones per hour. The temperature normally maintained in a combustion chamber is about 700^{o}C and may increased about 1000^{o}C when electricity is to be generated.

Advantages:

- ✓ The residue is only 20-25% of the original waste
- ✓ The clinker can be used after treatment
- ✓ Safest from hygienic point of view
- ✓ Transportation cost is low
- ✓ It require little space
- ✓ It can generate 3 MV of power from 300 tons of solid waste

Disadvantages:

- ✓ Capital and operating cost is high.
- ✓ Need skilled persons
- ✓ Formation of smoke, dust and ashes need further disposal and may cause air pollution too.

Pyrolysis (OR) Destructive distillation:

The chemical constituents and chemical energy of some organic waste can be removed by destructive distillation of solid waste.

In this process, the combustible solid wastes are heated in a chamber known as pyrolysis reactor at 600-1000^{o}C in oxygen free environment. This is an endothermic process, and thus differ the conventional incineration.

Pyrolysis of solid waste yields the following components:

Tar or oil phase containing methanol, acetone, acetic acid etc.

Gaseous phase containing hydrogen, methane, CO, CO_2 etc.

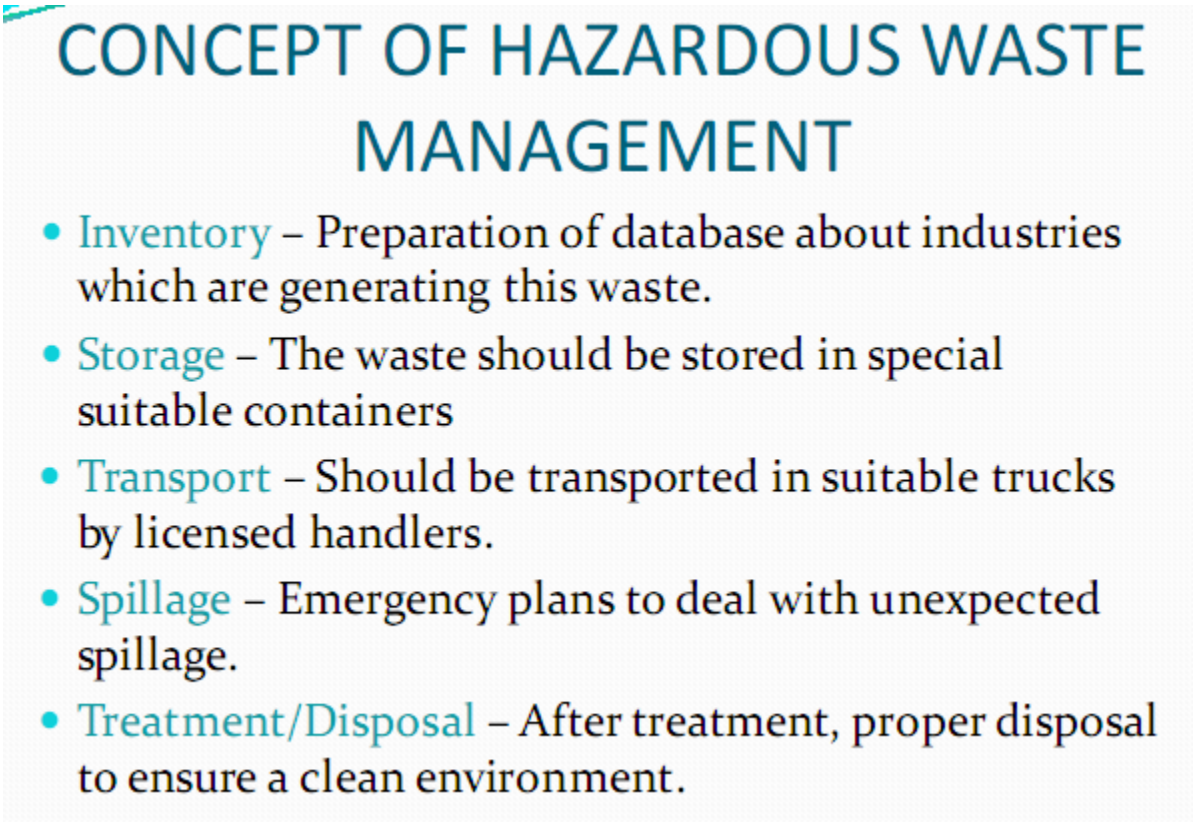
Solid phase containing carbon, inert material like rock, metal, glass etc

Advantages:

- ✓ Volume reduce about 90%
- ✓ Absence of pollution problem

Disadvantages:

- ✓ Incomplete destruction of cytotoxins
- ✓ Relatively high investment and operating cost



Bio medical waste management

Bio-medical waste means any waste, which is generated in bio technology labs, nursing homes, dispensaries, and hospitals etc.

Option	**Waste category**	**Treatment and Disposal**
Category No. 1	Human anatomical waste (human tissues, organs, body parts)	Incineration/ deep burial
Category No. 2	Animal wastes (animal tissues, organs, body, experimental animals used in research)	Incineration /deep burial
Category No. 3	Microbiology and biotechnology waste (waste from lab cultures, stocks or specimens of micro organisms, live or attenuated vaccines, human and animal cell culture used in research and infectious agents from research and industrial laboratories waste from production of biological toxins, dishes and devices and for transfer of cultures)	Incineration/ microwaving/local autoclaving
Category No. 4	Waste sharps (needles, syringes, scalpels, blades, glass, etc. that may cause puncture and cuts. This include both used and unused)	Disinfection (chemical treatment /autoclaving/microwaving/ and mutilation/shredding)
Category No. 5	Discarded medicine and cytotoxic drugs (waste comprising of outdated, contaminated, and discarded medicine)	Disinfection , destruction and drug disposal in secured landfills
Category No. 6	Solid waste (items contaminated with blood, and fluids including cotton, dressings, soiled plaster casts, linen, beddings, other material contaminated with blood)	Incineration @ autoclaving and microwaving
Category No. 7	Solid waste (waste generated from disposal items other than the waste sharps such as tubing, catheters, intravenous sets etc)	Disinfection by chemical treatment @ autoclaving/ microwaving and mutilation/ shredding

Category No. 8	Liquid waste (waste generated from laboratory and washing, cleaning, house keeping and disinfecting activities)	Disinfection by chemical treatment discharge into drains
Category No. 9	Incineration ash (ash from incineration of any bio medical waste)	Disposal in municipal landfill
Category No. 10	Chemicals used in production of biological chemicals used in disinfection, as insecticides, etc	Chemical treatment and discharge into drain for liquids and secured land fill for solids

Colour and coading

Colour coading	**Container type**	**Waste category**	**Treatment option**
Yellow	Plastic bag	Cat. 1,2,3,6	Incineration/deep burial
Red	Disinfected container/Plastic bag	Cat. 3,6,7	Autoclaving/microwaving/chemical treatment
Blue/White translucent	Plastic bag/Puncture proof container	Cat. 4,7	Autoclaving/microwaving/chemical treatment and destruction/shredding
Black	Plastic bag	Cat. 5,9,10	Disposal in secured landfill

Biomedical waste disposal methods

Microwaving

Microwaving method is used to kill bacteria and pathogenic organism by the action of microwave of a frequency of about 245 MHz and wave length of 12-24 cm.

The water contained in the waste rapidly heated by microwave, the pathogenic organisms are destroyed by heat conduction. The efficiency of the microwave disinfection should be checked routinely.

Advantages:

- ✓ Good disinfection efficiency under appropriate operation condition
- ✓ Drastic reduction in waste volume

- ✓ Enviromentally sound

Disadvantages:

- ✓ Relatively high investment and operating cost
- ✓ Potential operation and maintenance problem

Shredding:

Shredding or pulverizing reduce the size of the waste articls, resulting in a uniform mass of material. It is accomplished with hammer mills and rotary shredders.

The decomposable materials in waste are isolated from glass, metal, and othe inorganic items through sorting and separating operation.

There are carried out mechanically, using difference in such physical characteristics of the waste as size, density, and magnetic properties.

Autoclaving:

Autoclaving method is used for the pupose of disinfecting and treating bio-medical waste. During this process temperature, pressure, and time factor are very important.

For e.g when operating a vaccum autoclave, for disinfection and treating bio-medical waste

Temperature not less than 121^{o}C or not less than 135^{o}C

Pressure 15 psi (pound per square inch)/31 psi

Time not less than 45 minutes/ not less than 30 min

Medical waste shell not be considered properly treated unless the time, temperature, and pressure are given enough. Generally autoclave has a computer recording device which will automatically and continuously monitor and record data's , times of day, load identification number and operating parameters throughout the process of autoclaving.

Unit -4

Bio diversity

Biodiversity refers wide variety of life on the earth. It describes the number, variety and variability of living organism.

Genetic diversity:

Variation of genes within the species is known as genetic diversity. A species with different genetic character is known as genera. There are number of species within individual species, which are slightly different from one another.

Genes are the basic units, to transmit genetic information from one generation to other. Variation in genetic level differs in size, shape, colour, and nutrient content. It is the basic level of biological diversity. Genetic diversity is raw material from which new species arises through evolution.

Examples: Banana varieties, Teak wood varieties, mango varieties, goat varieties, dog varieties, varieties of human being.

Species diversity:

A discrete group of organisms of same kind is known as species. It is the diversity between different species. The sum varieties of the entire living organism at the species level are known as species diversity.

Plant species: Apple, mango, rice, wheat etc.

Animal species: Lion, tiger, elephant, deer etc

Measure of species diversity:

Species richness:

Number of varieties species in a particular area weighed by some measure of abundance such as number of individual or biomass.

Species evenness:

It refers to the number of species that can be found in an area.

An ecosystem in where all the species are represented by the same numbers of individuals has high species evenness.

An ecosystem in where some species are represented by many numbers of individual and other species are represented by very few individuals, is said to have low species evenness.

Ecosystem diversity:

It is set of biotic components(plants, animals) interacting with one another and with abiotic components. The diversity at the ecological or habitat level is known as ecosystem diversity.

Example: Pond ecosystem, Lake ecosystem, Marine water system, forest ecosystem.

Values of biodiversity:

Biodiversity has contributed in many ways to the development of human.

Direct value or Consumptive use:

These are direct use value where the biodiversity product can be harvested and consumed directly. These goods are consumed locally. Example : Food, fuel, and drugs.

(a) Food: The most fundamental value of biological resources particularly plant is providing food. Basically three crops i.e, wheat, maize, and rice constitute more than two third of food requirement all over world.

(b) Fish: Through the development of aquaculture, techniques, fish and fish products have become the largest source of protein in the world.

(c) Fuel: Since ages forests have provided wood which is used as fuel. Moreover fossil fuels like coal, petroleum, natural gas are also product of biodiversity which are directly consumed by human.

(d) Drug and medicine: The tradition medicine practices like Ayurveda utilize plants or their extracts directly. In allopathic, the pharmaceutical industry is much more dependent on natural products. Many drugs are derived from plants.

Productive values:

Biodiversity products (derived from plants and animals) are marketed. It is important to the economics of many countries. Many industries are dependent upon the productive use of biodiversity.

Animal	Animal Product
Sheep	Wool
Silk worm	Silk
All animals	Leather
Fish	Food
Marine animals	Raw material for many manufacturing products
Elephant	Tusk

Industry	Plant product
Paper, pulp, plywood, etc	Wood
Textile industry	Cotton
Food industry	Fruits and vegetables
Pharmaceutical	Plant extracts

Pharmaceutical industry:

Source	Products	Use
Poppy	Morphine	Analgesic
Bee	Beesting venom	Arthritis
Fungus	Pencillium	Antibiotic
Cinchona bark	Quinine	Malariya
Reserpine	Rauwolfa	Hypertension drug

Social value:

It refers to the manner in which the bio-resource are used to the society. These values are associated with the social life, religion and spiritual aspects of the people.

Many plants and animals are considered holy and sacred in India and are worshipped like Tulsi, peepal, Neem tree, cow, snack etc. In Indian society great cultural value is given to forest. Tiger, peacock, and lotus are named as the national animal, bird, flower respectively.

Ethical value or Existence value:

It involves ethical issues like “all life must be preserved”. It is based on the concept of “live and let live”. The ethical value means that a species may or may not be used, but its existence in nature gives us pleasure. Thus ethical believes protect the biological diversity.

Aesthetic values:

The beautiful nature of plant and animals insist us to protect biodiversity. The most important aesthetic value of biodiversity is eco-tourism. Natural landscapes at undisturbed places are a delight to watch and also provide opportunities for recreation activities like bird watching, photography, the pleasant music of birds, color of butterfly, fragrance of flowers, dancing of peacock etc are very important for aesthetic value. It promote eco-tourism which generate revenue by designing of zoological, botanical gardens, national park, wildlife conservation etc.

Optional value:

The optional values are the potential of biodiversity that are presently unknown and need to be known. The optional values of biodiversity suggest that any species may be proved to be a valuable species after some day.

Example: Biotechnology field searching of species for curing the disease of cancer and AIDS. Medicinal plants and herb play a very important role in our Indian economic growth.

Ecosystem service value:

It refers to the services provided by ecosystem like prevention.

(i) Carbon dioxide fixation through photosynthesis

(ii) Maintaining of essential nutrients by carbon (C), oxygen (O), nitrogen (N), Sulphur (S), Phosphorus (P) cycles.

(iii) Maintaining water cycle and recharging of ground water.

(iv) Soil formation and protection from erosion.

(v) Regulating climate by recycling moisture into the atmosphere.

(vi) Detoxification and decomposition of waste.

(vii) Soil erosion, prevention of floods, maintenance of soil fertility, pollution absorption, reduction of the threat of global warming.

Hot spots of biodiversity

Areas which exhibit high species richness as well as high species endemism are termed as hot spots of biodiversity.

Mayers identified 25 such hot spots of biodiversity on a global level out of which two are present in India, namely Eastern Himalaya and Western Ghats.

These hotspots covering less than 2% of world's land area are found to have about 50% of terrestrial biodiversity.

According to Mayer et al an area is designated as a hotspot when it contains at least 0.5% of the plant species as endimics.

About 40% of terrestrial plants, 25% of vertebrates' species are endemic and found in these hot spots.

Examples

Western amazon

Madagascar

North & East Borneo

West Africa

Brazilian Atlantic forest

These are the areas of high diversity, endemism and are threatened by human activities.

Eastern Himalaya

In the area of 7278 square km Sikkim about 4250 plant species are found of which 60% are endemic.

Out of world recorded flora 30% are endemic to India of which 35,000 are in Himalayas.

Western Ghats

It extends along a 17,000 square km strip of forest in maharastra, Karnataka, Tamil Nadu, and kerala. It has 40% of total endemic species.

62% amphibians and 50% lizards are endemic to western Ghats.The major centers of diversity are Agastyamalai Hills and silent valley the New Amambalam Reserve Basin.

Although the hotspots are characterized by endemism, interestingly a few species are common to both the hotspots in India.

Threats to biodiversity or Factors influencing the biodiversity

Extinction or elimination of a species is a natural process of evolution. In the geological period, the earth has experienced mass extinction. During evolution, species has died out and have been replaced by others. However, the rate of loss of species in geologic past has been a slow process, keeping in its view the vast span of time going back to 444 million years. The process of extinction has become particularly fast in the recent years of human civilization. In this century, the human impact has been so severe that thousands of species and varieties are becoming extinct annually.

E.O Wilson estimate the extinction at 10,000 species per year or 27 per day. This gives an alarm regarding the serious threat to biodiversity.Over the last 150 years the rate of extinction has escalated more dramatically, If the present trend continues we would lose 1/3rd to 2/3rd of our current biodiversity.

Increasing human population raises demand for land, house, raw materials, fuels, food on natural resources. If the same or present trends continues million of animals and plants may be destroyed in the next few decades. Deforestation, habitat loss, soil erosion, climate, urbanization resulted loss of biodiversity.

<u>Major causes for reduction in biodiversity:</u>

1. Destruction of natural ecosystems (deforestation, habitat loss, soil erosion, poaching)
2. Unfavorable changes in the biotic and abiotic factors due to
    a) Natural calamities
    b) Environmental pollution (urbanization)
    c) Invasion by exotic species
    d) Over exploitation of selected species
3. Increasing concentration of green-house gases in our atmosphere which threaten our planet in global temperature.

<u>Habitat loss</u>:

The losses of population of inter breeding organism is caused by habitat loss. It threatened a wide range of animal and plants.

Destruction of wet land – due to draining and pollution

Destruction of marine biodiversity – due to human intervention

Fragmentation:

The loss of habitat is installments so that the habitat is divided into small and scattered patches, phenomenon known as habitat fragmentation.

Fragmentation reduces populations so greatly and hence leads to poor weather, extinction of wild animal and birds.

Deforestation:

Conversion of forest and grassland into agricultural lands, construction of dams, industrial plants, hydroelectric project, have contributed to the loss of biodiversity. Forest fire, flood, destruction of forest greatly reduce the CO2 from the atmosphere by way of photosynthesis. This leads to green house effect.

1. Destruction of wetland: wet land, estuaries, mangroves destroyed due to draining, filling and pollution.
2. For Raw material and production of drugs: for the production of hybrid seeds the wild plants used as raw material. As a result many plant species become extinct. For production of drugs pharmaceutical companies collect wild plants and several medicinal plants.

Poaching of wildlife:

Poaching means killing or commercial hunting or animals. Animals are killed illegally for their meat, skin, internal organs, medicines, hides, ivory, horns etc.

Types of poaching:

Subsistence poaching: killing of animals to provide food for their survival.

Commercial poaching: killing animals to sell their products.

Sports poaching: Killing animals for recreation.

Factors influencing poaching:

Human population: increase of population causes degradation of wild life.

Commercial activities: smuggling of wild life products and animals to get more profit

Over Exploitation:

Many plant and animals species have been over-exploited by human, some time to the point of extinction.

Pet and Exotic Plant trade:

Each year millions of birds, fish, amphibians, and reptiles are captured for sale in most of the countries. These species end up in zoos, aquariums and pet stores. Plants are also at risk, particularly Cacti and Orchids that are very valuable in black market.

Scientific Research:

Most animals that are used for scientific research are not endangered. These animals, however, are threatened when habitat loss is also taken into consideration. The chimpanzee and orangutan are two such examples that are threatened for these reasons.

Predator and Pest control:

Extinction or near extinction can also occur when people attempt to exterminate pest and predator species that compete with humans. The use of pesticides to control insect pests, especially DDT and dieldrin, has reduced the population of some bird and amphibian species.

Mining Activity:

It is one of the major causes of loss of biodiversity. Mining leads to deforestation and aids in soil erosion. The particular whole place is threatened. In addition, poorly managed mining sites also create problems such as spreading diseases, interfacing of river navigation, sometimes, dissolved sediments runoff to the natural water sources causing detrimental effects to flora and fauna. Some of the chemical used in the processing of metal also lead to pollution to air and water,

Lack of legal systems:

There are several rules and regulations and laws that are implemented all over the world to conserve biodiversity. At the same time there are also many illegal activities challenging biodiversity.

Conservation of biodiversity

In-situ conservation:

Conservation of flora and fauna within its natural habitat is called in-situ conservation. Example: Biosphere reserves, national parks, wild life sanctuaries etc.

Around 4% of total geographical area of the country is used for in-situ conservation. Biosphere reserves-7, National parks-80, wild life sanctuaries-420, Botanical garden-120.

Biosphere reserves:

Cover large area (<5000 sq km) protect species for long time. It protect maximum number of species, serve as a site of recreation and tourism, useful for education and research purpose.

Examples:

Gulf of Mannar-Tamilnadu

Nilgiri-At the tri junction of (Tamilnadu, Karnataka, Kerala)

Manas-Assam

Sunder bans-Westbangal

National Parks:

It is small reserves covering area of 100 to 500 sq kms. It is used for enjoyment through tourism to protect wildlife.

Example

Gir	Gujarat	Lion
Periyar	Kerala	Tiger, Elephant
Corbett	Uttarakhand	Tiger
Kanha	M.P	Tiger

Wild life sanctuaries:

It is reserved for the conservation of animals. It allows operation such as harvesting of timber forest products.

Example

Nal sarovar bird	Gujarat	Water birds
Mudumalai wild life	Tamilnadu	Elephant
Vedanthangal bird	Tamilnadu	Waterbirds

Wild Ass Sanctuary Gujarat Wild Ass, Wolf

Advantages:

1. It is cheap and convenient method
2. The species get adjusted to the natural disaster like drought, floods, and forest fire.
3. It conserves genetic diversity of all existing species
4. This prevents from exotic species.
5. It supports for research, education, monitoring etc

Disadvantages:

1. Large Surface area is required to preserve the biodiversity.
2. Maintenance of the habitat is not proper due to pollution and shortage of staff.
3. In order to maintain food chain, large number of organisms should be protected.
4. Maintenance is also very difficult.

Project Tiger:

In 1973, the project was launched in palamau Tiger Reserve, and various Tiger reserves were created in the country based on a "core-buffer" strategy, To maintain viable population of Tiger in India, and to preserve Tiger (23 reserves) was started in 1973, when Tiger population dwindling around 270.

19^{th} century 45,000 Tigers

In 1973, 1827 Tigers

In 1990 project Tiger helped to increase the population of Tigers from 1,200 to 3,500.

In 2008 there were more than 40 project Tiger reserves covering an area over 37,761 square Km

In 2008 the Tiger population had dropped to 1,411.

Project rhino

Project rhino was launched in 1984 to maintain population of rhinos

Indian rhino-abounded in the alluvial grasslands of major river systems (Brahmaputra, Ganges, Indus) in the northern part of the south Asia subcontinent.

20^{th} century, only a few rhino remained in Assam, Bengal, and Nepal.

In 1905 10 -20 rhinos.

Kaziranga celeberated its century in 2005. 1,700 rhinos (70 % of world's populations ; 85% of Assam's)

"Indian Rhino Vision 2020" The goal of IRV 2020 is to increase the total rhino population in assam from 2000 to 3000 by the year 2020.

Project elephant

Project elephant was launched in February 1992 to maintain population of elephant (25 reserves)

The project elephant in India also aimed to decrease the human-elephant battle and help in the welfare of domesticated elephants in India.

Estimation of wild elephant population in the year 2007-08.

Till now 26 Elephant Reserves (ERs) extending over about 60,000 sq km have been formally notified by various state Governments.

Consent for establishment of 6 more Ers – Baitarini ER & South Orissa ER, Lemru & Badalkhod in Chattisgarh and Ganga-Jamuna (Shiwalik) ER in UP, Khasi ER in Meghalaya has been accorded.

Ex-situ conservation:

Conservation involves protection of flora and fauna outside the natural habitats.

Example

Gene banks, seed banks, sperm and ova banks

In vitro plant and microbial culture collection

Captive breeding of animals and artificial propagation of plants, with possible reintroduction into the wild; and

Collecting living organism for zoos, aquaria, and botanical gardens for research and public awareness.

National bureau of Fish Genetic Resources in Allahabad collect and preserve genetic material of rare fish. National bureau of plant resources in New Delhi collect and preserve genetic material of crops.

<u>Long term captive breeding:</u>

It involve capture, maintenance and breeding in captivity on long term basis of endangered species. It is usually under taken for species which have lost their habitats permanently or the species forced to extinction due to source factors in the habitat.

Short term propagation:

The endangered animal maintained and breed in captivity under human care, are subsequently released in wild habitat. The method is usually undertaken when population of species decline due to some temporary setback in their living condition.

Translocation / Re-introduction:

Moving the population of endemic species from particular place to other place to save them from extinction. They can also re-introduce into an area from which they have either declined or disappeared due to human activity.

Botanical Gardens:

It is a plot of land on which trees, shrubs, are grown for study or display. Gardens are used to preserve rare, endangered plant species, for doing research and promote sustainable development. Now a days they have seed banks, tissue culture units.

Gene bank:

Genes of various species can be preserved at very low temperature for period 10-15 years. Collection of living material in the form of zoo animals. Botanical collections and seeds together with DNA collection have been termed as gene banks.

Institute	Crops
Central Institute for cotton Research, Nagpur	Cotton
Central Plantation crops Research Institute, Kasargod	plantation crop
Central Potato Research Institute, Simla	Potato
Directorate of Oilseeds Research, Hyderabad	oil seeds
Directorate of Wheat Reasearch, Karnal	Wheat
Indian Agricultural Research Institute, New Delhi	Maize

Seed bank:

Seed are dried to a moisture content of less than 6%. The seed are then stored in freezer at -18^{o}C or below. Because seed DNA degrade with time, the seeds need to be periodically replanted and fresh seeds collected for another round of long-term storage.

Seed storage:

Based on duration of storage, seed bank collects are classified into three groups.

(1) Base collection. (2) Active collection (3) Working collection

Base collection:

Seeds can be conserved for long term (50-100 years), at about -20^{o}C with 5% moisture content. They are distributed only for regeneration.

Active collection:

Seeds are stored at 0^{o}C temperature and the seed moisture is between 5 to 8%. The storage is for medium duration .i.e., 10-15 years. These collections are used for evaluation, multiplication, and distribution of the accessions.

Working Collections:

Seeds are stored for 3-5 years at 5-10^{o}C and usually contain about 10% moisture. Such materials are regularly used in crop improvement programmes.

Egg pulling:

This refers collection of egg and hatching then in zoos or research centers

Madras crocodile bank preserved various state of forest crocodile eggs.

Aquaria:

It is mainly used for the captive propagation of endangered fresh water species.

Reproductive Technology:

In order to maintain the genetic diversity, advanced reproductive technology is applied which includes

i. Embryo transfer technology

ii. Crypto preservation of gametes and embryos

The use of DNA technology enables to conserve the whole DNA of a plant or animal cell. Gene that are given genetic variation, illness or discrepancy can be identified, isolated and conserved. Creation of transgenic crops, genetically modified crops, proved to withstanding against the pest and environmental stress. Artificial insemination, incubation, embryo manipulation are some of the techniques providing an innovative and effective approach to biodiversity conservation.

Advantages:

1. Survival of endangered species is increasing due to special care and attention.

2. Using advanced techniques to improve the species concerned.

3. Controlled supervision and assured food, shelter and security measure are the must in this method so that species can survive longer and may breed more than usual.

4. It is the lost resort to protect endangered species.

5. The quality of offspring may be improved by genetic modification.

It is for long term conservation

Disadvantages:

1.As the wild life is a vast and diverse assemblage of plants , animals and microbes, it is very difficult to conserve through specific methods.

2. Requires large areas

3. Expensive to establish and maintain

4. It is not a viable option for protection of rare species.

5. Prone to damage from disease and insect attacks

6. Man-made

7. The freedom of wildlife is lost

8. The animal cannot survive in the natural environment

9. Natural disaster

10. Human error in handling

Endangered species of India

International Union for conservation of Nature and Natural resources (IUCN) publish the Red Data Book which include the list of endangered species of plants and animals.

The Red data symbolizes the warning signal for those species where are endangered and if not protected are likely to become extinct in nature.

Red data book contains the list of endangered species of plants and animals.

The 2000 Red list contains assessment of more than 18,000 species, 11,000 of which are threatened. According to the Red List in India

44 plant species-critically endangered

113 plant species- endangered

87 plant species- vulnerable

18 animal species – critically endangered

54 animal species – endangered

143 animal species – vulnerable

It may not be of direct relevance here to give a complete list of endangered flora and fauna of our country. However, a few species of endangered reptiles, birds, mammals, and plants are given below.

(a) Reptiles: Python, Monitor lizard, estuarine crocodile, green sea turtles, Gharial, tortoise
(b) Carnivorous mammals: Indian wolf, red fox, sloth bear, red panda, tiger, leopard, striped hyena, Indian Lion, golden cat, desert cat.
(c) Primates: Hoolock gibbon, Lion-tailed macaque, Nilgiri langur, capped monkey, golden monkey
(d) Plants: A large number of species of orchids, Rhododendrons, medicinal plants like Rauvolfia serpentine, the sandal wood tree santalum, cycas beddonei etc

The zoological survey of India reported that cheetah, pink headed duck and mountain quail have already become extinct from India.

Endemic Species of India

India has two biodiversity hot spots and thus possesses a large number of endemic species.

Out of about 47,000 species of plants in our country 7000 are endemic. Thus, Indian subcontinent has about 62% endemic flora, restricted mainly to Himalaya and Western Ghats.

Some of important endemic flora include orchids and species like sapira himalayana, Uvaria lurida, Nepenthes Khasiana, Pedicularis perroter etc,

A large number of out of a total of 81,000 species of animal in our country is endemic. The Western Ghats are particularly rich in amphibians (frog, toad etc) and reptiles (lizards, crocodiles etc).

About 62% amphibians and 50% lizards are endemic to Western Ghats. Different species of monitor lizards, recticulated pyton and Indian salamander and viviparous toad Nectophhyryne are some important endemic species of our country.

Endangered Species:

Animals which face the threat of extinction due to various unfavorable factors in their natural habitats are called endangered species.

Examples: Siberian Tigers, Red wolf, Mountain Gorilla,

Extinct Species:

A species is said to be extinct when it is not seen in the wild for 50 years at a stretch.

Examples: Dodo, Passenger pigeon

Exotic Species:

It is not a habitat species but introduced in the system intentionally or accidently that make the environment very competitive.

Example: Introduction of water hyacinth originally from Brazil in India is greatly multiplying as weed.

Maxican weed came along with American wheat and contaminate wheat seeds.

Parthenium mature rapidly and deplete the nutrients from soil and suppress the cultivated crops and hence ecologically harmful.

Keystone Species:

It is a species that play a critical role in maintaining of an ecological community. Some species are key to the functioning of habitat and their loss would lead to greater than average change in other species population or ecosystem process. They are known as keystone species.

Indicator Species:

A species that indicate particular environmental condition such as certain soil or rock types is called as keystone species.

An indicator species is a plant or animal which is used to gather information about an environment or area.

Examples: Lichens are sensitive to toxic gas such as SO_2 and Ozone.

Grease wood indicates saline soil

Mosses often indicates acid soil

Tubifex worm indicates oxygen

Unit -5

National Concern

The Ministry of Environment and Forest, Government of India published a document on Nation conservation strategy and policy statement on Environment and development in June 1992.

For the protection of environment, India legislated various acts which include the following.

1. Water (prevention and control of pollution) act, 1974 (Amended upto 1988).
2. The water (prevention and control of pollution) Rules, 1975.
3. The water (prevention and control of pollution) Cess Act, 1977 (amended in 1991).
4. The water (prevention and control of pollution) Cess Rules, 1978.
5. The Air prevention and control of pollution) Act, 1981(amended in 1987)
6. The air (prevention and control of pollution) Cess Rules, 1978
7. The air (prevention and control of pollution) Act 1981 (Amended in 1987)
8. The Air (prevention and control of pollution) Rules, 1982.
9. The Air (prevention and control of pollution) (Union territories) Rules, 1983.
10. The Environment (protection) Rules, 1986.
11. The Noise Pollution (Regulation and control) Rules, 2000.
12. The Ozone Depleting substances (Regulation) Rules, 2000.
13. The Wildlife (protection) Amendment Act 2002.
14. The Biological Diversity act, 2002.

Functions of state Pollution Control Board

The functions of the State Pollution Control Board are as follows:

1. To advise the state governments on matters relating to pollution and on citing of industries.
2. To plan programmes for pollution control
3. To collect and disseminate information
4. To lay down effluent and emission standards
5. To issues consent to start industries and for other activities for compliances of prescribed emission and effluent standards.

6. To carryout inspection.

Functions of central Pollution control Board

The functions of central pollution Board are as follows:

1. To advise the Central Government on matters relating to pollution
2. To contribute the activities of the State Pollution Control Boards
3. To provide Technical assistance to the State Boards, carry out and sponsor investigations and research relating to control of pollution.
4. To plan and organize training for personnel
5. To lay down standards
6. To plan national wide programme for pollution control
7. To collect, compile and publish technical and statistical data, prepare manuals and code of conduct.

International concern

United Nations organized the first major conference on environment in Stockholm on 5th June. This day is celeberated as world Environment day.

Kyoto protocol

Kyoto protocol was adopted on 11th December 1997. The countries which took part in the convention decided to achieve the targets by taking the following measures.

1. To reduce green house gas emission in their countries.
2. To implement projects to reduce emission in other countries

Rio Declaration 1992

- This conference was held in Rio de Janeiro, Brazil in 1992 (June 3 Brazil in 1992 (June 3 - 14)
- It was a United Nations Conference on It was a United Nations Conference on Environment and Development (UNCED).Environment and Development (UNCED).
- Around 179 countries participated.

- UNCED proclaimed the concept of sustainableUNCED proclaimed the concept of sustainable development as a workable objective for development as a workable objective for everyone around the world

Objectives

- ✓ Establishing a new and equitable global Establishing a new and equitable global partnership through the creation of new levels partnership through the creation of new levels of cooperation among States, key sectors of of cooperation among States, key sectors of societies and people.
- ✓ Working towards international agreements which respect the interests of all and protect which respect the interests of all and protect the integrity of the global environmental and the integrity of the global environmental and developmental system.

Achievements of the Conference

- ✓ The Rio DeclarationThe Rio Declaration -- A document produced at A document produced at Achievements of the ConferenceAchievements of the Conference consisting of 27 principles to the Conference consisting of 27 principles to guide future sustainable development
- ✓ Agenda 21Agenda 21 — a Programme of action to reach a Programme of action to reach global sustainable development in the 21global sustainable development in the 21 century.
- ✓ The agenda states that socio-economic development is linked with environmental development is linked with environmental protection.
- ✓ The UNFCCUNFCC treaty to stabilize GHG emission.treaty to stabilize GHG emission.

The Rio Declaration Principles

1. right of humans
2. State sovereignty
3. Right to development
4. Protection in the development Process
5. Eradication of Poverty
6. Priority for the Least Developed

7. State Cooperation to Protect Ecosystem
8. Reduction of unsustainable production and Reduction of unsustainable production and consumption.
9. Capacity Building for Sustainable Development Capacity Building for Sustainable Development
10. Public participation.
11. National Environmental Legislation
12. Supportive and Open International Economic Supportive and Open International Economic system.
13. Compensation for Victims of Pollution and Compensation for Victims of Pollution and other environmental damage.
14. State Cooperation to Prevent Env. dumpingState Cooperation to Prevent environment. Dumping
15. Precautionary principle
16. Internalization of environmental costs.
17. Environmental impact assessment
18. Notification of Natural disaster
19. Prior and timely notification
20. Women have a vital role
21. Youth Mobilization
22. Indigenous People have a vital role
23. People under Oppression
24. Warfare
25. Peace, Development and Environmental and environmental prptection.
26. Resolution of Environmental disputes
27. Cooperation between State and People Cooperation between State and People

Vienna Convention

In 1985, the Vienna convention was adopted to formalize international cooperation on ozone depletion issue. The original protocol would have reduced the production of CFC by half by 1998.

Johannesburg Summit 2002

- ✓ This conference was held in Johannesburg, South Africa in 2002 (August 26- sep 4).
- ✓ It was a world summit on sustainable development.
- ✓ It focused the world's attention and direct action toward meeting difficult challenges like conservation of natural resources, improving people's lives, etc.

- Recognizing the social and poverty dimension of sustainable development
- Acknowledging that global environment treaties are mutual with World Trade rules.
- Recognizing the mutual and joint roles of states, companies and civil society.
- Initial steps towards setting up a system for international corporate social responsibility
- Action plans towards sustainable consumption, but nothing concrete.
- Halving those suffering hunger by 2015 and encouraging sustainable agriculture
- Minimizing adverse health and environmental effects of chemicals by 2020.
- Halving the number of people without safe clean water and sanitation by 2015.
- Only removing sustainability inhibition fossil fuel subsides "where appropriate"
- Significantly reducing rate of biodiversity loss by 2010 but not reversing it.
- Reversing trend in natural resource degradation, but no targets or dates.
- Restoring fish stock urgently, to levels to enable countries to produce " maximum sustainable yields"
- The effective removal of the precautionary principle from issues like biodiversity, resource use.
- But there were no specific target on agriculture, energy, transport waste or natural resources.

Wild life conservation

The Indian Forest Act of 1865 was the first attempt at legislation relating to forest India by the British. A revised Indian Forest Act was passed in the year of 1878. The Madras Forest Act 1882, was a pioneer in the forest legislation during the British regime.

Due to inadequacies of the Forest Act to prevent wildlife, a separate Wild Elephant Preservation Act waspassed in 1879 extending to certain provinces only. The Wild Bird Protection Act 1887 was passed and as a consequence of this act the vedanthangal Bird Sanctuary was created.

The government of India passed a comprehensive Wild Birds and Animals Protection Act, 1912. This act of 1912 prohibited the killing or capturing of wild animals and birds and the wildlife considered endangered was listed in the schedule for special protection. Indian Forest Act of 1927 came into existence and this Act with several state amendments was in force in many part of the country. As a consequence the Kaziranga sanctuary was established.

The Wild Birds and Animals Protection Act, 1935 was issued as an amendment to the Act of 1912 amended drastically, by including many more birds and animals for protection.

The first National Forest Policy was enunciated after independence in 1952 and at the time the area under forest was only 23.7%. It emphasized the need to increase the forest area to 33% to ensure ecological balance in the country. But in spite of this, the forest area got reduced to 19.4%.

In 1960's most of the state governments allowed free grazing in the forest. It made sharp decline in wildlife population. In 1969 it was found that the tiger population in India had been reduced to 1750 tigers from 40,000 available in 1900. The Project Tiger was started in 1973 to ensure the present wildlife.

The Wildlife (Protection) Act, 1972 is a comprehensive Act for protection of wild animals. The Act of 1972 with amendments in 1982, 1986 and 1991, deals with protection of endangered species of flora and fauna, and prescribes severe penalties for offenders. An important aspects of Wildlife Law is that onus of proof is on the accused and not on the

prosecution. The latest amendment of 1991 provides for setting up of Zoo Authority of India for upgrading the conditions of zoos, exchange of animals, captive breeding, etc.

Forest and wildlife

1927- The Indian Forest and Amendment, 1984, is one of the surviving colonial statutes. It was enacted to " consolidate the law related to forest, the transit of forest produce, and the duty leviable on timber and other forest produce".

1972- The wildlife Protection Act, Rule 1973 and Amendment 1991 provide for the protection of birds and animals for all matters that are connected to it whether it be their habitat or the waterhole or the forests that sustain them.

1980- The Forest (conservation) Act and Rules, 1981, provides for the protection of and the conservation of the forests. The Government of India made the following rule under the act.

The wildlife (Stock Decaration) Rules, 1973.

The Wildlife (Transaction Taxidermy) Rules, 1973.

The Wildlife (Protection) Licensing (Additional matters for consideration) rules, 1983.

The recognition of zoo rules, 1992.

The Wildlife (Protection) Rules, 1995.

The Wildlife (Specified plants-conditions for possession by license) Rules, 1995.

The Wildlife (Specified plants Stock Declaration) central Rules, 1995.