UNIT – 3

Environmental pollution

ENVIRONMENTAL POLLUTION-DEFINITION:- Any undesirable change in the physical, chemical or biological characteristics of any component of the environment (air, water, soil) which can cause harmful effects on various forms of life or property.

Types of environmental pollution:- a) Air pollution b) Water pollution c) Soil pollution d) Marine pollution e) Noise pollution f) Thermal pollution g) Nuclear hazards

Pollutants:

A substance which is hazardous to human beings, plants animals, environment etc is called as pollutants.

Types of pollutants:

1. Bio degradable pollutants - decompose rapidly by natural processes.

2. Non- degradable pollutants- do not decompose or slowly decompose in the environment

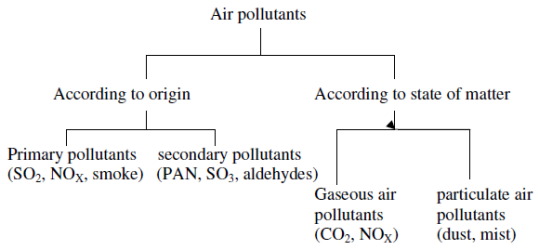
Air pollution:

It may be defined as "the presence of one or more contaminants like dust, smoke, mist and odour in the atmosphere which are injurious to human beings , plants and animals

Sources of air pollution

Natural sources	Man Made Sources(anthropogenic)
1. Volcanic eruption	thermal power plants (fly ash, SO_2)
2. Forest fires	industrial units
3. Biological decay	vehicle emission
	Petrol vehicles
	Sea salt spray
	fossil fuel burning
4. Pollen grains of flowers	Agricultural activities
	Metallurgical plants (SO_2, CO_2)
	Fertilizer plants
	Textile mills
	Refineries
	Paper and pulp mills

Classification of air pollutants:



SOURCE AND EFFECT OF AIR POLLUTIONS:

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Sulphur dioxide:

- The combustion of sulphur containing fuels such as coal and oil.
- It can be converted into sulphuric acid.

Human Sources:

- Coal burning in power plant (88%)
- Industrial processes (10%)

Environmental effects:

- In humans : it causes eye irritation, cough, lung diseases including lung cancer and asthma
- In plants: it causes damage of leaves, bleaching of chlorophyll which turns leaves brown, damage to crops and to growth of plants.

Oxides of nitrogen (NOx)

Nitric oxide, nitrogen dioxide and nitrous oxide are the three main oxides of nitrogen found in the atmosphere

Sources:

The sources for the oxides of nitrogen are:

- Bacterial decomposition of nitrogenous compounds
- Combustion during lightning: During lightning, oxygen and nitrogen in the atmosphere combine to give oxides of nitrogen.
- Industries and automobile exhaust - Air is sucked into the IC engines. At high temperatures, nitrogen and oxygen in the air combine to form nitric oxide.

Effects:

The oxides of nitrogen combine with moisture in the atmosphere to form nitrous and nitric acid. This leads to increase in the acidity of rain water.

Formation of photochemical smog: oxides of nitrogen combine with hydrocarbons present in the atmosphere forming peroxyacyl nitrate.

Carbon monoxide

Sources:

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- Cigarette smoking, incomplete burning of fuels.
- Automobile exhaust- carbon monoxide is formed during the combustion of fuel such as petrol.(77%)
- Industries: carbon monoxide is released by industries such as iron and steel and petroleum .

$CO_2 + C \text{ -------} \rightarrow 2CO$

$2CO_2 \text{ ---------} \rightarrow 2CO + O_2$

Effects:

In humans:

- When the atmosphere is polluted with carbon monoxide, on inhalation, CO combines with the hemoglobin to form car boxy hemoglobin and hence oxygen carrying capacity of the blood decreases.
- This causes, headache, dizziness, unconsciousness.
- When inhaled for a long duration it may cause even death.
- In environment: it increase globe temp.

Lead pollutant:

Sources:

The exhaust from automobiles which use lead tetraethyl as antiknocking agent.

Paint pigments: Litharge and red lead (oxides of lead) and lead chromate are used as pigments. These cause lead pollution.

Effects:

- It leads to anemia and blood cancer in human beings.
- Lead enters the blood and various organs of the body including the brain and the Kidneys leading to dysfunction of the kidney and damage to the brain.

Suspended particulate matter (SPM):
Sources:
Industries, Vehicles' and unpaved roads

Effects:
Nose irritation, throat irritation, lung damage, bronchitis, asthma, reproductive problems and cancer.

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Ozone (O3):

Sources:

Chemical reactions among volatile organic compounds.

Effects:

Nose, throat irritation, lung damage, bronchitis and asthma.

Photochemical smog: smoke + fog = smog

Sources:

The brownish smoke formed due to chemical reactions among nitrogen oxides and hydrocarbon in sunlight.

Effects:

Nose, throat irritation, lung damage, bronchitis and asthma.

Hydrocarbons:

Sources:

- Cigarette smoking, incomplete burning of fuels.

Effects:

- Nose, throat irritation, lung damage, bronchitis, asthma, it cause carcinogenic activity.

Control of air pollution:

Source Control:

- Use only unleaded petrol.
- Use petroleum products and other fuels that have low sulphur and ash content.
- Reduce the no. of private vehicles
- Ensure the houses; schools are not located on busy streets.
- Plant trees along busy streets to reduce particulates, CO and noise.
- Industries should be situated outside the city
- Use catalytic converters to control CO &hydrocarbons
- Using non conventional energy
- Using bio filters

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Control measures in industries:

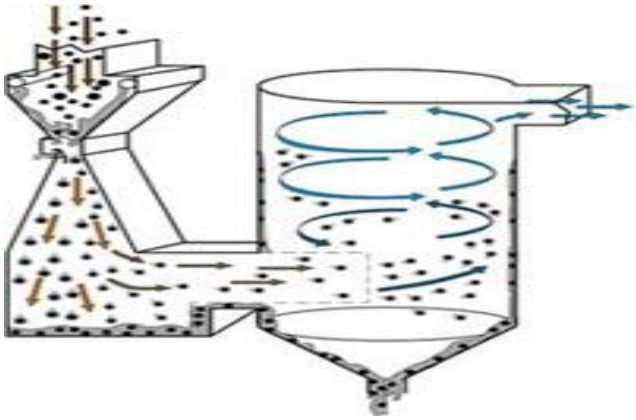
- The **emission rates** should be restricted to permissible levels by industries.
- Air pollution **control equipments** must be made mandatory.
- Continuous **monitoring of the atmosphere for the pollutants**, to know the pollution levels.

EQUIPMENTS USED TO CONTROL AIR POLLUTION

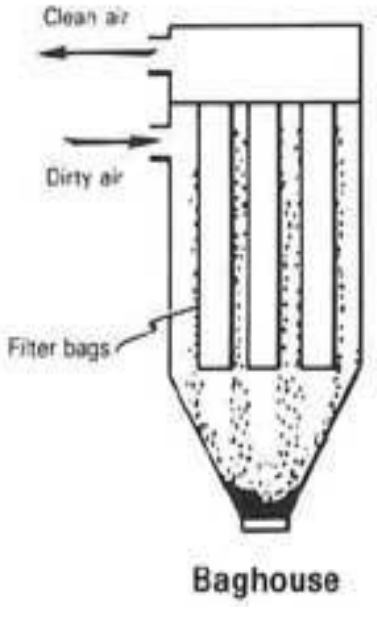
- Use **sufficient supply of oxygen** in combustion chamber, so that the combustion is complete.
- Use **mechanical devices** such as

  1. Wet scrubbers
  2. Cyclone separator
  3. Bag house filter
  4. Electro-static Precipitators

WET SCRUBBER



BAG HOUSE FILTER



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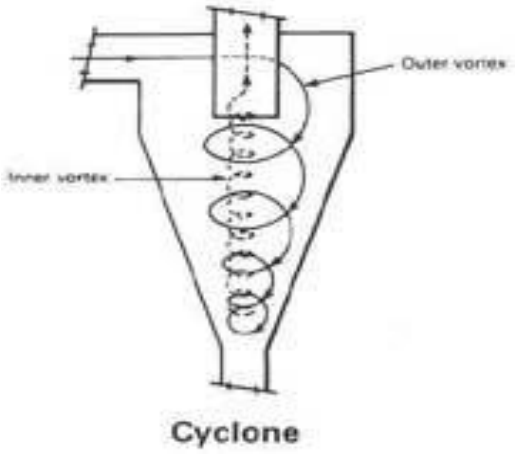
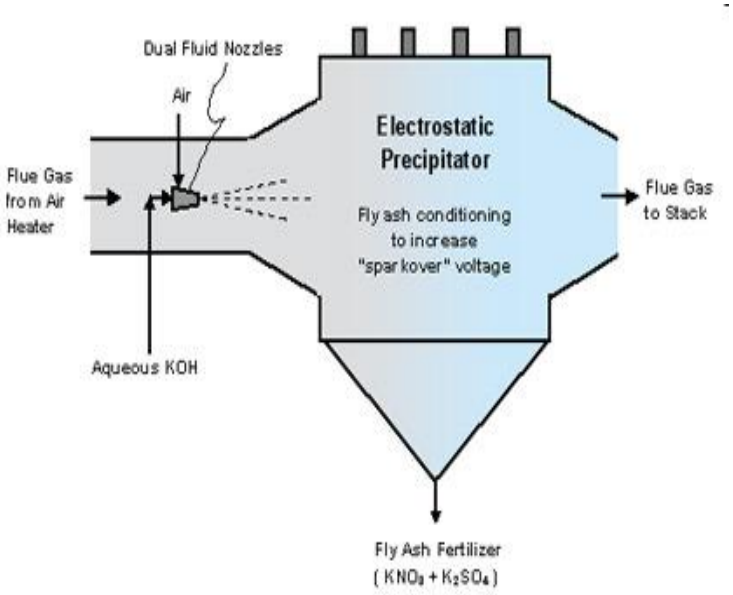
CYCLONE SEPERATOR



ELECTROSTATIC PRECIPITATOR



WATER POLLUTION

Any alteration in physical, chemical or biological properties of water, as well as the addition of any foreign substance makes it unfit for health and which decreases the utility of water, is known as water pollution.

Definition of effluent: Liquid waste flowing out of a factory, farm, commercial establishment, or a household into a water body such as a river, lake, etc.,

Main sources of water pollution are:

- Domestic and municipal sewage
- Industrial waste
- Agricultural waste
- Radioactive materials, etc.,

POINT AND NONPOINT SOURCES

Two types of water pollutants exist;

Point source

Point sources of pollution occur when harmful substances are emitted directly into water.

e.g., Oil spill

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Nonpoint source.

A non-point source delivers pollutants indirectly through environmental changes.

e.g., Fertilizer from a field is carried into a stream by rain

Types of pollutant:

1. Infectious agents: Bacteria, viruses, protozoa

Source: animal waste.

Effect: variety of diseases

2. Oxygen demanding waste:

Dissolved oxygen (DO) is the amount of oxygen dissolved in given quantity of water at a particular P and T. The saturation point 8-15mg/lit.

Sources: Sewage, paper waste, food processing waste.

Effects: affect to water quality, affect fish survival and migration.

3.Inorganic chemicals : Acids, Pb, arsenic, selenium, sodium chloride and fluorides.

Causes : surface runoff, effluents

Effects: Cause skin cancer, damage nervous system, harm to fish and aquatic life, lower crop yields.

4. Organic chemicals: Oil, gasoline, plastics, solvents, detergents.

Causes: Industrial effluents, surface runoff forms.

Effects: Causing effect nervous system ,cancer, harm fish and wild life.

5. Plant nutrients:

Nitrate, phosphate and ammonium ions

Causes: sewage, runoff water with agriculture fertilizer.

Effects: Excessive growth of algae, lower the oxygen carrying capacity.

6. Sediment: Soil

Causes: Land erosion.

Effects: Can reduce photosynthesis, Affect aquatic food webs.

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Control of water pollution:

- Avoid Pesticides and fertilizers on sloped land areas.
- The nutrient rich water can be used as fertilizer in the fields.
- Separate drainage of sewage and rain water should be provided to prevent overflow of sewage with rain water.
- Planting more trees.
- Use nitrogen fixing plants to supplement the use of fertilizers.
- Public awareness
- Strictly implement the water act against offenders
- Domestic treatment
  - Screening
  - Aeration
  - Sedimentation
  - Filtration
  - Disinfection
- Industrial waste water treatment
  - Preliminary treatment
  - Primary treatment
  - Secondary treatment
  - advanced treatment

WASTE WATER TREATMENT:

Objective of waste water treatment:

1. To convert harmful compounds into harmless compounds.
2. To eliminate the offensive smell.
3. To remove the solid content of the sewage.
4. To destroy the disease producing microorganisms.

Preliminary Treatment:

In preliminary treatment, the suspended solids and floating objects are removed using coarse screens and sieves.

Primary Treatment or settling process:

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In primary treatment, the maximum proportions of the suspended inorganic/ organic solids are removed from the liquid sewage. The liquid material passes into the sedimentation tank and finely suspended particles are allowed to settle by adding coagulants like Alum**.**

$Al_2(SO_4)_3 + 6H20 \rightarrow 2Al(OH)_3 \downarrow + 3H_2SO_4$

Secondary Treatment or Biological treatment:

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

(a) Trickling Filter process:
It is a circular tank and is filled with either coarse or crushed rock .Sewage is sprayed over this bed by means of slowly rotating arms
When sewage starts percolating downwards, microorganisms present in the sewage grow on the surface of filtering media using organic material of the sewage as food. After completion of aerobic oxidation the treated sewage is taken to the settling tank and the sludge is removed. This process removes 80-85% of BOD.

(b) Activated Sludge process:
Activated sludge is biologically active sewage and it has a large number of aerobic bacteria's, which can easily oxidize the organic impurities.
The sewage effluent from primary treatment is mixed with the required amount of activated sludge. Then the mixture is aerated in the aeration tank. Under these conditions organic impurities of the sewage get oxidized rapidly by the microorganisms.
After aeration, the sewage is taken to the sedimentation tank. Sludge's settle down in this tank called activated sludge. A portion of which is used for seeding fresh batch of the sewage. This process removes about 90-95% of BOD.

Tertiary Treatment:

Remove detergents, metal ions, nitrates and pesticides, as these are not removed in the earlier treatments. The phosphates are removed as calcium phosphates by adding calcium hydroxide at pH 10-11. At this pH, ammonium salts are also converted into ammonia. The effluent is chlorinated to remove pathogenic bacteria's and finally passed through activated charcoal to absorb gases.

Disposal of sludge:

Sludge formed by Different steps can be disposed by ,

(i) Dumping into low lying areas
(ii) Burning of sludge
(iii) Dumping into the sea
(iv) Using it as low grade fertilizers

Flow chart:

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Screening →Sedimentation → Coagulation → Activated sludge treatment or Trickling filter process → sterilization

Soil Pollution:

It may be defined as “the contamination of soil by human and natural activities which may cause harmful effects on living beings”.

Types:

1.Industrial wastes

Sources and effects:- pulp and paper mills, chemical industries, oil refineries , sugar factories etc., These pollutants affect and alter the chemical and biological properties of soil. As a result , hazardous chemicals can enter into human food chain from the soil, disturb the bio chemical process an d finally lead to serious effects.

2.Urban wastes

Sources and effects:- Plastcs, Glasses, metallic cans, fibers, papers , rubbers , street sweepings, and other discarded manufactured products. These are also dangerous.

3.Agricultural practices

Sources and effects:- Huge quantities of fertilizers, pesticides, herbicides , weedicides are added to increase the crop yield. Apart from these farm wastes, manure, slurry , are reported to cause soil pollution.

4.Radioactive pollutants

Sources and effects: These are resulting from explosions of nuclear dust and radio active wastes penetrate the soil and accumulate there by creating land pollution.

5.Biological agents.

Sources and effects: Soil gets large quantities of human, animal and birds excreta which constitute the major source of land pollution by biological agents.

Control measures of soil pollution

The pressure on intensification of farm activities increases for two reasons

1. population growth
2. Decrease of the available farm land due to urbanization

The soil pollution can be controlled by

1. forestry an d farm practices

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2. Proper dumping of unwanted materials
3. Production of natural fertilizers
4. Proper Hygienic condition
5. Public awareness
6. Recycling and Reuse of wastes
7. Ban on Toxic chemicals.
8. Effluents should be properly treated before discharging on the soil.
9. Solid waste should be properly collected and disposed off by appropriate method.
10. From the waste, recovery of useful products should be done.
11. Cattle dung should be used for methane generation.
12. Microbial degradation of biodegradable substance for reducing soil pollution.

Nuclear Hazards:

The radiation hazard in the environment comes from ultraviolet, visible, cosmic rays and micro wave radiation which produces genetic mutation in man.

Sources of Nuclear Hazards:

1. Natural Sources – which is in space which emit cosmic rays
2. Man made sources (Anthropogenic sources) These are nuclear power plants, X-rays , nuclear accidents, nuclear bombs, diagnostic kits etc

Effects of Nuclear Hazards:

1. Exposure of the brain and central nervous system to high doses of radiation causes delirium, convulsions and death within hours or days.
2. The use of eye is vulnerable to radiation. As its cell die, they become opaque forming cataracts that impair sight.
3. Acute radiation sickness is marked by vomiting , bleeding of gums and in severe cases mouth ulcers.
4. Nausea and vomiting often begin a few hours after the gastrointestinal tract is exposed . Infection of the intestinal wall can kill weeks afterwards.
5. Unborn children are vulnerable to brain damage or mental retardation, especially if irradiation occurs during formation of the central nervous system in early pregnancy.

Control measures:

1. Nuclear devices should never be exploded in air.
2. In nuclear reactors, closed cycle coolant system with gaseous coolant may be used to prevent extraneous activation products.
3. Containments may also be employed to decrease the radioactive emissions.
4. Extreme care should be exercis3ed in the disposal of industrial wastes contaminated with radio nuclides.

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5. Use of high chimneys and ventilations at the working place where radioactive contamination is high. It seems to be an effective way for dispersing pollutants.
6. Stoppage of leakage from the radioactive materials including the nuclear reactors, industries and laboratories.
7. The disposal of radioactive material must be safe and secure.
8. The protective garments must be worn by the workers who work in the nuclear plants.
9. The natural radiation must be at the permissible limits and they must not cross it.

SOLID WASTE MANAGEMENT

Each household generates garbage or waste day in and day out. Management of solid waste is very important in order to minimize the adverse effects of solid wastes.

Types of solid wastes:

1. **Urban wastes**
   Sources:
   A) Domestic wastes – Food waste, Cloth, Waste paper etc
   B) Commercial wastes – Packing material, cans, bottles, polythene etc.
   C) Construction Wastes – Wood, concrete debris etc.
   D) Bio medical wastes – Anatomical wastes , infectious wastes etc.,
2. **Industrial wastes**
   Sources:
   A) Nuclear power plants – generates radioactive wastes
   B) Thermal power plants – produces fly ash in large quantities
   C) Chemical industries- Produces large quantities of hazardous and toxic materials
3. **E-Wastes**
   Sources:
   A) Used computers, gadgets, electronic equipments and accessories.

Effects of solid waste:

- Physicochemical and chemical characteristics affecting productivity of soils.
- Toxic substance contaminates the ground water.
- Burning of materials produce dioxins, furans causes' cancer.

Steps involved in solid waste management:

Solid waste generation
↓
Collection of waste
↓
Transportation

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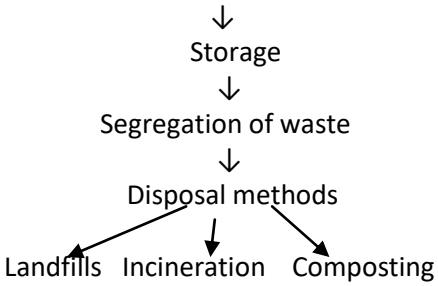

Methods of disposal of solid waste:

a. Landfill:

The bottom is covered with several layers of clay, plastic & sand –protects ground water contamination.

- Landfill is covered with clay, sand & gravel.
- Methane gas is collected and used to produce electricity.

b. Composting:

The biodegradable waste is allowed to decompose into oxygen rich medium and quality rich environment is formed which improves soil fertility rate.

c. Incineration: Burning of waste at high temp (700^{o}C -1000^{o}C) in combustion chamber and used to produce electricity and incinerate100-150tonnes per hour.

Landfill

Composting

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Incineration

TYPES INVOLVED SOLID WASTE MANAGEMENT:

1. **REDUCE, REUSE, And RECYCLE:**
   - A. Reduce the usage of raw materials:
     If usage is reduced, generation of waste also reduced.
   - B. Reuse of waste materials:
   - (i). Refillable containers can be reused
   - (ii). Discarded cycle tubes can be made into rubber rings.
   - C .Recycling of materials:
   - (i). Old Al cans **and** bottles are melted and recast into new cans and bottles**.**
   - (ii). Preparation of cellulose insulation from paper
   - (iii). Preparation fuel pellets from kitchen waste.

2, **Production of biogas and manure**

Role of an individual in prevention of pollution:

1. Plant more trees
2. Help more in pollution prevention than pollution control
3. Use water, energy and other resources efficiently
4. Purchase recyclable, recycled and environmentally safe products
5. reduce deforestation
6. Remove NO from motor vehicular exhaust
7. Use of eco friendly products.
8. Use stairs instead of elevators
9. Use public transportation walk or ride a bicycle
10. Plant trees around building
11. Avoid leaded petrol.
12. Avoid plastics.
13. Install waste saving equipments.
14. Recycle glass metal and paper.
15. Compost garden waste
16. Segregate waste and recycle
17. Buy locally made long losing material
18. Buy environmentally degradable products.

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19. Take some bag from home to market to purchase

DISASTER MANAGEMENT:

Hazard

It is a perceived natural event which threatens both life and property

Disaster

A disaster is the realization of this hazard

It is defined as the geological process and it is an event concentrated in time and space in which a society or subdivision of a society undergoes severe danger and causes loss of its members and physical property.

Types

1. Natural disasters – refers to those disasters that are generated by natural phenomena
2. Man made disasters – refers to the disasters resulting from man made hazards.

Flood:

Definition: Whenever the magnitude of water flow exceeds the carrying capacity of the channel within its bank, the excess of water over flows on the surroundings causes floods.

Types:

1. Slow kinds: Runoff from sustained rainfall ,snow melts exceeding the capacity of a river's channel.

2. Fast kinds: sudden release of water from dam, landslide, or glacier.

Effects:

1. Damage to building and property
2. Soil erosion is the major loss of agriculture
3. Any product submerged by flood water cannot be rescued
4. Water supplies – Contamination of water. Clean drinking water becomes scarce.
5. Diseases – Unhygienic conditions. Spread of water-borne diseases.
6. Crops and food supplies – Shortage of food crops can be caused due to loss of entire harvest.
7. Trees – Non-tolerant species can die from suffocation.
8. Transport - Transport links destroyed.

Methods of control:

Flood management:

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1. Diverting excess water through channel or canals like river, lake.
2. Advance meteorological information will prevent flood damage
3. River networking.
4. Optical and microwave data.
5. Flood warning given by central water commission.
6. Reduction of run off by increasing infiltration through appropriate forestation.

Cyclone:

Cyclone is meteorological phenomena intense depressions forming over the open oceans and moving towards the land

- Most large-scale cyclonic circulations are centered on areas of low atmospheric pressure.
- Cyclones are powerful destructive and active from days to weak and speed varies 180-500km/hr.
- A broad area of low pressure rotating "counter-clockwise" (cyclonically) is also a cyclone.

Occurrence:

- 1 .Tropical cyclone in the warm oceans are formed, because of heat and moisture.
- 2. Sea surface temperature must below 25^{O}c .
- 3. It moves like spinning top at the speed of 10-30km/hr.
- 4. Indian cyclone occurs during oct -dec or April – may.

Effects:

- Tropical cyclones are responsible for large amounts of damage to human life, crop, roads,

Transport, tanks wherever they strike.

- Slow down the developmental activities of the area.

Control measures:

- Planting more trees on coastal areas.
- Satellite images are used by meteorological departments for forecasting the weather conditions which reveal the strength and intensity of the storm.
- Radar system is used to detect cyclone

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LANDSLIDES:

The movement of earthy materials like coherent rock, mud, soil and debris from higher region to lower due to gravitational pull is called landslide

Causes:

1. Earthquake, shock, vibration
2. Deep water ground mining
3. Movement of heavy vehicles on the unstable sleepy region
4. Downhill movement of earth caused by rain.
5. Erosion in the hilly tract due to runoff water.
6. Underground caves, underground mining operation.

Effects:

1. Increase erosion of soil
2. Block the roads
3. Damage the houses, crop yield, life stock
4. Property damage,
5. Injury
6. Death
7. Adversely affect a variety of water supplies,
8. Affect fisheries, sewage disposal systems, forests, dams, and roadways.

Control measures:

1. Planting of deep rooted vegetation
2. Wind Breaks : Wind breaks and shelter belts or trees are established to reduce wind erosion and also for retaining soil moisture
3. Agro forestry: In this method crops are planted together in strips or alleys between trees and shrubs that can provide fruits and fuel wood. The trees and shrubs provide shade which reduce water loss by evaporation and preserve soil moisture.
4. Unloading the upper parts of the slope.
5. Concrete support.
6. Draining the surface and subsurface water from sloppy region.
7. Soil stabilization by using quick lime in weak areas.
8. Soil Conservation:
   Ways to reduce soil erosion:

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Terracing : Terracing reduces soil erosion on steep slopes by concerting the land into a series of broad, level terraces. This retains water for crops at each level and reduces soil erosion by water runoff.

Contour Farming: This method is adopted for gently sloped land. This involves planting crops in rows across the contour of gently sloped land.

9. Encouragement for construction of bridges water ways
10. Create national parks, sanctuaries biosphere.

Earthquake:

An earthquake is a sudden vibration caused on the earth's surface due to the sudden release of tremendous amount of energy stored in the rocks under the earth's crust.

Causes:

- Volcanic eruptions, rock falls, landslides, and explosions, hydrostatic pressure of manmade water bodies.
- Underground nuclear testing.
- Decrease underground water level.
- Disequilibrium in any part of the earth crust
- Its measures by Richter scale.

Less than 4 – insignificant, 4-4.9 – minor, 5-5.9- damaging, 6-6.9 – destructive,7-7.9 – major, more than 8 – severe damage.

Effects:

- Earthquakes produce deformation of ground space.
- This includes damage to buildings and in worst cases the loss of human life.
- The effect of earthquakes usually leads to the destruction of structures such as buildings, bridges, and dams.
- They can also trigger landslides.
- Tsunami

Earthquake management:

1. Constructing earthquake resistant building
2. Wooden houses are preferred
3. Seismic hazard map should give the information about the magnitude of intensity of anticipated earthquakes.

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4. To prevent an earthquake hazard the building should be properly designed.
5. Do not construct houses on high risk prone areas.
6. In case of an earthquake move out of the building and came in the open but not panic.
7. Do not use lifts in case of an earthquake.

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