

Environmental pollution

2.1 Introduction

2.2. Air pollution

- **Classification of air pollutants**
- **Causes of air pollution**
- **Consequence of air pollution**
- **Equipments used to control air pollution:**
- **Control measures of air pollution**

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MODULE –II

ENVIRONMENTAL POLLUTION

2.1 INTRODUCTION

Pollution is derived from Latin word ‘polluere’ which means ‘to contaminate’ any feature of environment. Pollution is the effect of undesirable changes in our surroundings that have harmful effects on plants, animals and human beings. Pollution has become a very common yet serious issue in today's world. It has been there for a long time even before human evolution such as volcanic eruption, wildfire which lead to various photochemical reactions in the atmosphere. ... And, one of the pollutants is human and human-created machines. The pollution is the process or act that human did during our daily lives which had pollute or contaminated the environment or a state of being polluted with harmful chemical substances that may cause health problems to human beings or even cause some deathly disease such as cancer which is the growth of abnormal cells in the human bodies.

The Unfavorable alternation of our surroundings is called pollution. It changes the quality of air, water, land which interfere with human being health & other life on the earth. Depends on the nature of pollutant, generated from various sources, pollution are in many kinds.

(Ex) pollutants from industry, thermal & nuclear power plants, domestic wastages, chemical fertilizers, insecticide.

Pollution may be local, regional, trans-boundary or global. The agent which causes pollution is called pollutant.

Pollutants

Biodegradable

1. Decompose naturally
 2. Fast process
- (Ex) Sewage, heat, noise

Non bio degradable

1. Do not decompose
(or) slowly decompose.
 2. Slow process.
 - 3, Very difficult to remove
- (Ex) DDT, aluminum cans
Mercury salts.

Types of pollution

1. Air pollution
2. H₂O pollution
3. Soil pollution
4. Marine pollution
5. Noise pollution
6. Thermal pollution
7. Nuclear hazards.

2.2 Air pollution

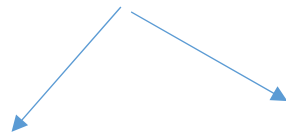
Air we breathe in use to be pure and fresh. But, due to increasing industrialization and concentration of poisonous gases in the environment the **air** is getting more and more toxic day by day. Also, these gases are the cause of many respiratory and other diseases.

The presence of one (or) more contaminants like dust, smoke, mist, odour in the atmosphere which are injurious to human being, plants and animals.

Composition of atmospheric air

- $N_2 \longrightarrow 78\%$
- $O_2 \longrightarrow 21\%$
- $Ar \longrightarrow <1\%$
- $CO_2 \longrightarrow 0.037\%$
- H_2O vapour \longrightarrow remaining
- $O_3, He, NH_3 \longrightarrow$ Trace amount.

Sources of air pollution



Natural sources

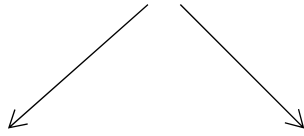
1. Volcanic eruptions,
2. Forest fire,
3. Biological decay,
4. Pollen grains,
5. Marsh gases
6. Radio active materials

Man-made activities

1. Thermal power plants
2. Vehicle emissions
3. Fossil fuel burning
4. Agricultural activities.

Classification of pollutants

Air pollutants



Primary air pollutant

1. Air pollutants are emitted

in harmful form.

(ex) Co, No, So₂

2. primary pollutants are known as

Indoor pollutants.

(ex) radon gas

Secondary air pollutant

1. Air pollutants reacted with

one (or) more other pollutant

to create a new pollutant.

(ex) O₃, H₂SO₄, aldehyde

2. Secondary pollutants are known as

Poisonous substances

Common air pollutants – causes – consequence

1. Carbon monoxide (co)

- Colour less, odourless gas
- It is poisonous gas to air-breathing animals.
- c. Emitted from incomplete combustion of fossil fuels and wood.
- Industries and cigarette smoking also produce CO

Effects:

- It affects the O₂ carrying capacity of blood. So the reduced amount of O₂ is supplied to brain, heart, tissues causes head ache & anemia.
- At high level, it causes Coma, brain cell damage and death.
- It increases the global temp.

2. Nitrogen – dioxide (NO₂)

- It is a reddish brown irritation gas-air pollutant.
- It is converted into nitric acid
- NO₂+ moisture → HNO₃
- Found in the emission of auto mobiles and industry.

Effect:

- Causes respiratory problems Asthma, Bronchitis.
- Acid deposition of HNO₃ can damage tree, soil, aquatic life in lakes, metal corrosion.

3. Chromium

- Solid toxic metal, emitted into the atmosphere as particulate matter.
- Produced from chromium manufacture, chromium plating ,paint, smelters.

Effect:

- Affects central nervous system, cancer, gastro intestinal ulcer.

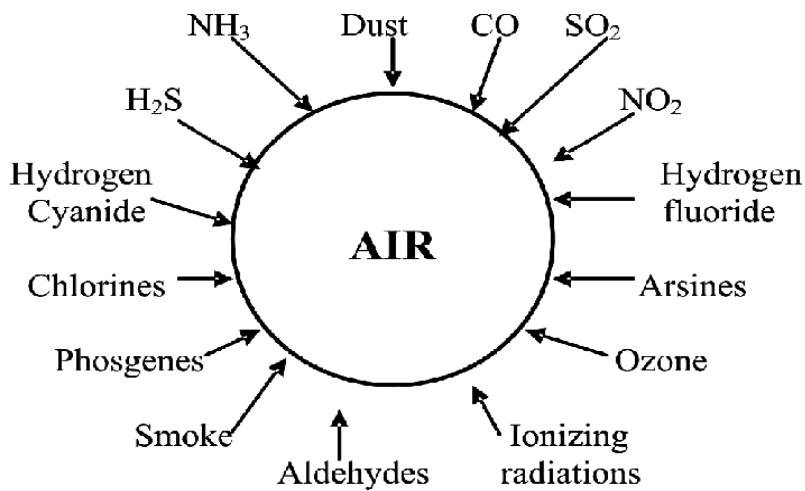
4. Ozone (O₃)

- O₃ is a gas composed of three oxygen atoms
- It is formed when oxides of nitrogen react with volatile organic compounds in the presence of sunlight.
- O₃ is good when it is present in the ozone umbrella above the earth. But bad when it is present at the ground level.

Effect:

- Chest pain, Coughing, Throat irritation, Asthma, damage vegetation & ecosystem, Reduced crop production, Climate changes.

Causes, consequence and control measures of Air pollution



Source: *Engineering Chemistry by Ravikrishnan*

Causes of air pollution

- Agriculture: Hydro Carbon released by plants, pollen grains, insecticide cause air pollution.
- Dust: Dust in the air is increased by dust storms, wind, volcanoes, automobiles.
- Industries: Combustion of fossil fuels like coal, petroleum in industries
- Auto mobiles: The combustion of petrol and diesel in auto mobiles releases harmful gases into the air. They also produce dust. Vehicles are the major source of air pollution in India.
- Ionizing radiations: Testing of atomic weapons, atomic explosions release Alpha, Beta, Gamma particles into the air.
- Freons: Use of freons, CFC in refrigerators, coolants, filling agents in aerosol packages cause pollution.
- Aerosol: Aerosols are small particles of solid (or) liquid substance in the air. They prevent the gaseous exchange in the air. They prevent the gaseous exchange between plants and atmosphere. It also change the climate.
- Chemical industries including pesticides, fertilizers, weedicides, fungicides.
- Cosmetics.
- Processing industries like cotton textiles, wheat flour mills, asbestos, Welding, stone crushing, gem grinding.

Consequence of air pollution

- Death: When air is polluted with poisonous gases, death comes as a result immediately.
- (Ex) Bhopal episode – due to the leakage of methyl isocyanate – toxic gas into the air kill the mass of 3000 human beings.
- Green house effect: Green house effect is the increased warming of the earth, caused by the rise in CO₂ Content of the air. Due to this effect, the polar ice caps are melted, as a result sea level rises. Coastal regions, and low lying areas all over the world will be go under H₂O.
- Global warming: The overheating of the earth by the increased amount of green house is called global warming.
- Crop losses: Heavy loss of the crop plants is caused by smog. It damage leafy vegetables, Cereals, textile crops, ornamental plants, fruits & forest trees.
- Vomiting: SO₂ Causes vomiting.
- Jaundice: Arsines induce RBC breakdown & jaundice.
- Oxygen Carrying Capacity: CO reduces O₂ carrying capacity of RBC by its permanent combination with heamoglobin.
- Caughing: Caughing is induced by phosgenes.
- Headache: It is induced by SO₂
- Cancer: It is caused by air pollutants like ash smoke, chromium, nickel.
- Cardiac diseases: Cadmium causes high blood pressure and heart disease.
- Pneumonia: Pneumonia is caused by breathing into much of manganese particles.
- Depletion of ozone layer: It is due to freons & CFC in Ac
- Acid rains: precipitation of oxides of sulphur and nitrogen with rain is termed as acid rain.
- Acid rain affects materials, organisms & aquatic eco system.

Equipments used to control air pollution:

- The emission of exhaust from automobiles can be reduced by devices such as “ positive crankcase ventilation valve and catalytic converter”.
- Electrostatic precipitators can reduce smoke and dust from industries.

- Gaseous pollutants rising from industries can be removed by 'differential solubility' of gases in H₂O
- A 'fine spray' of water in the device called 'scrubber' can separate many gases like NH₃, SO₂ from the emitted exhaust.
- Certain gases can be removed by filtration. (or) absorption through activated carbon.
- At the government level, pollution can be controlled by framing legislations.
- Euro II standard is introduced to reduce the pollutants in air.

Control of air pollution

- Use only unleaded petrol.
- Use petroleum products and other fuels that have low sulphur & ash content.
- Plant trees along busy streets because they remove particulates and carbon monoxide and absorb noise.
- Industries and waste disposal sites should be situated outside the city.
- Ensure that houses, schools, restaurants & places, where children play are not located on busy street.
- Use catalytic converters to help control the emissions of carbon monoxide & hydrocarbons.
- The emission rates should be restricted to permissible level by each & every industry.
- Continuous monitoring of the atmosphere for the pollutants should be carried out to know the emission levels.
- Incorporation of air pollution control equipments in the design of the plant layout must be made mandatory.

Module II

Environmental pollution

Disaster

2.12 Floods

2.13 Cyclones

2.14 Land slides

2.15 Earth quakes

2.16 Tsunami

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Disaster

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. Natural calamities, of different types and intensities affect nations all over the world. Because of the large geographical size of the country, India often faces natural calamities like floods, cyclones and drought occurring fairly frequently in different parts of the country. At times, the same area is subjected to floods and drought situation in successive seasons or years. While not all natural calamities can be predicted and prevented, a state of preparedness and ability to respond quickly to a natural calamity can considerably mitigate loss of life and property and human suffering, and restore normalcy at the earliest. It is, therefore, of paramount importance that a plan of action for dealing with contingencies that arise in the wake of natural calamities is formulated and periodically updated.

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.

2.13 Floods

Flood is a term used to denote an enormous amount of water. When there is an outflow of water in a place, it is said to be flooded. The situation caused when the water becomes uncontrollable is said to be flooded. The flood may take different forms such as in the form of heavy rainfall when there is a breaking of the dam. Furthermore, the melting of snow also leads to flooding. Floods lead to an overfull and huge spread of water but are not considered safe for the purpose of drinking. Thus floods bring with them a number of diseases such as typhoid, cholera and many others. Here, we shall discuss the various causes of floods. Whenever the magnitude of water flow exceeds the carrying capacity of the channel within its banks the excess of water overflows on the surroundings causes floods.

Causes of floods

1. Heavy rain, rainfall during cyclone causes floods
2. sudden snow melt also raises the quantity of water in streams and causes flood
3. sudden and excess release of impounded water behind dams
4. clearing of forests for agriculture has also increased severity of floods.

Flood management

1. Encroachment of flood ways should be banned
2. Building walls prevent spilling out the flood water over flood plains
3. Diverting excess water through channels or canals to areas like lake, rivers etc., where water is not sufficient,
4. Optical and microwave data from IRS is also used for flood management
5. Flood forecasts and flood warning are also given by the central water commission

2.14

Cyclones

Cyclones are rapid inward air circulation around a low-pressure area. The air circulates in an anticlockwise direction in the Northern hemisphere and clockwise in the Southern hemisphere. Cyclones are usually accompanied by violent storms and bad weather. The word Cyclone is derived from the Greek word Cyclos meaning the coils of a snake. It was coined by Henry Peddington because the tropical storms in the Bay of Bengal and the Arabian Sea appear like coiled serpents of the sea. It is a meteorological process, intense depressions forming over the open oceans and moving towards the land.

Effect:

1. The damage depends on the intensity of cyclone the damage to human life, crops, roads, transport, could be heavy
2. Cyclone occurrence slow down the developmental activities of the area

Cyclone management:

1. Satellite images are used by meteorological departments for forecasting the weather conditions which reveal the strength and intensity of the storm.
2. Radar system is used to detect the cyclone and is being used for cyclone warning

Case studies

Cyclone in Orissa – 1999

2.15 Land slides:

A **landslide** is the mass movement of rock, soil, and debris down a slope due to gravity. It occurs when the driving force is greater than the resisting force. It is a natural process that occurs in steep slopes. The movement may range from very slow to rapid. It can affect areas both near and far from the source. The movement of earthy materials like coherent rock, mud, soil and debris from higher to lower region to gravitational pull is called landslides.

Causes:

1. Movement of heavy vehicles on the unstable sloping regions create landslides
2. Earthquake, shocks, vibrations and cyclone create landslide

2.16 Earth quakes

An earthquake is a sudden movement of the Earth, caused by the abrupt release of strain that has accumulated over a long time. For hundreds of millions of years, the forces of plate tectonics have shaped the Earth as the huge plates that form the Earth's surface slowly move over, under, and past each other. An earthquake is a sudden vibration caused on earth surface with the sudden release of tremendous energy stored in rocks under the earth's crust.

Causes:

1. Disequilibrium in any part of the earth crust

2. Underground Nuclear testing
3. Decrease of underground water level.

Effect:

Damage the settlements and transport systems

Collapses houses and their structures

Deformation of ground surface

Tsunami

Earthquake management:

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

2.17 Tsunami

A tsunami is a large wave that is generated in a water body when the seafloor is deformed by seismic activity. This activity displaces the overlying water in the ocean.

Causes of tsunami

1. Seismic activities like earthquakes, landslides, volcanic eruptions, explosions, can generate tsunami.
2. Deformation of the sea floor due to the movement of plates.

Concept of Tsunami

A tsunami is not a single wave but a series of waves like the ordinary waves which we see on a sea.

Effects on Tsunami

1. Tsunami attacks mostly the coastlines, causing devastating property, damage and loss of life

2. Tsunami can kill lot of human beings, livestock's, etc
3. Tsunami may also spread lot of water borne diseases.

Tsunami Management

Earthquakes under the water are monitored by sensors on the floor of the sea.

The sensors send the information of floating buoys on the surface, whenever they detect any changes in pressure of the sea

The information is then relayed to satellites, which passes it on to the earth stations.

Finally the country make the people alert through the media to take all necessary precautions.

Case studies:

Tsunami in India

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MODULE –II

Environmental pollution

2.7 Marine pollution

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MODULE –II

Environmental pollution

2.7 Marine pollution

Marine pollution is defined as the discharge of waste substances into the sea resulting in harm to living resources, hazards to human health, hindrance to fishery and impairment of quality for use of sea-water. Marine pollution is associated with the changes in physical, chemical and biological conditions of the sea water. The undesirable change occurring in the sea is called marine pollution.” The main reason for marine pollution is an aquatic pollution.

Causes of marine pollution

1. Industries pass the effluents into the sea through pipes.
2. Municipal wastes and garbage are dumped into the sea.
3. The fishing boats and ships discard old & useless fishing nets into the sea.
4. The passengers of ship and the fish farmers throw the plastics into the sea.
5. The fertilizers and pesticides applied on the agricultural fields are washed into the sea by the surface run off.
6. Oil spilling, due to leaks in the oil tanker, ships cause oil pollution.
7. Oil leak, from oil rig, oil refineries, pipelines.
8. Loading and unloading of oil in ships cause oil pollution.
9. Accident of cargo ship carrying toxic substances such as oil, gas, pesticides, fertilizers, industrial wastes, causes marine pollution.
10. Off shore oil exploration and oil extraction cause pollution.
11. Gulfwar created much marine pollution. About 750 oil wells in Kuwait were set on fire

Consequence of marine pollution

1. Oil pollution cause damage to marine fauna & flora including algae, fish, birds, invertebrates.

About 50,000 to 2,50,000 birds are killed every year by oil.

2. Oil spilling in sea water reduces the body temperature in bird.

3. Oil film are reduce the rate of oxygen uptake by water .

4. The continuous oil films reduce photo synthesis process and formation of oxygen.

5. The thin film of oil on the surface of H₂O is called oil slick. The Oil slick damages the mangrove plants.

6. In certain countries drinking water is obtained from sea water by desalination. The desalinated drinking water is contaminated with oil.

7. Coral reefs, the gardens of the sea are damaged by oil slick.

8. Sea birds, sea cows, aquatic mammals are affected by oil pollution.

Control of marine pollution

1. The industries must contain sewage treatment plant before discharging effluents into the sea.

2 Coastal wastes should be periodically analyzed for detecting pollution levels.

3. Soil erosion in the coastal land should be arrested by suitable control techniques.

4. Re creational beaches should be maintained to meet hygienic and aesthetic standard.

5. The urban growth near the coasts should be regulated.

6. Sewage materials can be removed by screening, sedimentation & decomposition process.

7. Volatile part of oil can be removed by evaporation. About 50% of the oil is removed by this process.

8. Oil spill is removed by emulsification process. It is done by applying chemical dispersants on the oil.

9. The oil deposited on the rocks and harbor walls can be cleaned with high pressure.
10. A bacterium “*pseudomonas putida* “ is prepared by genetic engineering to eat away the oil slick.
11. People should be educated about marine ecosystem and the benefits offered by them.
12. Local communities must be involved in protecting & managing their coastal resources.

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- **Sounds and their decibel scale**
- **Causes of noise pollution**
- **Consequence of noise pollution**
- **Control measure of noise pollution**

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MODULE –II

ENVIRONMENTAL POLLUTION

2.8 Noise pollution

Sound is mechanical energy from a vibrating source. Unpleasant and unwanted sound is called noise. Sound can propagate through air, liquid or solid. Sound is pressure perturbation in the medium through which it travels. Sound pressure creates alternate compression and rarefaction. Sound pressure does not produce linear impact on human. A logarithmic scale has been devised.

Noise is measure in terms of SPL which is a log ratio of sound P to a std. P. It has a dimensionless unit decibel (dB). Sound can affect ears either by loudness or by pitch (frequency). The CPCB has recommended the permissible noise levels for various places.

Noise pollution is generally defined as regular exposure to elevated sound levels that may lead to adverse effects in humans or other living organisms. According to the World Health Organization, sound levels less than 70 dB are not damaging to living organisms. If you work for 8 hours daily in close proximity to a busy road or highway, you are very likely exposed to traffic noise pollution around 85dB. Noise pollution, unwanted or excessive sound that can have deleterious effects on human health, wildlife, and environmental quality. Noise pollution is commonly generated inside many industrial facilities and some other workplaces, but it also comes from highway, railway, and airplane traffic and from outdoor construction activities.

Noise pollution is defined as, the unwanted, unpleasant (or) disagreeable sound that causes discomfort for all living beings.

Sounds and their decibel scale

- Rocket engine – 180 dB
- Jet plane take off – 150 dB
- Threshold of pain – 140 dB
- Recorded music (max) – 130 dB
- Construction works, news paper press – 100 dB
- Motor cycle – 90 dB

- Ordinary conversation – 70/80 dB
- Air conditioning unit/ Light traffic – 60 dB
- Normal living room – 50 dB
- Library or soft whisper – 30 dB
- Threshold of hearing – 0 dB

Causes of noise pollution

1. Heavy noise is produced by industries.(Ex) steel industry, rice mill, saw mill etc.
2. In industries noise is produced by,
 - i. Construction
 - ii. Product fabrication
 - iii. Product assembly
 - iv. Power generation
 - v. Processing activities
3. The transport noise mainly comes from road traffic rail traffic & air crafts
4. Train produces more noise than road traffic.
5. Maximum noise is produced by jet air craft (100db)
6. Badly managed roads produce more noise.
7. Domestic noise is produced from human dwelling places. (Ex) loud speakers, playing of children, church bells, temple bells, grinders etc.

Consequence of noise pollution

1. Noise reduces the power of hearing.
2. It gives pain to the ear.
3. It interferes with communication system.
4. It causes stress.
5. Noise increases the secretion of adrenaline hormone into blood stream which is responsible for blood pressure.

6. It increases the rate of heart beats, & blood pressure
7. It causes head ache, constriction of blood vessels, dilation of pupil of the eye.
8. It causes deafness, emotional upsets.
9. Noise causes physical (or) mental fatigue and lack of concentration.
10. Ultrasonic sound can affect the digestive, respiration cardio vascular systems and semicircular canals of the internal ear.

Control measure of noise pollution

1. Legislation should be framed
2. The sources that generate unwanted sound should be reduced.
3. Noisy auto mobiles should be condemned (punished)
4. Auto mobiles wheels should be oiled properly
5. Industrialists must take up necessary steps to control noise.
6. Lubricate the machines properly
7. Noise producing machines should be placed in closed room
8. Loud speakers should be set at low sound.
9. Trees absorb noise and this reduce the noise pollution so, thick vegetation must be growth around industries, cities and on the sides of roads.
10. Residential houses should be constructed for away from industries, factories & airports.

MODULE –II

Environmental pollution

2.11 Pollution case studies

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MODULE –II

ENVIRONMENTAL POLLUTION

2.10 Pollution case studies

Air pollution: Bhopal gas tragedy

The careless siting of industries and relatively poor regulatory controls leads to ill health in the surroundings. The Bhopal gas tragedy on December 2nd 1984, where Union Carbide's Plant leaked 43 tons of Methyl Isocyanate and other substances, used in the manufacture of pesticides is one of the worst industrial accidents in the recent past. Of the 5,20,000 people who were exposed to the gas - 8,000 died during the first week and another 8,000 later. The impact of the survivors is visible even today.

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Fig 2.10.1 Bhopal gas tragedy plant

Source: Environmental science & Engineering by Gilbert.M

CHERNOBYL REACTOR INCIDENT

On April 25, 1986, Russian engineers and scientists begin preliminary tests on Chernobyl power plant's 4th reactor. In order to control the experiment, the automatic control system was shut down. After some work, stability was reached at very low power outputs. Unfortunately, manual control of the water pressure wasn't maintained. The reactor began to create excess heat. Without the automatic control, the control rods couldn't be reinserted in time; a deadly chain reaction had begun. Within a matter of 3-4 seconds, the reactor went from 5% output to 100 times its normal level.

The water in the reactor flash-boiled, creating an explosion that leveled thousands of tons of concrete and steel, including the housing for the reactor. The steam carried almost 70% of the nuclear material out of the reactor into the surrounding environment. Several thousand volunteers died on the scene, and it is estimated that 7,000 to 10,000 volunteers died in total, considering short and long-term effects. Thousands of miles from the scene, the birth defect rate became double the world average.



Fig 2.10.2 Chernobyl reactor

Source: Environmental science & Engineering by Gilbert.M

It is also estimated that 150,000 were put at risk for thyroid cancer, and over 800,000 children were put at risk of contracting leukemia. 2 million acres of land (1/5 of

the usable farmland in the Ukraine) was, and still is, completely unusable. It remains difficult to determine the scope of the disaster; radiation resulting from the event was detected all over the globe. It is estimated that it may cost up to \$400 billion and will take up to 200 years to correct the damage done to the area, and to compensate those affected by the meltdown.

WATER POLLUTION

ARSENIC POLLUTION IN GROUND WATER

An example of groundwater pollution caused by excessive extraction is that fluoride contamination. It has spread across 19 states and across a variety of ecological regions ranging from the Thar desert, the Gangetic plains and the Deccan plateau. Source: When the bedrock weathers the fluoride leaches into water and the soil. surfaced during the last three decades - extraction of groundwater which has resulted in the tapping of aquifers with high fluoride concentrations was noticed during 1970s and the 1980s when there was massive state investment in rural water development for irrigation as well as for drinking. Encouraged by state subsidies on diesel and electricity, people invested in diesel and submersible pumps in a bid to extract groundwater through borewells. This policy aggravated the fluoride problem. Effects: combines with the bones as it has an affinity for calcium phosphate in the bones. Excess intake of fluoride can lead to dental fluorosis, skeletal fluorosis or non-skeletal fluorosis. Correction: - Defluoridation plants and household water treatment kits are stop-gap solutions. (Ref: Sushmitha Baskar & R.Baskar)

MARINE POLLUTION IN TAMIL NADU: OCEANS NOT SPARED

Industrial pollution has threatened the natural habitats of pearls in the pearl banks of Tuticorin coast in the Gulf of Mannar. It has affected fish and other organisms as far as 30 kms south of Tuticorin due to effluents released from chemical industries. Tannery

wastes have caused the pollution of coastal waters from Chennai to Vedaranyam. The effect of diversity of phytoplankton ecology of mangrove estuaries of Tuticorin is greatly affected by industrial effluents. The Chennai coastal waters showed high levels of pesticides like DDT, lindane, endosulphan and heptachlor. The bioaccumulation of these pesticides in marine organisms could pose major health hazards.

SOIL POLLUTION : COCA COLA SOFT DRINK BOTTLING UNIT

The Coca cola bottling unit at Palakad district at Kerala, discharged large amount of sludges. These sludges are used as fertilizer by the near by farmers.

But, analysis of sludge showed that it contains, toxic metals like cadmium & lead. Analysis indicate that, the level of these toxic element would pollute the land, local water supply and the food chain.

MARINE POLLUTION (GULF WAR)

Gulf war took place in Kuwait from Jan 16- Feb 26, 1991 between Iraq & USA.

During the war, American fighters dropped nearly a lakh of bombs, and forced the Iraq army to withdraw from Kuwait. During the retreat of Iraq, they have set fire nearly 700 oil wells of Kuwait.

Most of the oil wells are on shore of the sea, oil from oil well spills out into the sea. The floating oil over sea H₂O covered nearly, 80 km long 25 km wide area.

The burning of oil wells continued nearly for 10-months. Burning of oil wells released large amount of pollutants like CO₂ & SO₂ into the atmosphere.

Effects

- (1) Nearly one million birds have been killed due to oil slick.
- (2) It change the desalination plant as in effective.

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2.9 NUCLEAR HAZARDS (RADIO ACTIVE POLLUTION)

- **Causes of nuclear Hazards**
- **Consequence of nuclear hazards**
- **Control measures of radio active pollution**

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MODULE –II

ENVIRONMENTAL POLLUTION

2.9 Nuclear Hazards (Radio active pollution)

The visions a nuclear disaster can bring are horrific to say the least. In the past, they have been known to cause catastrophic destruction and loss of life. Unfortunately, these are just the immediate results. Those people who do survive may deal with chronic illness, physical, mental, and emotional disfunction, and an increased incidence of disease manifestations such as cancer.

By definition, radiation is a form of energy. It comes from man-made sources such as X-ray machines, from the sun and outer space, and from some radioactive materials such as uranium in soil. Small quantities of radioactive materials occur naturally in the air we breathe, the water we drink, the food we eat, and in our own bodies. Radiation that goes inside our bodies causes what we refer to as internal exposure. The exposure that is referred to as external comes from sources outside the body, such as radiation from sunlight and man-made and naturally occurring radioactive materials. Eighty percent of typical human exposure comes from natural sources and the remaining 20% comes from artificial radiation sources, primarily medical X-rays.

These adverse health effects can range from mild effects, such as skin reddening, to serious effects such as cancer and death, depending on the amount of radiation absorbed by the body, the type of radiation, the route of exposure, and the length of time a person is exposed. Exposure to very large doses of radiation may cause death within a few days or months. Exposure to lower doses of radiation may lead to an increased risk of developing cancer or other adverse health effects.

The following is a list of major nuclear disasters of the world.

- Fukushima, Japan - 2011
- Chernobyl, Russia - 1986

- Three Mile Island, US - 1979

Radioactive materials are composed of atoms that are unstable. An unstable atom gives off its excess energy until it becomes stable. The energy emitted is radiation.

- The process by which an atom changes from an unstable state to a more stable state by emitting radiation is called radioactive decay or radioactivity.
- Radioactive materials are dangerous because of the harmful effect of certain types of radiation on the cells of the body. The longer a person is exposed to radiation, the greater the risk.
- People receive some radiation exposure each day from the sun, radioactive elements in the soil and rocks, household appliances like television sets and microwave ovens, and medical and dental X-rays.
- Radiation cannot be detected by sight, smell, or any other sense.

Causes of nuclear Hazards

1. Nuclear Hazards are takes place by two sources.

- Natural sources
- Man-made sources.

2. Natural sources

- The very important natural source is space, which emit cosmic rays.
- soil, rocks, air, water, food, radio active radon-222 also contain one (or) more radio active substances.

3. Man made sources

Man made sources are nuclear power plants. X-rays, nuclear accident, nuclear bombs, diagnostic kits, etc., where radio active substances are used.

Consequence of nuclear hazards

- Radiation cause gene mutation. It leads to genetical defects in future generation.
- Internal bleeding and blood vessel damage may show up as red spots on the skin.
- It causes birth of dead babies, defects in new born babies ,destruction of cities, animal& plants, loss of hair, anemia, reduction in fertility.
- It causes carcinoma (cancer), Leukemia (Blood cancer), Thyroid cancer, Bone cancer, mental retardation.
- It inhibit the mitosis (cell division) process.
- Pine tree forests are destroyed by gamma radiations of cobalt (or) cesium.
- Population & ecosystem are destroyed.
- It inhibit the enzyme secretion.
- Continuous exposure of a person with radiation may lead to cummulative radiation damage and death.

Control measures of radio active pollution

- Atomic bomb explosion must be stopped.
- Radio active wastes must be stored in under ground tanks where they gradually decay in a harmless manner.
- The workers should wear radiation indicators to know the total amount of radiation to which they have been exposed.
- Reactors must be insulated in broad concrete walls to prevent the penetration of radiations.
- Use of glass spectacles will protect the eyes from UV light because UVL Cannot penetrate into the glass.
- production of isotopes should be minimized.
- Nuclear medicines & radiation therapy should be applied when absolutely necessary with minimum doses.
- Use of high chimneys & ventilation at the working place where radio active contamination is high. It is a effective way for dispersing radio-pollutants.

- Out of the ionizing radiation types (Alpha particles, Beta particles, Gamma rays and X-rays) Alpha particles can be stopped by a sheet of paper and cannot penetrate the human skin. Beta particles can be stopped by clothing or a thin sheet of aluminium. Whereas the Gamma rays and X-rays can be stopped only by thick concrete or lead walls.

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MODULE –II

Environmental pollution

2.4 Soil pollution

- Causes of soil pollution
- Consequences of soil pollution
- Control of soil pollution

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2.4 Soil pollution

Soil is the thin layer of organic and inorganic material that covers the Earth's rocky surface. The organic portion, which is derived from the decayed remains of plants and animals, is concentrated in the dark uppermost "topsoil." The inorganic portion, which is made up of rock fragments, is formed over thousands of years by physical and chemical weathering of bedrock.

Soil contaminants are spilled onto the surface through many different activities. Most of these are the result of accidents involving the vehicles that are transporting waste material from the site at which it originated to the site at which it is to be disposed. Others involve accidents involving vehicles (automobiles, trucks and airplanes) not transporting wastes, but carrying materials, including fuel, that, when spilled, contaminate the soil.

Soil pollutants:

1. Plastic,
2. Rubber
3. Leather
4. Cloth
5. Broken glasses
6. Radio active elements
7. Dead animals
8. Pesticides, Herbicides, etc.

Causes of soil pollution

- **Industrial wastes:** Disposal of industrial wastes is the major problem for soil pollution. Industries like pulp & paper mills, chemical industries, sugar factories, fertilizer, coal & mineral mining industries disposed their wastes into land.
- **Urban wastes:** Urban wastes consist of both commercial & domestic wastes. It is a dried sludge of sewage. Sewage contains glasses, metallic cans, fibers, fuel residue and other discarded products. These waste products are not easily decomposed.
- **Agricultural practices:** Modern agricultural methods pollute the soil to a large extent. Based on agro-technology a large quantity of fertilizers, pesticides, herbicides, weedicides are added to increase crop yield. These inorganic chemicals pollute the soil.

- Radio active pollutants: Radio active pollutants are coming from nuclear dust explosion, nuclear testing labs & industries. These pollutants penetrate into the soil and accumulate there by creating land pollution.
- Biological agents: Soil gets large quantities of human, animal & birds excreta which is the major source of land pollution by biological agents.
- Municipal sewage, waste water and wrong method of agricultural practices also induce the heavy soil pollution.

Consequences of soil pollution

- Bad smell: The waste from hotels, houses, dead animals, garbage , floating materials release unbearable bad smell.
- Dirty surroundings: The dumping of wastes on the streets and road sides spoils the aesthetics of the site.
- Insecticides: It induce gene mutation in human being
- Cancer: Chromium & DDT cause cancer in human tissues
- Sex hormones: DDT in the soil affects sex hormones in mammals & birds
- Decline of reproduction: Due to the accumulation of DDT in soil reduces the reproduction capacity of the mammals & birds.
- Bio magnification: Increasing accumulation of pesticides in higher organisms is called bio magnification.
- Desertification
- Decrease in the extent of agricultural land
- Top soil erosion
- Excess use of irrigation leads to waterlogging and soil salinisation.
- Fertilizer run off leads to the eutrophication of waterways.

Control of soil pollution

- Cleaning up of polluted soil

- Planting trees as a part of afforestation/ shelter belts/wind breakers
- Reduction, Recuse, Re-cycle principles helps to control and prevent the soil pollution.
- Soil erosion: Soil erosion is controlled by planting more trees, strip cropping, contour cultivation, constructing diversion channels.
- Proper dumping of unwanted materials:
- Kitchen wastes are dumped into municipal waste container kept on the sides of streets.
- Solid wastes of kitchen, municipality, hospital, broiler, houses, agriculture are treated by the following methods .
 - Land fill- Burying under ground
 - Comporting - making manure
 - Incineration - Burning
- Pesticides are used in the limited amount.
- Biological pesticides& fertilizers are used instead of chemical fertilizers.
- Appropriate water management practices in agriculture
- Land sliding & water logging is prevented.
- Sewage water must be treated by primary,secondary and tertiary treatment steps.
- People should be trained regarding the sanitary habits.
- Proper soil conservation measures to minimize the loss of top soil
- Government should ban some important toxic chemical like DDT, BHC which cause the soil pollution. INM, IPM, using bio pesticides and integrated environment friendly agriculture to reduce pesticides or fertilizers

Environmental pollution

2.6 Thermal pollution

- **Causes of thermal pollution**
- **Consequence of thermal pollution**
- **Control of thermal pollution.**

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MODULE –II

ENVIRONMENTAL POLLUTION

2.6 Thermal pollution

Thermal pollution is the degradation of water quality by any process that increases the ambient water temperature. Thermal pollution refers to the release of warm H₂O into the water body. It is the undesirable change in the temperature of the water body. Thermal pollution increases water temperature, causing a change (lowering) of dissolved oxygen levels. This disrupts the body of water's ecological balance, resulting in the suffocation of some plant and animal species while encouraging the overgrowth of others.

Causes of Thermal pollution

1. Nuclear power plants Industries, nuclear & thermal power plants use water to cool machinery and then discharge the warmed into a stream.
2. Research institutes, nuclear experiments and explosions discharged a lot of unutilized heat into nearby H₂O stream
3. Emissions from nuclear reactor & processing installation are also responsible for increasing the temp of water bodies.
4. Coal-fired power plants: Coal – fired power plants are the major source of thermal Pollutants
5. The heated effluents decrease the dissolved oxygen content of water.
6. It results into killing of fish and other aquatic flora & fauna.
7. Industrial effluents: Due to disposal of heat water into the sea, it increases the Steam temp to a level, at which natural dissipation of heat will be in efficient.
8. Domestic Sewage: Discharge of domestic sewage into the water body decreases the dissolved oxygen content.
9. Water temperature rises when trees and tall vegetation providing shades are cut down.

10. Soil erosion caused by construction, removal of stream side vegetation, poor farming practices, overgrazing and recreation increases the amount of suspended solids in the water.
11. Thermal pollution can also occur through earthquakes.

Consequence of thermal pollution

1. Dissolved oxygen content decreases in warm water.
2. Warm water prevents the penetration of oxygen into deep cold waters.
3. The toxicity of pesticides and detergents increases with increase in temp.
4. Metabolic activities of organisms increase in warm H₂O but warm water contain less oxygen. Hence organisms are affected.
5. Warm H₂O disturbs spawning of animals.
6. Fish migration is affected by warm H₂O.
7. Blue green algae dominate in H₂O bodies due to thermal pollution.
8. Sponges, molluscs & crustaceans are eliminated at temp above 37⁰ c. This results in a change in the biodiversity.
9. Thermal pollution interfere with biological activities & reproduction system.
10. Change in temp change the seasonal variation.

Control of thermal pollution.

Thermal pollution is controlled by three methods.

- Cooling ponds
- Cooling towers
- Spray pond

1. Cooling pond:

The hot water obtained from industries is stored in ponds. Here natural evaporation cools the water. After cooling, the water is drained into natural water bodies.

2, Cooling towers

The hot water is passed through a system of coiled pipes kept in a tower. The hot water is allowed to flow down under from the top of the tower. Cool air is allowed to flow over the pipes upward from the bottom of the tower.

3, Spray ponds

The hot water from the industries are sprays through nozzles (sprayers) into fine water droplets. Heat is dissipated from these droplets and the water is collected in spray ponds.

4. Artificial lakes

Artificial lakes are man made bodies of water which offer possible alternative to once through cooling. The heated effluents can be discharged into the lake at one end and the water for cooling purposes may be withdrawn from the other end. The heat is eventually dissipated through evaporation.

MODULE –II

ENVIRONMENTAL POLLUTION

2.5 SOLID WASTE MANAGEMENT OF URBAN & INDUSTRIAL WASTE

Sources

- Land fill
- Incineration
- Composting

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MODULE –II

Environmental pollution

2.5 Solid waste management of urban & industrial waste

Solid waste management is a term that is used to refer to the process of collecting and treating solid wastes. It also offers solutions for recycling items that do not belong to garbage or trash. As long as people have been living in settlements and residential areas, garbage or solid waste has been an issue.

Depends upon the nature, solid wastes are classified into 3 types.

1. Urban (or) Municipal waste
2. Industrial waste
3. Hazardous waste

Sources of urban waste:

Urban waste (or) municipal waste include the following wastes.

1) Domestic wastes: The wastages coming out from the houses.

Ex. Food waste, cloth, paper, polythene bags, glass bottles.

2) Commercial wastes: Wastes coming out from the shops, markets, hotels, office, industrials etc.

Ex. Packing materials, cans, bottles, polythene bags etc.

3) Construction wastes: Wastages of constructing materials.

Ex. Wood, concrete, debris.

4) Biomedical wastes: Wastages of organic materials.

Ex. Anatomical wastes, infection wastes.

Sources of industrial waste:

Industrial waste include the following wastes.

- Nuclear power plants: It generates radio active wastes.
- Thermal power plants: Produces fly ash
- Chemical industries: Produces hazardous and toxic materials.
- Other industries: Produce, packing materials, rubbish, Organic wastes, acids, alkalis, plastic, paper, wood,oil,paints,dyes etc.

Sources of Hazardous waste:

Chemical manufacturing company, petroleum refineries, paper mills, smelters, radio active substances, biological wastes and other industries.

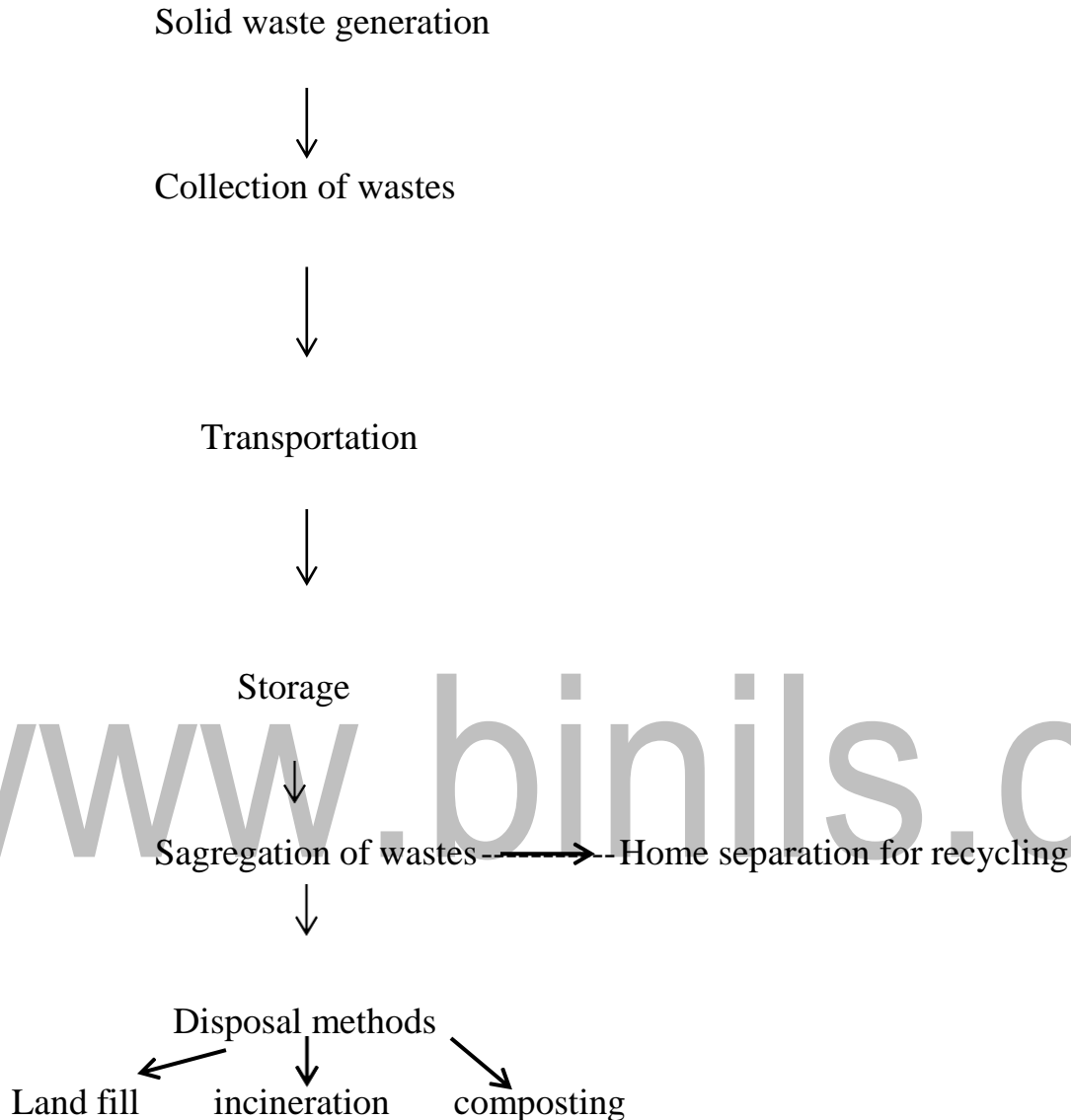
Conscience of solid waste of urban & industries:

- Due to improper disposal of municipal solid wastes on the road side, it produces fuel smell
- Breeding of vector insects.
- Breeding of disease producing germs.
- Degradation of soil.
- Contamination of ground water.
- Burning releases smoke which cause cancer.
- Burning releases furans, dioxins and poly chlorinated biphenyis Which are harmful to human beings.

Control measurement (or) process of solid waste management:

Sollid waste management includes the waste generation, mode of collection, transportation, segregation of wastes and disposal techniques.

Flow chart:



1) Land fill

- Land fill is a solid waste management disposal site where solid wastes are allowed to decompose in a safe way.
- Municipal solid wastes, hospital, animal, plant wastes sludge, soil, powders, dusts are deposited and covered & disposal off in land fills.
- The land fill may be made above ground (or) below ground (or) above- below ground.
- Before filling, the site is lined with liners to prevent see page and contamination of ground water.

- When the filling reaches a thickness of 1.5m, it is covered with earth of 6 inches.
- The wastes are decomposed by bacteria in 2-4 months.
- Bio gas produced during decomposition, it can be used for the generation of electricity.

Advantages

- a. Simple & economical method
- b. Segregation is not required
- c. Land fill areas are used for other purpose
- d. Waste is returned to the soil as manure.

Dis advantage

- a. Bad odour
- b. Mosquitoes& flies breed
- c. Large area is required
- d. Chances for fire.

2. Incineration

- Incineration is the burning (or) combustion of wastes. The plant used for incineration is called incinerator.
- Enormous amount of heat is produced and the heat is used to produce steam from H₂O, steam generates electricity.
- The temp normally maintained in a combustion chamber is about 700⁰c-1000⁰.
- The combustable substance like rubbish, garbage, dead organisms are disposed by this method.

Advantage

- a. It is a safe method from by hygienic point of view.
- b. Requires little space .
- c. It produces 3 MW of electricity per day by incinerating wastage 300 tonnes.

Dis advantage

- a. Operating cost is high
- b. Needs – skilled person
- c. Formation of smoke , dust, ash need further disposal method due to which air
 - i. pollution may be caused.

3. Composting

- Composting is an aerobic microbial process which degrades organic matter into manure called composte.
- Bulk organic waste is converted into a manure by biological action.
- The combustable wastage are dumped in ground earthen trenches in layers of 1.5m and it is covered.
- Actinomycetesmicro organisms are introduced for active decomposition.
- Finally the decomposed products converted into powdery brown colouredodourless mass known as humus (or) manure.
- It is used in the agricultural field.

Advantages

- a. It increases the water retention, & ion-exchange capacity of soil.
- b. Low cost.

Disadvantage

- a. Non combustable substances are disposed separately
- b. Use of compost has not yet caught up with farmers & hence no assured in market.

Vermicomposting

Although not significant in terms of waste diversion, vermicomposting is being used insome places. This method of composting uses a container of food scraps and a special kindof earthworm. Over time, the food is replaced with worm droppings, a rich brown matter that serves as an excellent natural plant food.

4. The Solid waste management stresses three R's type

They are

- Reduction in use
- Reuse
- Re cycling

This will reduce pollution.

SIGNIFICANCE OF SOLID WASTE MANAGEMENT

In communities where appropriate sites are available, sanitary landfills usually provide the most economical option for disposal of non recyclable refuse. However, it is becoming increasingly difficult to find sites that offer adequate capacity, accessibility, and environmental conditions.

Landfills will always play a key role in solid-waste management. It is not possible to recycle all components of solid waste, and there will always be residues from incineration and other treatment processes that will eventually require disposal underground.

Landfills can actually improve poor-quality land. In some communities properly completed landfills are converted into recreational parks, playgrounds, or golf courses.

MODULE –II

ENVIRONMENTAL POLLUTION

2.3 WATER POLLUTION

- Types of water pollution
- Causes of water pollution
- Consequence of water pollution
- Control measures of water pollution

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2.3 WATER POLLUTION

When the quality or composition of water changes directly or indirectly as a result of man's activities such that it becomes unfit for any useful purpose is said to be polluted.

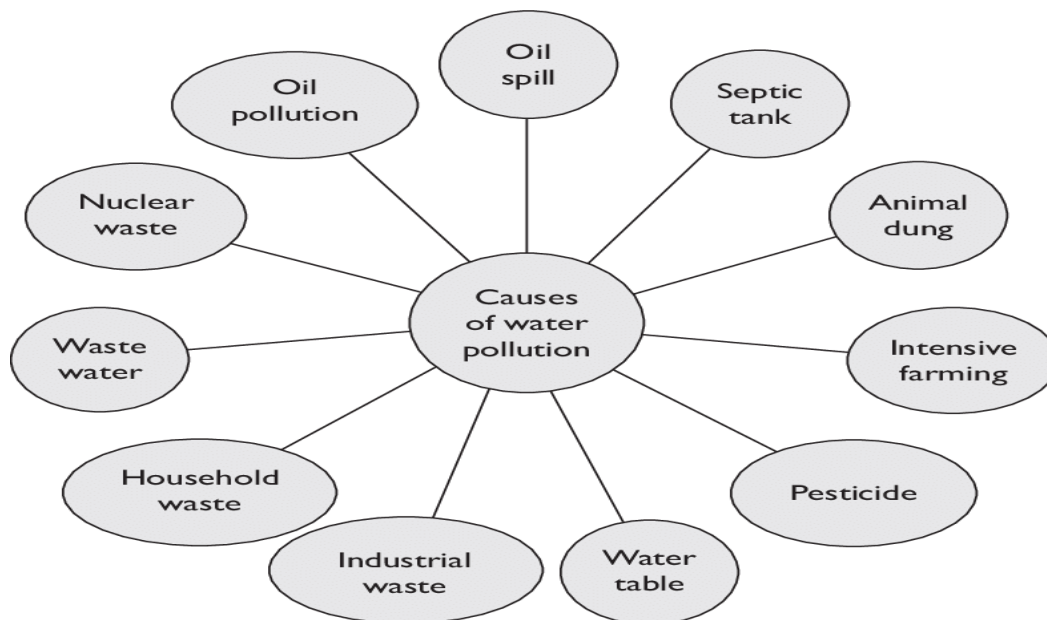
Water pollution (or aquatic pollution) is the contamination of water bodies, usually as a result of human activities. Water bodies include for example lakes, rivers, oceans, aquifers and groundwater. The alteration in physical, chemical, and biological characteristics of water, which may produce harmful effects to humans and aquatic life.

The main water pollutants include bacteria, viruses, parasites, fertilizers, pesticides, pharmaceutical products, nitrates, phosphates, plastics, faecal waste and even radioactive substances. These substances do not always change the colour of the water, meaning that they are often invisible pollutants.

Two types of pollutions:

Point source of pollution: This source of pollution can be readily identified because it has a definite source and place, where it enters the water. Eg: Municipal industrial discharges pipes.

Non point source of pollution: When a source of pollution cannot be readily identified such as agricultural runoff, acid rain etc, it is called as non point source of pollution.



Source :Fig 2.3.1 Environmental science & Engineering by Ravikrishna

Water pollutants

- Domestic sewage
- Industrial pollutants
- Pesticides
- Herbicides
- Fertilizers
- Plankton blooms
- Temp
- Silt
- Radio activity
- Bacteria & virus
- Oils.

Causes of water pollution

- Domestic sewage : The city sewage is released into the river. Domestic sewage consists of human faces, urine and dirty used-up water in houses. It contains a large noof pathogenic bacteria & Virus.
- Industrial effluents : All industrial plants produce some organic & inorganic chemical wastes. The non-usable chemicals are dumped in H₂O.
- The industrial waste include heavy metals (Hg,Cu,Pb,Zn),detergents, petroleum, acids, alkalies, phenols, carbonates, alcohol, cyanides, chlorine.
- Thermal pollution
- Many industries use water for cooling process. so, the resultant warm H₂O is discharged into rivers. This brings about thermal pollution.
- Fertilizers : The fertilizers used for crops are washed into ponds and rivers.
- Pesticides : Pesticides are used to control pests in fields and houses. They include DDT,BHC,Endrin.

- Radio active wastes : Liquid Radio active wastes are released into the sea around nuclear installations. The oceanic currents carry the radio activecontaminants every where.
- Oil pollution : Oil pollution is due to ship accidents, loading & discharging of oil at the harbor, oil refineries.
- Retting :The process of decaying coconut husk to get fiber for making coir is called retting. Retting releases H_2S . It makes water pollution.

Consequence of water pollution

- Water-borne Disenses : Diseases like jaundice, cholera, typhoid, diarrhea, are transmitted through contaminated water.
- Poor oxygenation : Oil present on the surface of water prevent water oxygenation. This reduces respiration& metabolism in aquatic organisms.
- Poor photosynthesis : Oil pollution prevent photosynthesis in phyto plankton.
- Biochemical oxygen demand (BOD) : BOD is the amount of oxygen required by the micro organisms in H_2O . BOD is higher in polluted H_2O and lesser in drinking H_2O . Increased BOD, reduces the dissolved oxygen in H_2O ,causing death of aquatic flora & fauna.
- Reduction in productivity : Intensive agriculture increases the amount of silt in lakes & river. Silt prevents the penetration of light to depths and thus reduces primary production.
- Eutrophication :The increased productivity of lakes & ponds brought about by nutrient enrichment is known as eutrophication. Because, domestic sewage & fertilizers contain large quantities of nutrients, which induces the growth of algae . The rapid growth also consumes all nutrients &oxygen in H_2O .
- Diseases.
- The chemical contaminants in H_2O make the fresh water is unfit for drinking purpose.
- Causes skin cancer, neck damage, damage the nervous system, liver & kidney.

Control measures of water pollution

- The sewage H_2O should not be allowed into river, pool, reservoirs.
- The sewage H_2O should be collected in separate tanks, and treated & recycled.
- Rain water should not be allowed to enter sewage drainage.

- Pesticides & chemical fertilizers should be used in the limited way.
- Bio fertilizers like blue-green algae are used instead of chemical fertilizers.
- Nitrogen fixing green plants are used to improve the fertility of soil.
- Surface run off of manure and fertilizers are allowed in the fields.
- Water should be properly chlorinated.
- Suitable laws, standards & practices should be framed to regulate the discharge.
- The administration of water pollution control should be in the hands of state (or) central government.
- Adopting the necessary scientific techniques for the environmental control of catchment areas of rivers, ponds (or) streams.

WATER QUALITY PARAMETERS – physical, chemical and biological

It is a measure of the condition of water relative to the requirements of one or more biotic species and or to any human need or purpose. It is most frequently used by reference to a set of standards against which compliance can be assessed. The most common standards used to assess water quality relate to health of ecosystems, safety of human contact and drinking water.

Standards

In the setting of standards, agencies make political and technical/scientific decisions about how the water will be used. In the case of natural water bodies, they also make some reasonable estimate of pristine conditions. Different uses raise different concerns and therefore different standards are considered. Natural water bodies will vary in response to environmental conditions. Environmental scientists work to understand how these systems function, which in turn helps to identify the sources and fates of contaminants. Environmental lawyers and policymakers work to define legislation with the intention that water is maintained at an appropriate quality for its identified use.

The vast majority of surface water on the planet is neither potable nor toxic. This remains true when seawater in the oceans (which is too salty to drink) is not counted. Another general perception of water quality is that of a simple property that tells whether water is polluted or not. In fact, water quality is a complex subject, in part because water is a complex medium intrinsically tied to the ecology of the Earth. Industrial and commercial activities (e.g.

manufacturing, mining, construction, transport) are a major cause of water pollution as are runoff from agricultural areas, urban runoff and discharge of treated and untreated sewage.

Drinking water quality

The public health for drinking water, US recommended the following specification for drinking water.

- The water should be crystal clear.
- Colourless.
- Odourless.
- Free from disease causing bacteria.
- Turbidity should not exceed 10ppm.
- The pH should be in between 7-8.5.
- Total hardness should be less than 500ppm
- Total dissolved solids should be less than 500ppm
- The fluoride content should be less than 1.5ppm
- There should be no H_2S in the water.
- Pb,Cr,Mn.Ar salts should not be present in the H_2O .

(Notes

Sewage → waste of domestic (or) industrial origin

Sanitary Sewage → domestic wastage + industrial wastage

Sewer → waste carried pipe

Sullage → waste water from bathroom

Garbage → degradable solid waste, mostly organic partially inorganic

Drainage → the run off from roads, buildings and other catchment areas)