# ENVIRONMENTAL SCIENCE

**Course Code : 18 CE M01**

# UNIT-4
# ENVIRONMENTAL POLLUTION



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# CONTENTS

- **Environmental Pollution:** Cause, effects and control measures of air pollution, water pollution, marine pollution, soil pollution, noise pollution and Solid waste management, nuclear hazards
- **Environmental Legislations:** Environment protection Act, Air, Water, Forest & Wild life Acts, issues involved in enforcement of environmental legislation, responsibilities of state and central pollution control boards

# POLLUTION

- Environmental Pollution can be defined as any undesirable change in physical, chemical, or biological characteristics of any component of the environment i.e. air, water, soil which can cause harmful effects on various forms of life or property.
- **Pollution**: The term pollution can be defined as influence of any substance causing nuisance, harmful effects, and uneasiness to the organisms
- **Pollutant**:- *Any substance causing Nuisance or harmful effects or* uneasiness to the organisms, then that particular substance may be called as the pollutant.

**(1) Natural Pollution:** This type of pollution is limited in its occurrence generally

- from natural hazards like volcanic eruptions, emissions of natural gas, soil erosion, ultraviolet rays, cosmic rays etc.,

**(2) Man made Pollution:**

- Pollution is usually categorized as Air Pollution; Water Pollution; Thermal Pollution; Noise Pollution; Land & soil Pollution; Radio Active Pollution and Marine Pollution .

# CLASSIFICATION OF POLLUTION

- **Degradable non- persistent pollutants**

This pollutant can be broken down rapidly by natural process e.g. Domestic waste, garbage and sewage etc.

- **Slowly Degradable non- persistent pollutants**

This pollutant remains in the environment for a long period of time, in unchanged condition, may for more than few decades e.g. Pesticides, aerosols etc.

- **Non -Degradable pollutants**

This pollutant never get degrade by any process. e.g. toxic element like lead, mercury, nuclear waste etc

# TYPES OF POLLUTION

- WATER POLLUTION
- AIR POLLUTION
- LAND POLLUTION
- NOISE POLLUTION
- NUCLEAR POLLUTION
- E- WASTE



1. Indoor pollution
2. Outdoor pollution

# DIFFERENT POLLUTANTS

| S.No. | Pollutants | Examples |
|---|---|---|
| 1. | Gases | Nox, Sox, COx |
| 2. | Industrial waste | Soot,smoke,tar,dust |
| 3. | Metal waste | Hg, Pb, Zn, Nickel |
| 4. | Acids | $H_2SO_4$ |
| 5. | Agro pesticide | Fungicides, bactericides |
| 6. | Domestic waste | Garbage, Rubbish |
| 7. | Radioactive waste | Nuclear Ash from atomic Reactors |
| 8. | E waste | From IT sector |

# CLASSIFICATION OF POLLUTANTS

- Pollutants may be classified according to origin and state of matter.

a) **According to Origin:** Air pollutants are divided into two categories as primary & secondary.

Primary air pollutants are those which are emitted directly into the atmosphere.

Eg: C; CO; $CO_2$; SOx ; N; S; H; NOx; CFC's etc .

Secondary air pollutants are those which are produced in the air by the interaction among the primary air pollutants or by reaction with atmospheric constituents.

- Eg: Ozone ( $O_3$); Smog; Para Acetyl Nitrate ( PAN); Acid Rain ; Aerosols.

**b) According to State of Matter:** Air pollutants include fine solids; liquids and gases. Dust, Smoke, Fumes etc are examples for solid particles whereas fog is an example for liquid particles. Benzene ( $C_6H_6$ ), Methane ( $CH_4$ ) are gaseous air pollutants.

Listed below are the major air pollutants:

| **Compound** | **Pollutants** |
|---|---|
| Carbon oxides | Carbon Monoxide (CO); Carbon dioxide |
| Sulphur oxides | Sulphur dioxide ($SO_2$); Sulphur Trioxide ($SO_3$) |
| Nitrogen oxides | $NO_2$;Nitrous oxide($N_2O$);Nitrogen Peroxide($N_2O_5$) |
| Organic compounds | $CH_4$; Propane ( C3H8) ; Benzene; CFC |
| Photochemical Oxidants | Ozone ($O_3$); PAN; Aldehydes |
| Radio active substances | Iodine ; Strontium ; Plutonium |

- ***Smog:*** *Smog is a combination of smoke and fog or various gases when react* in the presence of sunlight. The effects of smog on human health cause for respiratory, irritation to the eyes, diseases related to nose, throat, bronchitis, pneumonia, headache, nerves, liver, kidneys.
- The first smog related deaths were recorded in London in 1873, when it killed 500 people. In 1892, December, London had worst experiences causing 1000 deaths. In 1940's severe smog began covering the cities of Los Angeles in USA.
- **Para *Acetyl Nitrate (PAN):*** *PAN which is a harmful chemical form in nature* and causes irritation of eyes and other human sense organs. It may also cause blisters on the skin.

- ***Aerosols:*** *These are Suspended Particulate matter. It consists of dust, soot,* asbestos particles, Pb, Ni, Nitrate and sulphate salts, fumes, mists, smoke and sulphuric acid particles etc..
- These particles measure less than 1 micron in size because of that, they directly enter into respiratory track.
- Exhaust gases from aero planes, automobile industries are the main sources for releasing aerosols.

# 1. AIR POLLUTION

- Presence/addition of any contaminant to the air which cause harm to the health of living organisms

# CLASSIFICATION OF AIR POLLUTION

- **Primary pollutants**

  Ash, salt particles, pollen and spores, smoke, wind blown dust, $CO_2$, CO, NOx, SOx, VOCs, SPM

- **Secondary pollutants**

Smog = sunlight + NOx.

Acid rain = water + SOx

Ozone = Volatile org + NOx

# Effect of pollutants

- **Air pollution and Human health**

Irritation of eyes, throat and nose

Respiratory damage through tobacco smoke

Conculsions, delirium, coma due to lead-posioning.

- **Air pollution and Vegetation and Animals**

The direct use of pesticide on agriculture plants and fed to animals.

- Rise in Ozone causes Necrosis i.e. damage leaves
- Rise in $NO_2$ cause Abscission i.e. premature fall
- Rise on $SO_2$ cause yellowing of leaves
- So pollution qualitatively and quantitatively effect on plants.

# Effect of pollutants (ctd..)

- **Effects on Materials**

Abrasion and corrosion of material due expose to air.

Acid gases like O3, SO2, NO2 affect strength of textile.

Building material, Paper, paints get affected.

- **Effects on Climate**

Due to cutting of natural vegetation the carbon cycle has been broken. So keep 33 % forest.

$CO_2$ absorbed heat and it cause to global warming.

Release of CFC gases affect ozone layer and reduce capacity to trap UV rays.

# Air pollution effects

- CO is attached to blood hemoglobin for a long time, it accumulates and reduces the oxygen carrying capacity of blood. This impairs perception and thinking, slows reflexes and causes headaches, drowsiness, dizziness and nausea and blurred vision.
- Chronic exposure of the leaves to air pollutants can break down the waxy coating that helps prevent excessive water loss and leads to damage from diseases, pests, drought and frost.

# CONTROL MEASURES

- Proper fuel and exhaust system in vehicles
- Use of dry and wet collectors, filters, electrostatic precipitators.
- Providing greater height to the stacks – discharge pollutants away from the ground.
- Substitution of raw materials that cause more pollution.

# 2. 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 purpose it is said to be polluted.

(1) Marine water bodies and

(2) Fresh Water bodies

- Water is a good solvent for many substances. Because of this property water cannot exist in its pure form at many parts of the world. Water pollution is mainly because of sewage, industrial disposals.

**Chemical Characteristics:**

- pH, Biological Oxygen Demand, Dissolved Oxygen, Chemical Oxygen Demand

**Water Pollutants:**

- **Disease causing agents:**
- **Water soluble inorganic chemicals:** Acids, salts and compounds of toxic metals such as Pb, Hg can make water unfit to drink, harm fishes and other aquatic life.
- **Water Soluble Organic chemicals:** Oil, gasoline, pesticides, detergents and many other water soluble chemicals.
- **Heat:** Large quantity of water is heated when it is used in the cooling towers of thermal power plants.
- **Sewage:** Sewage is waste water from municipal area where there is human habitation.

# SOURCES & EFFECTS

## 1. Industrial Effluents

Water is discharged from industries after having been used in production processes. This waste water may contain acids, alkalis, salts, poisons, oils and in some cases harmful bacteria.

- **Minamata disease** is a neurological syndrome caused by severe mercury poisoning. Symptoms include numbness in the hands and feet, general muscle weakness, narrowing of the field of vision and damage to hearing and speech. In extreme cases, insanity, paralysis, coma, and death follow within weeks of the onset of symptoms.
- Minamata disease was first discovered in Minamata city in Japan in 1956. It was caused by the release of methyl mercury from, the Chisso Corporation's chemical factory, which continued from 1932 to 1968.

- This highly toxic chemical bio- accumulated in shellfish and fish in Minamata Bay which when eaten by the local populace resulted in mercury poisoning. While cat, dog, pig, and human deaths continued over more than 30 years, the government and company did little to prevent the pollution.
- **Fluorosis**: People suffer from a disease called fluorosis after consuming water containing fluorine for sufficiently a long time. Quantity of fluoride in water is only 1 ppm. Diseases caused by fluorosis are:
- Back pain and cannot easily bend.
- Joints get stiffened as so movement of joints is impaired.
- Teeth are the worst effected and a brown coating appears on the enamel of teeth giving bad appearance.
- Persons with fluorosis cannot stand straight freely.

2. **Mining and Agricultural Wastes**
   Mines, especially gold and coal mines, are responsible for large quantities of acid water.
3. **Agricultural pesticides, fertilizers and herbicides** may wash into rivers and stagnant water bodies. Agricultural water pollution leads to **Eutrophication** & **Water Bloom**

- **Eutrophication** is the ecosystem response to the addition of artificial or natural substances, such as nitrates and phosphates, through fertilizers or sewage, to an aquatic system. Eutrophication also occurs when fresh water bodies like ponds, lakes, pools which contain organic waste material. Because of that, the fresh water ponds and lakes get polluted. Eutrophication is a type of water pollution.

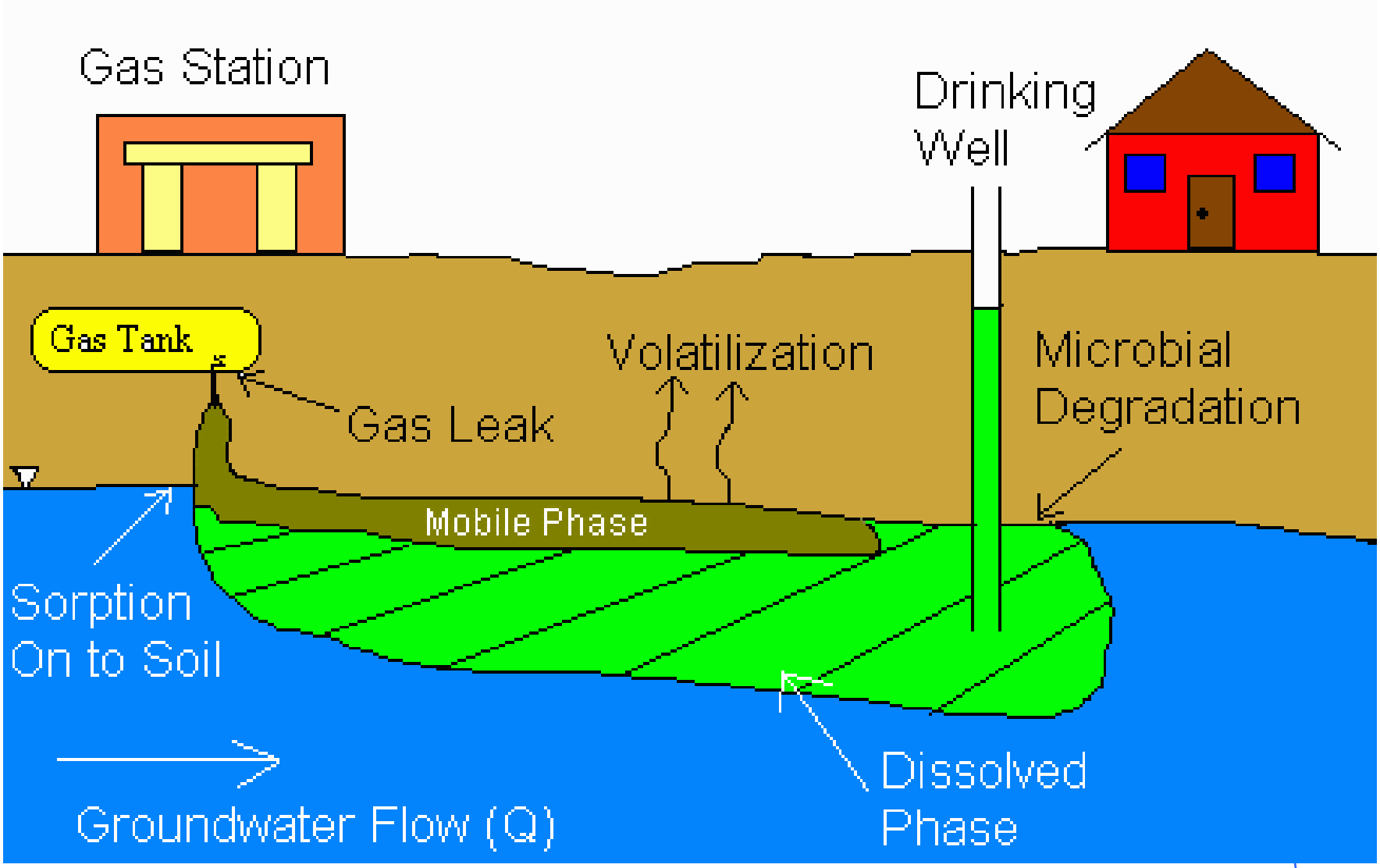
**Ecological effects of Eutrophication:**

- Excessive nutrients in water bodies promote plant growth which leads to a drop in water quality;
- Disruption of the natural ecosystem E.g. lack of oxygen for shellfish and marine life (causing a drop in their population).
- Decrease in the recreational and aesthetic value of water bodies
- Health problems when it occurs in drinking water reserves
- Coral reef decline
- Decreased biodiversity,
- Changes in species composition and dominance, and
- Toxicity effects.
- Toxic phytoplankton species
- Decreases in water transparency (increased turbidity)
- Colour, smell, and water treatment problems
- Dissolved oxygen depletion
- Increased incidences of fish kills
- Loss of desirable fish species

- **Water Bloom** is defined as “A growth of algae at or near the surface of a body of water, such as a pond”. This is another kind of water pollution because of the presence of Blue Green Algae ( BGA).
- Blue-green algae are microscopic organisms that can be considered as simple aquatic plants that occur naturally in habitats such as marine waters, rivers, lakes, damp soil, tree trunks, hot springs and snow. They can vary considerably in shape, colour and size.
- They usually are present in low numbers. Blue-green algae can become very abundant in warm, shallow, undisturbed surface water that receives a lot of sunlight.
- When this occurs, they can form blooms that discolor the water or produce floating rafts or scums on the surface of the Because of the presence of B G A, the water turns blue in color or blue green which is unsuitable for drinking. This type of pollution of fresh water bodies by Blue Green Algae is generally called “*Water Bloom*”

4. **Sewage Disposal and Domestic Wastes:** Sewage as well as domestic and farm wastes were often allowed to pollute rivers and dams.

- Diarrhea, Cholera, Typhoid


Gas Station
Drinking Well
Gas Tank
Gas Leak
Volatilization
Microbial Degradation
Mobile Phase
Sorption On to Soil
Groundwater Flow (Q)
Dissolved Phase

# Prevention and Control Measures

1. Drinking water should be boiled, cooled and then used.
2. Disinfection of drinking water should be done by using chemicals like bleaching powder.
3. Pesticides and insecticides should be prevented from nearby use of water lakes, ponds and pools.
4. Drainage water should not be allowed to mix with drinking water.
5. Drainage system should be maintained properly.
6. Chlorination process is to be adopted for drinking water. For 1 litre of water 30 -40 mg of chlorine is to be added to get perfect disinfection. It kills bacteria, fungi, fungal spores and other microbes also.

# *Marine Pollution*

- Pollution of oceans is damaging the marine environment and is becoming a major problem. Marine environment is interesting for various reasons such as Sea food; Navigation; Adventure; Tourism etc.,
- Marine Pollution is harmful and its danger can be identified in a variety of ways.

The effects of oil pollution depend mainly on the following factors:

- Type of oil and its viscosity;
- amount / quantity released;
- distance covered;
- time;
- average water temperature

# Marine Pollutants

- Pathogens
- Sediments
- Solid wastes
- Heat
- Freshwater
- Brine
- Toxic Inorganics
- Toxic Organics
- Petroleum and oil
- Nutrients
- Radioactive materials
- Oxygen demanding materials
- Acids and Bases

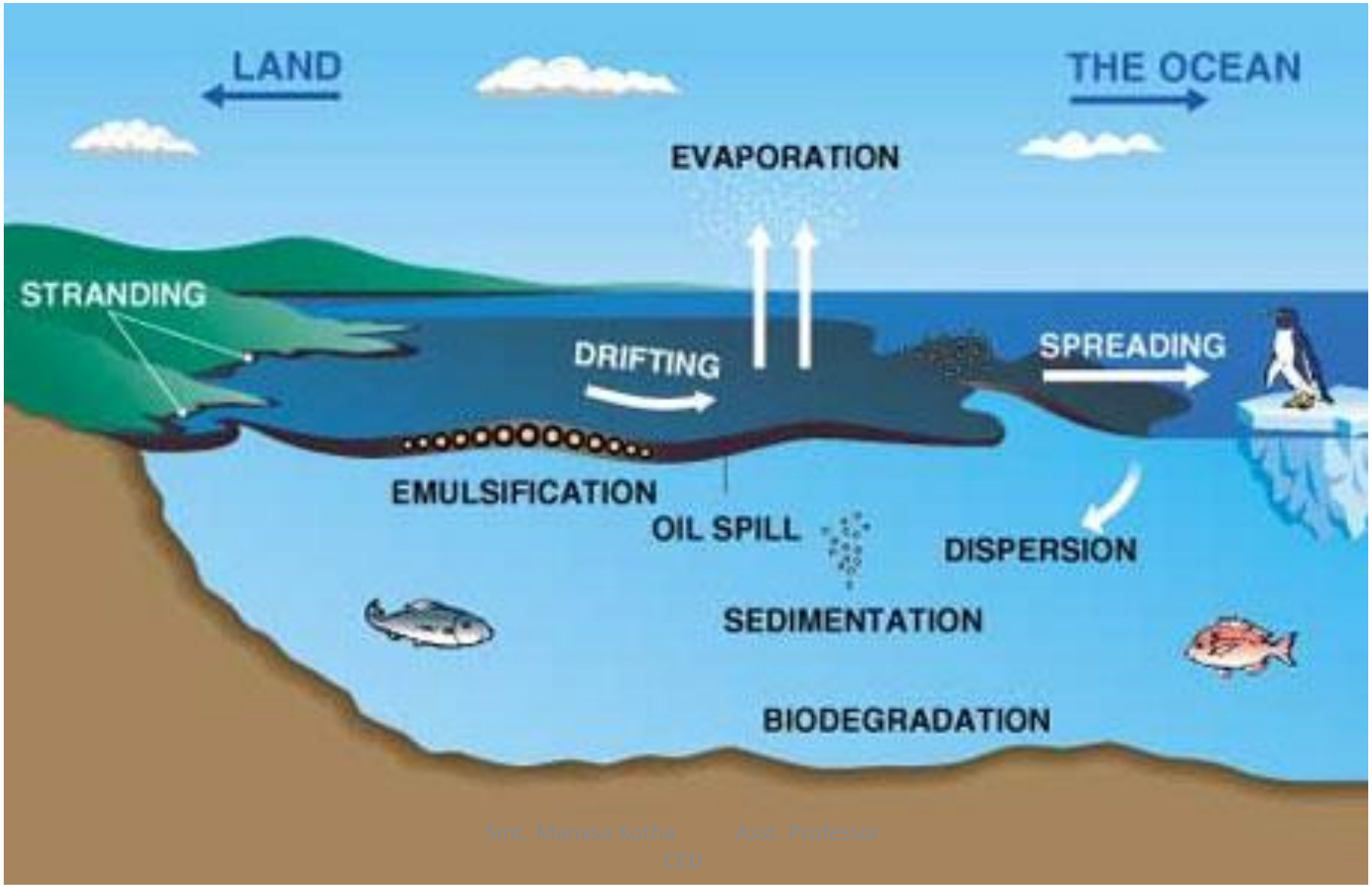
# Sources:

- Marine commerce
- Industry
- Electrical Power generation
- Sewage treatment
- Other Non Industrial Wastes
- Recreation
- Construction

# Sources and Causes

- **Marine Oil Pollution:** Oil is basically an important pollutant which destroys marine environment.
- **Sources:** Run-off oil from streets; disposal of lubricants from machines; Off shore oil and gas exploitation from off-shore drilling; blowouts at off-shore drilling rigs; oil escaping under high pressure from a bore hole in the ocean floor.
- Waste chemicals, mud and accumulation of toxic substances in the ocean in the form of mercury, dioxin, PCBs, PAHs (Poly Aromatic Hydrocarbons), Radioactivity. benzene; xylene (colorless, flammable liquids) and heavy metals such as lead; copper; nickel, mercury also cause for marine pollution during the off shore drilling activities.
- Both dumping and exploitation of ocean resources cause ocean pollution also.

# Fate of Oil


LAND
THE OCEAN
EVAPORATION
STRANDING
DRIFTING
SPREADING
EMULSIFICATION
OIL SPILL
DISPERSION
SEDIMENTATION
BIODEGRADATION

- **PAHs:** It is a chemical compound and organic pollutant. These occur in oil , coal and tar deposits and are produced as by products of fuel burning. PAHs are lipophilic (they mix more easily in oil than water). Eg for PAHs are:

Acenaphthene; Anthracene; Benzopyrene; Chrysene; Coronene; Fluorene; Pyrene.

- **Other sources from land :** The major sources of marine pollution originating from the land vary from country to country. Effluents are discharged either directly into the sea or enters the coastal waters through rivers.
- Thousands of barrels of oil burn when oil wells were set on fire. Tanker accidents on land carries oil to the nearby streams / canals and cause for marine pollution. Due to burning of oil, smoke, $SO_2$, $NO_2$, CO are added towards atmospheric contamination.

- Natural release
- Oil tanker and other ship accidents – Largest Oil Spills (World-Level)
  - Gulf War oil spill, Persian Gulf, January 23 1991

1. Ixtoc oil well, S Gulf of Mexico, June 3, 1979
2. Nowruz oil field, Persian Gulf, February, 1983
3. Castillo de Bellver, off Cape Town, South Africa, August 6, 1983
4. Amoco Cadiz (BP/Amoco, USA) - Britanny, France, March 16 1978
5. Torrey Canyon, South England, March 18 1967
6. Sea Star,Gulf of Oman, December 19, 1972
7. Urquiola, La Coruna, Spain, May 12, 1976
8. Hawaiian Patriot, N Pacific February 26, 1977
9. Othello, Tralhavet Bay, Sweden, March 20, 1970

- Operation of ships other than tankers
- Offshore oil drilling and production plat forms
- Refinery operation

- **Dry Docking**

All ships need periodic dry docking for servicing repairs, cleaning the hull etc. During this period when the cargo compartments are to be completely emptied, residual oil finds its way into the sea.

- **Bilge and fuel oils**

As ballast tanks take up valuable space, additional ballast is sometimes carried in empty fuel tanks. While being pumped overboard it carries into the sea. Individually, the quantity of oil released may be small, but it sometimes becomes a considerable amount when all the shipping operations are taken into consideration.

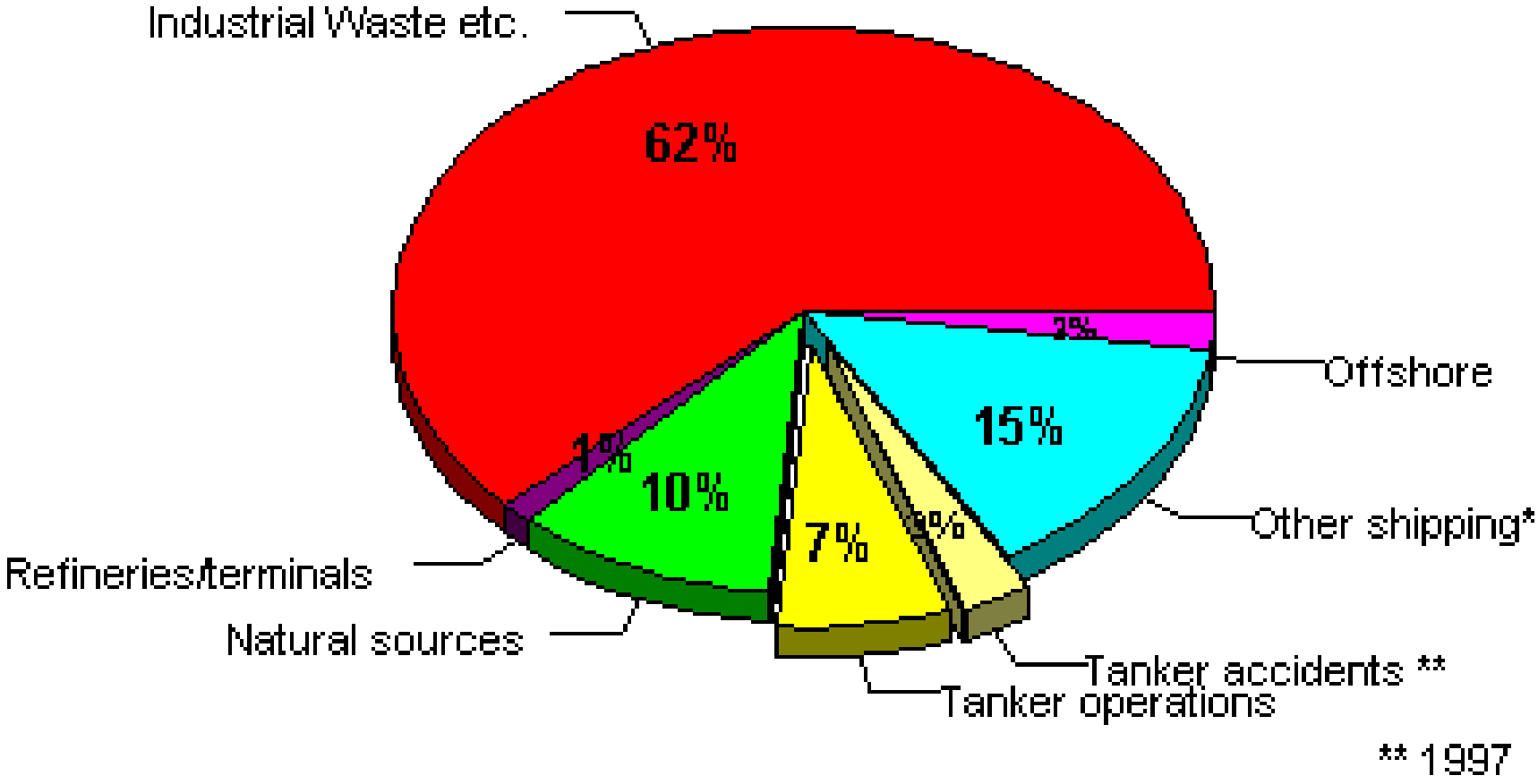
- **Tanker accidents**

A large number of oil tanker accidents happen every year. Sometimes this can result in major disasters , such as that of Exxon Valdez on marine environment.

- **Offshore Oil Pollution**

The oil that has extracted from the sea bed contains some water, even after it is passed through oil separators the water that is discharged contains some oil, which adds to marine pollution. Drilling mud, which are pumped down; oil wells when they are being drilled, normally contain 70 - 80 % of oil. They are dumped on the sea bed beneath the drilling platform, thus heavily contaminating the water. In addition, the controlled release of oil from the wells can be catastrophic events resulting in oil pollution

# Source of oil pollution into the sea




** 1997

Source: UN Environmental Programme (UNEP), 1990.

* Non-tanker accidents, Bilge and Fuel oil, Dry-docking

- **Oil spill- India** - In 1994, June, Indian authorities began siphoning off 700 tons of oil from the Sea Transporter, a 6,000-ton Greek cargo ship which had been anchored off Aguada after it ran aground following a cyclone on June 5.
- In March 25, 2005, 110 tonnes oil spilled in Goa port.

| S No | SOURCE | EFFECT |
|---|---|---|
| 1. | Sewage & run- off from forestry | Depletes oxygen in water causes killing of fishes. |
| 2. | Sediments from mining Sediments | clog in the gills of fishes |
| 3. | Sewage from municipalities, towns; cities etc… | Contaminate sea food |
| 4. | Industrial discharge; pesticides from farms | Cause disease in coastal marine life |
| 5. | Oil from off shore drilling; industries / automobiles | Low level contamination kill larvae whereas high level contamination causes death for sea fishes |
| 6. | Litter (rubbish), waste, plastics Etc | Marine life disturbs |
| 7. | Hot water from power plants | Kills corals. |

# Control Measures

- Improving existing sewage disposal facilities
- Ensuring individual houses have sewage disposal systems (such as septic tanks).
- Large resorts should use and manage their own packaged treatment plants.
- Marine planning and management should be considered as processes such as land – sea interaction; inter disciplinary co-operation; participation of public & private sector organisations; balance between protection and development public participation
- Oil tankers are double hulled (two layered bottom) to reduce the chance of oil leakage.
- Recycling facilities for used oil.

**Physical methods**

- Skimming: The oil could be removed from the surface
- Oil can be removed by suitable absorbents Ex.: Saw Dust, Polyurethane foam

**Chemical Methods**

- Evaporation, Emulsification, Absorbents, burning of oil are effective methods
- Super bug has been proved to be effective to clean up the oil pollution
- Oleophilic fertilizers enrich the soil eating microbes like pseudomonas sp and hence they could be used.
- To reduce the thermal pollution due to industrial effluents, high efficient heat exchangers should be used.
- Each industry should have a separate treatment plant to meet the standards which are given by central and state pollution control Boards.

# SOIL POLLUTION

- Soil is thin covering over the land consisting of a mixture of minerals, organic materials, living organisms, air and water.

**SOIL PROFILE :**

- The top layer – O horizon- freshly fallen and decomposed leaves, twigs, animal wastes, fungi and other organic materials- brown or black in colour
- Uppermost layer- A horizon-partially decomposed organic matter and inorganic mineral particles – darker and looser
- B horizon – subsoil contains less aquatic material and fewer organisms than A zone.
- C horizon – weathered parent material

- Land pollution is the demolition of Earth's land surfaces often caused by human activities and their misuse of land resources. It occurs when waste is not disposed properly.
- Urbanization and industrialization are major causes of land pollution.

# Causes of Soil Pollution

**The Quantitative Loss of soil:**

known as soil erosion and movement of surface litter of top soil from one place to another.

- Human and Animal Excreta

1. Insecticides.
2. Industrial wastes.
3. Radioactive waste.
4. Nitrification.

# Causes of soil degradation

- By wind and water accelerated by human activities such as farming, construction, overgrazing by livestock, burning of grass cover, deforestation.

**Excessive use of Fertilizers :**

- Fertilizers, insecticides, herbicides, pesticides, fungicides, rodenticides
- Soil fertility is lost
- Kill beneficial insects

# Effects of Soil Pollution

- Sewage and industrial effluents which pollute the soil ultimately affect human health.
- Acids, alkalis, pesticides, insecticides, weedicides, fungicides, heavy metals etc. in the industrial discharges affect soil fertility.
- Some of the persistent toxic chemicals inhibit the soil flora and fauna and reduce soil productivity. These chemicals accumulate in food chain and ultimately affect human health.
- Indiscriminate use of pesticides specially is a matter of concern.

# Effects of Soil Pollution (Ctd..

- Sewage sludge has many types of pathogenic bacteria, viruses and intestinal worms which may cause various types of diseases.
- Radioactive fallout on vegetation is the source of radio-isotopes which enter the food chain in the grazing animals. Some of these radio isotopes replace essential elements in the body and cause abnormalities.
- Strontium-90 instead of calcium gets deposited in the bones and tissues. The bones become brittle and prone to fracture.

# Control Soil Pollution

(i) Effluents should be properly treated before discharging on soil.

(ii) Solid wastes should be properly collected and disposed off by appropriate method.

(iii) From the wastes, recovery of useful products should be done.

(iv) Biodegradable organic waste should be used for generation of biogas.

(v) Cattle dung should be used for methane generation. Night soil can also be used in the biogas plant.

(vi) Microbial degradation of biodegradable substances.

# Integrated Treatment Methods

- Continuous contour trenches
- Live check dams – planting grass, shrubs and trees etc.
- Bund constructed out of stones.
- Earthen check bund- local soil, across the stream

# Noise Pollution

- Human ear is capable of perceiving about 85 decibels of sound. Beyond the limit, the ear drum cannot bear sound.
- In general, a sound is a vibration from a particular machine, place or material which can be heard clearly whereas a noise a mixed vibrations that will come to us from all directions.
- A sound can be clear and can be able to hear, whereas a noise will not be clear and cannot be heard.

# Sources of Noise

- Noise is an unwanted sound and noise pollution occurs through different sources:

1. Vehicles produce noise that leads to noise pollution.
2. Automobile industry is another source of noise pollution.
3. Noise pollution is very common in industrial areas where machines are working for factories making more noise.

- The sources of noise are more in urban and industrial areas, than in rural areas. The sources of noise may be stationary or mobile.
- The stationary sources include industries, loud speakers, mining operations, use of machineries, TV, Radio, Grinders etc.
- The mobile sources include Road Traffic, Highway Noise, Railway Traffic, Air Traffic.

**(1) Stationary sources:**

- **Industrial noise:** The main categories of industrial activity that are particularly relevant to the study of noise are the following:
- Product fabrication
- Product assembly
- Power generation by means of generators.
- Combusting process in furnaces. ( burning of gases)

- **Noise from construction works:** Construction noise, a major source of noise pollution is emitted by construction equipment. The sources of noise are dozers, excavators, front end loaders, soil compactors, cranes, air compressors, concrete vibrators, Riveting steel structure during the casting, dismantling of construction materials.
- **Noise from other sources:** These include sources such as sirens, barking dogs, ambulances, Police vehicles, Fire engines etc..,

## (2) Mobile sources:

- **Road traffic:** Of all sources of noise pollution, road traffic is the most prevalent and perhaps the most source of noise pollution.
- More people are exposed to noise from motor vehicles and the noise depends on various factors such as *Road location, Road design, Vehicle standards, Driver behaviors, Horns, Traffic density.*

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## Noise of common road vehicles

| Vehicle type | Noise(db) |
|---|---|
| Medium road traffic ( Main roads ) | 70- 80 |
| Heavy road traffic ( High ways ) | 80- 90 |
| Buses & Trucks upto 3.5 tons | 85- 95 |
| Trucks upto 3.5-12 tons | 90-100 |
| Motor cycles | 90-105 |

- Motor cycles with their exposed engines and inadequate silencing arrangements are notorious noise producers, which produce more than 30 times sound than a small passenger car.
- **Railway traffic:** Noise from railway traffic is not serious nuisance as compared to the road traffic noise. The level of noise associated with rail traffic is related to the type of engine, the speed of the train, track type and condition. The majority of noise emitted by trains is produced by the engine (or) by the interaction of wheels with the tracks, horns, warning signals at crossings etc..,

- **Air traffic:** The noise of air craft is different from that of road traffic in the sense it is intermittent. Noise is maximum during take off and landing. Noise made by jet planes is more disturbance than that of propeller driven air craft. Supersonic air craft produce noise at high levels due to its intensity.
- **Effects of Noise:** At 120 decibels the ear registers pain but hearing damage begins about 85 decibels. Apart from hearing loss, noise can cause lack of sleep, irritation, indigestion, ulcers, high B.P., Heart diseases, stress etc.,

- **Annoyance:** One of the most important effects of noise on human is annoyance. Due to this breathing rate affects.
- **Noise- induced hearing loss:** Exposure to noise for a long enough duration results in damage to the inner ear and thus decreases one's ability to hear. The louder the noise the less time it takes to cause hearing loss.

- **Effects on sleep:** Noise disturbs sleep. It has been found that the cases related to various levels of noise are associated with sleep disturbances. Sleep disturbance by noise depends on the characteristics of the noise such as frequency, loudness and whether the noise is continuous or intermittent.
- **Other effects:** There are many other effects of noises such involve aggression (ready to attack). People may turn mad and nerves may not function normally.
- People may be deformed in many ways including increased stress and strain, nonfunctioning of hands, legs etc due to noise pollution if exposed continuously.

# Control of Noise Pollution

- Noise pollution could be controlled by either reducing the noise at the source or by preventing its transmission.
- The first step in the prevention of noise pollution is to control the noise at source itself.

For ex: Lubrication of machines reduce the noise produced, Tightening the loose nuts, Reducing the vibrations produced by machines etc…

- *Failing to control the noise at its source, the second step is to prevent its transmission.*
- *For ex: keeping the noise machine covered in an enclosure so that the* sound does not escape and reach the receivers, construction of noise barriers on road sides, sound proof the buildings by using heavy curtains on the windows, acoustical tiles on the ceiling and walls, by sealing the cracks in the walls to reduce the noise coming from outside.

- If the noise levels are not able to bring down to the desired levels in some cases, the only alternative is to follow:

1. Avoiding horns except in emergency situations.
2. Sound proof or eco-generators and turning down the volume of stereos.
3. Conducting the awareness programs.

# SOLID WASTE MANAGEMENT

- **Solid Waste** is defined as " *any garbage, refused materials, sludge from a waste treatment plant and other discarded material including solids, semisolids etc resulting from industrial, commercial, mining, agricultural operations etc.*"
- Solid Waste Management has become very important role in order to minimize the adverse effects of solid wastes.
- Solid waste can be classified as Municipal Solid Waste ; Industrial Solid Waste; Hazardous Solid Waste; Agriculture Solid Waste; Mining Waste, Sewage Sludge Waste etc..

- Solid wastes are being produced since the beginning of civilization. The disposal of Solid Waste has been increased due to the rapid developments in industrialization and urbanization. High population density, intensive land use for residential, commercial and industrial activities led to generation of more solid waste.
- In Andhra Pradesh, the solid waste generated in medium and small municipalities in the range of 30 – 150 MT / day. The per capita generation of Municipal solid waste in class I cities is in between 100 – 500 gms / day per person.

- In metro cities in India, an individual produces an average of 0.8 kg/ waste/ person daily. The total muicipal solid waste (MSW) generated in urban India has been estimated at 68.8 million tons per year (TPY) (0.573 million metric tonnes per day (MMT/d) in the year 2008). The average collection efficiency of MSW ranges from 22% to 60%.
- MSW typically contains 51% organic waste, 17% recyclables, 11% hazardous and 21% inert waste. However, about 40% of all MSW is not collected at all and hence lies littered in the city/town and finds its way to nearby drains and water bodies, causing choking as well as pollution of surface water

# Sources of Solid Wastes

1. *Municipal Solid Waste is commonly known as garbage consists of packing* materials, furniture, clothing, bottles, food scraps, newspapers, home appliances; paints, batteries etc. Municipal solid wastes are arise from residential quarters, commercial ( markets, hotels, garages); institutions; public places, open areas/streets, parks, play grounds etc. MSW also include the following wastes:

- *Food Wastes usually generate from domestic houses, hotels, markets and* consist of fruits, vegetable residues resulting from the handling, preparation, cooking and eating of foods.

- *Rubbish waste* consists of combustible wastes (papers; cardboards, torn clothes, plastics, wood etc) and non – combustible waste (glass, crockery, aluminium tins, ferrous metals; construction wastes).
- *Demolition & Construction wastes* result from the construction, remodelling and repairing of residential, commercial buildings and industrial factories. These wastes include dust, stones, concrete, bricks, steel pieces etc..
- *Special Wastes* include street sweepings, road side litter, drainage debris; dead animals and abandoned vehicle parts.

2. *Industrial Waste* arise from industrial activities such as chemical industries; metal and mineral processing industries. Radio Active wastes are generated by Nuclear Power Plants. Thermal Power Plants produce fly ash in large quantities. Fly ash is a fine solid particles result from the burning of wood, coal and other combustible wastes.
3. *Hazardous Solid Waste* is any solid waste or combination of wastes that posses a substantial danger, now or in future to human beings and plant/animal life and cannot be handled or disposed.

Types of hazardous wastes:

- Wastes from specific and non-specific sources. For eg: disposable synergies from hospitals is a specific source identified as hazardous solid waste.
- Ignitable materials ( easily inflammable below 60$^{o}$C )
- Corrosive materials ( iron rods / pieces )
- Reactive materials ( undergoes rapid reaction with water or other substances and releases toxic gases eg: limestone / marble ).
- Toxic materials which consists of Pb, Cl ( Toxic to human beings )

# Effects of Solid Waste

The improper handling and transfer of the solid wastes results in various health and environmental problems. The main impacts of waste accumulation are:

- Garbage dumping places are breeding places for diseases.
- Rats and pigs roam and feed on garbage and transmit diseases like brain fever from pigs to human beings and plague from Rats.
- Solid wastes may choke the drains and gully pits resulting in water logging which in turn results in breeding of mosquitoes and then cause for Malaria & dengue in human beings.

- Noxious fumes ( harmful gas) may pollute air due to the burning of waste products especially plastic containers.
- Obnoxious ( very unpleasant ) odours pollute the air due to decomposition of organic solid wastes.
- Municipal solid wastes heap up on roads due to improper disposal system. Every year several tones of solid waste is dumped along the high-ways thereby spoiling the landscape ( appearance of an area of land ) .
- Urban and industrial solid wastes often contain a variety of toxic chemicals which may enter into the food chain and affect both terrestrial and aquatic organisms.

# SOLID WASTE MANAGEMENT

*Three R's –Reduce; Reuse & Recycle--- Refuse*

- ***Reduce in use of Raw Material:***
- Reducing the use of raw materials decrease the production of waste.
- For eg: Melting of broken plastic items and toys can be used for moulding them into new ones whereas plastic scrap which are not remoundable can be incinerated to get heat.
- For eg: Agriculture waste of rice husk and ground nut shells can be converted into non-polluting fuel. Fermentation of agricultural wastes produce ethanol which can be used as liquid fuel. These helps in reduction of raw material for manufacturing a few things and reduction in the usage of coal, wood etc..

- ***Reuse of solid waste Material:***
- Making rubber rings from the discarded cycle tubes which are used by newspaper vendors reduces the waste generation during manufacturing of rubber bands.
- Waste food and vegetable peelings can be reused as food for cattle.
- Producing biogas is possible from organic matter; human and animal excreta.
- Waste paper can be utilized for making paper covers. Wastes of silk industry containing large quantities of waste pupae can be used as poultry feed.

- ***Recycling of materials:***
- Recycling is the reprocessing of discarded materials into new useful products.
- Old aluminum cans and glass bottles are melted and recast into new cans and bottles. Worn-out tyres can be rebuttoned. Recycling of paper will reduce cutting of trees.
- The process of reducing ; reusing and recycling saves money; energy; raw materials and reduces pollution.

- https://www.indiawaterportal.org/topics/solid-waste#:~:text=In%20metro%20cities%20in%20India,)%20in%20the%20year%202008)
- https://timesofindia.indiatimes.com/india/in-30-years-india-tipped-to-double-the-amount-of-waste-it-generates/articleshow/74454382.cms

# Treatment of solid wastes:

Disposal techniques practiced in Municipal solid wastes.

(i) Sanitary Land Fill

(ii) Composting

(iii) Incineration.

**(i) Dumping** the solid waste at the out-skirts of the city, especially in low lying areas, or on either side of the road is very common. In case of mineral excavations, granite quarries or soil excavation for brick making, low lying areas are created. *Restoration to original level with solid wastes is a good example for sanitary landfill.*

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**(ii) Decomposition** of solid waste material is known as composting and the final product is called *compost. Compost contains nutrients (NPK)* for the growth of plants. A few methods of treatment and disposal of composting system are given below:

The composting systems can be broadly grouped as **aerobic** and **anerobic.** Composting systems can be operated either manually or mechanically in open pits or in enclosed digesters in addition to natural process.

**Aerobic composting** is a process in which bacteria, actinomycites, fungi and other biological forms are actively involve. Aeration is a natural process occurs on the surface areas of the composting mass, while the inner layers tend to progressively turn anaerobic.

- **Trench method** is best suited for flat land where excavation can be carried out easily. A trench 2 mts deep with 5 mts length and 2 mts wide is cut. The excavated soil is placed on the sides of the trench and the trench is filled with solid waste refuse in layers and finally with a soil cover .
- **Area method** is best used in areas where natural depressions exist as in quarries, valleys. The waste is put in the natural depressions and compacted a layer of soil is thrown on top. The process is repeated till the depression is filled up.

**(iii) Incineration** is a common sight to see small fires of burning dry leaves, paper etc on the sides of roads. However, such fires produce considerable smoke and air pollution.

- Increasing population and rising standard of living styles create the solid waste and require integrated policies/rules and technologies.

# Environmental Legislations

- The Govt of India has formulated about 30 acts and rules related to the environment. The environmental legislations passed by Govt of India are enlisted below:

**1. The Water ( Prevention & Control Pollution ) Act, 1974**

2. The Water (Prevention & Control Pollution ) Cess Rules 1978

**3. Forest ( Conservation ) Act 1980**

**4. The Air (Prevention & Control Pollution ) Act, 1981**

5. The Air (Prevention & Control Pollution ) Rules 1982

6. The Air (Prevention & Control Pollution ) for Union Territories Rules Act 1983.

**7. The Environment ( Protection ) Act, 1986**

8. The Environment (Protection ) Rules 1986
9. Hazardous Wastes Rules 1989
10. Manufacture and storage of hazardous chemical Rules, 1989
11. The Public Liability Insurance Act 1991
12. The Public Liability Insurance Rules 1991
13. The National Environment Tribunal Act, 1995
14. Bio medical waste, Rules 1998
15. Re-cycled plastics manufacture and usage Rules, 1999
16. Dumping and disposal of Fly ash --- notification
17. Noise Pollution Rules 2000
18. Municipal solid wastes Rules 2000
19. Ozone depleting substances rules 2000

# The Water (Prevention & Control of Pollution) Act, 1974

- The Water Act 1974 was enacted in Parliament to prevent and control water pollution and maintaining or restoring of wholesomeness of water.
- This Act is also to prevent the pollution of water by industrial, agricultural and, municipalities including domestic waste water that can contaminate natural water resources.
- Waste waters with high levels of pollutants that enter wetlands, rivers, wells etc cause serious health hazards. Individuals can do several things to reduce water pollution by avoiding chemicals for household use; reducing the use of pesticides in gardens and identifying the polluting sources .

The salient features and provisions of the Act are:

- Maintenance and restoration of quality of all types of surface and ground water.
- Establishment of State boards for pollution control.
- Prevention and control of water pollution.
- Central Government resolve disputes among the states if any arise
- To evolve methods of utilization of sewage and trade effluents in agriculture with proper treatment.

# *The Water ( Pollution) Cess Act 1978*

According to Water ( Pollution ) Cess Act, anyone consuming water has to pay certain amount of cess depending on:

- Whether the industry is using water for industrial purposes , spraying in mining areas or for boilers purpose to produce electricity.
- For domestic purposes.
- In processing units whereby water gets polluted and the pollutants are toxic.

However, those industries that had installed a suitable treatment plant for the treatment of industrial effluents can get a rebate of 70% on the cess payable. The major activities and provisions in the Water ( pollution ) cess Act can be summed up as follows:

- The Water cess Act provides for setting up of National Parks, Wild life Sanctuaries etc.,
- Under the Water cess Act, prohibition of hunting of the endangered species was mentioned. Protection to some endangered plants like Beddome cycas, Blue Vanda Orchid , Lady Sliper Orchid, Pitcher Plant etc. is also included.
- There is a provision for trade and commerce in some wildlife species with license for sale, possession, transfer etc.. This act provides legal powers to officers and punishment to offenders.

# The Air ( Prevention & Control of Pollution ) Act, 1981

- A team of Indians attended UN conference on “Human Environment” which was held at Stockholm ( Europe ) in the month of June 1972. Later the Air Act was enacted in the Indian Parliament in 1981..
- The objective of the Air Act is establishment of Central and State Boards to prevent and control and reduce air pollution. The air act has many sections in which 19, 20, 31A, 37 plays a vital role.

- Section -19 deals with the declaration of measures in case of industries to be established / already established.

For eg: Dust collector, noise recorder in addition to other relevant ones are important measures to establish a crushing unit.

- Section -20 deals the standards for emission of air pollutants.
- Section -31A deals with the closure of industry and disconnecting the electricity.
- Section – 37 deals with the penalties for violation of rules

- The Air Act has made provisions for appeals. An appellate authority consisting of a single person or three persons usually appointed by the Head of the State/the Governor to hear appeals as filed by any aggrieved party (industry ).
- The sources of air pollution such as industries, vehicles, thermal power plants etc are not permitted to release Pb, CO, $SO_2$; $NO_2$; volatile organic compounds, toxic substances beyond a prescribed level.

- The limits of air pollutants (micrograms/$m^3$) in an area are as follows:

| Area | $SO_2$ | $NO_2$ | Pb | CO |
|---|---|---|---|---|
| Industrial | 120 | 120 | 0.75 | 1.00 |
| Domestic | 80 | 80 | 1.50 | 5.00 |
| Hospitals, schools | 30 | 30 | 1.00 | 2.00 |

- The Act is created to take appropriate steps for the preservation of the natural resources of the Earth which ensure the high quality of air and ensures controlling the level of air pollution.

# The Environment ( Protection ) Act, 1986

Important features of this Act are:

- The Central Government put restrictions on an area in which any industry or operations shall not be carried out without any safe-guards.
- Emissions and effluents standards in respect of 61 categories of industries have been evolved and notified.
- Who ever fails (or) violate the environmental pollution Act, be punishable with imprisonment upto 5 years or with fine which may extend to one lakh rupees or both.
- Those industries who require consent under the Environment Act are required to submit an environmental audit report to the concerned Environment Board on or before 30th Sep every year.

# Forest (conservation) Act 1980

The objectives of the Forest ( Conservation ) Act are:

- Restrictions on preservation of forests and use of forest land for other purposes.
- Forest land or any portion thereof may not be used for non-forest purposes.
- Forest land may not be assigned by way of lease to a private person or to any corporation / agency.
- Forest land may not be cleared off trees which have grown naturally in that land.

The State Governments can make avail use of :

- Removal of forest produces, conversion timber etc for proper utilization.
- Granting of license to the agencies / inhabitants to collect timber and forest produce for their own use.
- Granting of license to persons for felled trees / timber and other forest produces for trade purposes.

The Forest (Conservation) Act also include:

- Prohibition of hunting, shooting, fishing, poisoning of water in forest areas.
- No clearance of forest land for cultivation or other purposes
- Protection of timber from fire.

# Salient features of CPCB

- The Central Pollution Control Board is a statutory organization, was constituted in Sep 1974 under the Water (Prevention and Control of Pollution) Act, 1974. CPCB provides technical services to the Ministry of Environment and Forests. The principal functions of the CPCB are:

1. It advises the Central Government in matters related to prevention and control of water pollution.
2. To improve the quality of air and to prevent control air pollution in the country.

3. Organizes training programmes for prevention and control of pollution.
4. Collects, compiles and publish the technical data and statistical data related to pollution.
5. Lays down standards of water quality parameters.
6. Establishes and recognizes laboratories for analysis of water, sewage samples.
7. CPCB has an automatic monitoring station in New Delhi. At this station RSPM ( Respirable Suspended Particulate Matter ); CO; $O_3$; $SO_2$; $NO_2$ etc are being monitored regularly.

- One of the mandates of CPCB is:

to collect, consolidate the statistical data relating to water pollution.

Hence, Water Quality Monitoring ( WQM) is utmost importance.

The State Pollution Control Boards ( SPCB) also have similar functions to be executed at State level and are governed by the directions of CPCB.