Soil Pollution

Definition

Soil pollution is defined as the degradation of soil and land due to industrial, agricultural and by other human activities.

Sources of soil pollution

- Urban wastes
- Industrial wastes
- Agricultural practices
- Soil conditioners
- Farm house waste
- Radioactive pollutants

Biological agents

Urban wastes:

- Urban wastes are classified into domestic and commercial waste
- All solid urban wastes are commonly termed as refuse.
- It contains garbage and rubbish materials like fibres, plastics, papers, bottles, glasses, leaves, street sweepings, abandoned vehicles and discarded products.

Industrial wastes

- Industrial waste mainly consists of organic and inorganic compounds along with non biodegradable materials.
- Textile, steel, paper, chemicals, cement, oil, dyeing and other industries are responsible for soil pollution. Some of the major industries and their contaminant in the soil

Industry Contaminants

- Papermill: chloride, sodium
- Sugar: Nitrogen, phosphorous
- Steel and coke: cyanide, phenols
- Refineries: phosphates, sulphur, chromium, phenol
- Fertilizers: chloride, nitrogen, phosphorous, potassium
- Pesticides: organic nitrogen, sulphate

Agricultural practices

- Most commonly used are insecticides, fungicides, herbicides
- Fertilizers discharge nitrogen, potassium, sulphate, nitrate, etc., in the soil. The

nitrate causes cancer and ***blue baby***.

Soil conditioners

ꕥ The soil conditioners are used to increase the fertility of the soil.

ꕥ These contain toxic metals such as arsenic, cadmium, lead, mercury, etc.

Farm house wastes

ꕥ Increase in population of cows, cattle, pigs, and poultries in the farm house results in the pollution of soil. Their faecal matter mainly consists of phosphate and nitrate which causes undesirable effect.

Radioactive waste

ꕥ Atomic reactor, nuclear radioactive devices releases the radioactive wastes.

ꕥ The radioactive nuclides such as isotopes of Sr90, Iodine129&131, caesium 137, barium 140, deposited on the land and continuously emit gamma radiations.

Biological agents

ꕥ Human, animals and birds excreta and pathogenic agents

ꕥ It is inhabited by bacteria, fungi, algae, protozoans, earthworms, molluscs and anthropoids etc.,

ꕥ These organisms are important agents in increasing and decreasing the soil fertility and physical texture of the soil

Effects of Soil Pollution

ꕥ Organic wastes enter the soil pores and decompose pathogenic bacteria spreading infection.

ꕥ Compounds containing Arsenic, mercury, chromium, Nickel, lead, cadmium, zinc and iron are toxic to life.

ꕥ Excess use of sodium, magnesium, calcium, potassium, sulphur, zinc and iron in the form of fertilizers, and pesticides inhibit plant growths and reduce crop yield.

ꕥ The disposal of cadmium from mining, metallurgy, chemical and electroplating industries cause chronic poisoning, formation of kidney stones.

ꕥ Presence of Arsenic in the soil causes chronic poisoning which leads to loss of appetite and weight, diarrhoea, gastro intestinal problems and sometimes skin cancer.

ꕥ Accumulation of methyl mercury compounds are much toxic than other form of mercury. It causes neurological problems and damages.

CONTROL OF SOIL POLLUTION

ꕥ Preserving the top soil which is the fertile soil. By planting of more trees soil erosion can be controlled.

ꕥ Disposal of properly treated industrial wastes, physically, chemically and biologically causes hazards.

ꕥ Agricultural land in the world is spoiled by soluble salts modern scientific technique can be used to reduce salts flow to soil.

ꕥ Fertilizers may be applied only after estimating soil and crop measures.

ꕥ Solid wastes should be properly collected and disposal off by appropriate method.

ꕥ Cattle dung should be used for methane generation night soil (human fasces) can also be used in the biogas plant to produce inflammable methane gas

Marine Pollution

ꕥ The contamination of sea water mostly by manmade activities thereby adversely affecting the flora and fauna of the marine habitat.

Sources of Marine Pollution

ꕥ According to International Maritime organization (MO), the different sources contributing marine pollution are

ꕥ Land based sources

ꕥ Air based sources

ꕥ Maritime transportation

ꕥ Dumping of wastes

ꕥ Off shore production.

Land based sources

ꕥ Storm water, Pipe lines

ꕥ Rivers, Radioactive wastes

Maritime transportation

ꕥ Disposal of oil during the normal cleaning process

ꕥ Accidental spill of oil.

ꕥ Disposal of garbage generated by the crews of marine vessels (the navy, fishing fleets, pleasure boaters etc.,)

Radio active material

ꕥ Nuclear weapon testing

ꕥ ***Toxic substances***

ꕥ Heavy metals, pesticides and acid rain.

Effect of Marine pollution

Organic matter

ꕥ Decomposition of organic matter present in the untreated or partially treated waste water causes

ꕥ Depletion of dissolved oxygen content of marine water.

ꕥ Death of marine plants and animals.

Eutrophication

ꕥ Disposal of effluent with more nitrogen and phosphorous causes Eutrophication

ꕥ Causes algal blooms which may discolour the water, deficiency of oxygen, toxic.

Pathogenic microorganisms

ꕥ Gastric and ENT infections, hepatitis, cholera and typhoid.

Oil spills –

Spilling of oil and oil products Affects respiration of plants and animals.

Toxic chemicals - Heavy metals, chlorinated hydrocarbons, dioxins and furans

ꕥ Damage the physiological process and functions of reproduction, feeding and respiration.

Pesticides- DDT and other chemicals

ꕥ Reproductive failure in marine mammals and birds.

Radioactive wastes - leakage or failure of radioactive wastes containers

ꕥ Causes more effects that could be devastating.

Thermal pollution

ꕥ Electrical generating plants along the marine coastal lines use of marine waters for cooling purposes.

CONTROL OF MARINE POLLUTION

ꕥ Careful handling of oil and petroleum products.

ꕥ Ban ocean dumping of sludge and hazardous material.

ꕥ Controlled use of pesticides and chemicals in agricultural activities in delta portions.

ꕥ Regulate coastal development

ꕥ Dispose fully treated municipal and industrial wastes.

ꕥ Protect sensitive areas from development, oil drilling and oil shipping.

ꕥ Ban on dumping of radioactive wastes.

NOISE POLLUTION

ꕥ Unwanted sound that produces adverse and harmful effects on living things.

Source of Noise pollution

ꕥ Transportation

ꕥ Industrial operations

ꕥ Air

ꕥ Construction activities

ꕥ Road

ꕥ Celebrations

ꕥ Rail-transportation

ꕥ Electric home appliances

ꕥ Incompatible land use.

Construction noise

ꕥ Earth moving equipment (rollers, tractors etc.,)

ꕥ Material handling equipment (Concrete mixers, pumps etc.,)

ꕥ Stationary equipment(Generators, compressors etc.,)

ꕥ Impact equipment (rock drills, impact pile drives.)

Effects of Noise pollution

ꕥ Physiological effects

ꕥ Head ache

ꕥ Muscular strain

ꕥ Hearing loss

ꕥ Nervous breakdown

ꕥ Heart diseases

ꕥ Emotional disturbances

ꕥ Mental depression

ꕥ Sleep disruption

Control of Noise pollution

ꕥ Earplugs, ear-muffs, noise helmets, head phones etc., may be used as ear protection aids.

ꕥ Provide proper lubrication to the machines.

ꕥ Providing proper maintenance to machines.

ꕥ Industrial zones, aerodromes and highways would be located outside the city limits.

ꕥ Minimum use of loudspeakers

ꕥ Creating public awareness about noise pollution and its effects through news papers, radio and televisions etc.,

THERMAL POLLUTION

Pollution due to heat which changes the physical and chemical properties of water, thus affecting the whole aquatic system.

SOURCES OF THERMAL POLLUTION

ꕥ Industrial waste water

ꕥ Nuclear power plant

ꕥ Domestic sewage

ꕥ Hydroelectric power

ꕥ Coal-fired power plants

Industrial waste water

ꕥ Use of water as a cooling agent in plants (natural gas, coal or nuclear) and factories causes thermal pollution.

Nuclear power plants

ꕥ Nuclear power plants, nuclear explosions, nuclear experiments discharge large amount of heat along with toxic radio nuclides.

Domestic sewage

ꕥ The domestic sewage which contains high BOD, COD and low dissolved oxygen, when discharged into water bodies raises its temperature.

Hydroelectric power

ꕥ Electric Power industries with cooling arrangements cause thermal pollution in receiving water bodies.

Coal Fired Power plants

ꕥ Many thermal power plant use coal as a fuel for producing electricity.

ꕥ Their condenser coils are cooled with water from nearby river or other water body.

This lowers the dissolved oxygen of water.

EFFECT OF THERMAL POLLUTION

ꕥ Reduction in Dissolved oxygen

ꕥ Change in water properties

ꕥ Increase in toxicity

ꕥ Effect on marine life

ꕥ The rate of photosynthesis

ꕥ Increased bacterial growth.

CONTROL OF THERMAL POLLUTION

ꕥ Temperature of water can be reduced by taking the water to wet or dry cooling towers used to pre-cool the water.

ꕥ Discharging the heated water into shallow ponds or canals, allowing it to cool, and reusing it as cooling water.

Artificial lakes

ꕥ 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.

ꕥ The heat is evaporated through dissipation in this method.

Nuclear Hazards (Radioactive pollution)

ꕥ Radioactive pollution is a special form of physical pollution of air, water, land with radioactive materials.

Radioactivity

ꕥ Is a property of certain elements (Ra, Th, U etc.,) to spontaneously emit protons (alpha particles) electrons(beta particles) and gamma rays(short wave electromagnetic waves) by disintegration of their atomic nuclides.

Sources of Radioactive pollution

ꕥ Natural sources

ꕥ Man-made sources

1. **Natural sources**

ꕥ The natural source of radioactivity

ꕥ Mainly of cosmic radiation - space

ꕥ Naturally occurring isotopes- environment.

ꕥ E.g. Radium-224, uranium-238, thorium-232 etc.,

2. **Man-made sources**

ꕥ By testing of nuclear weapons

ꕥ Establishment of nuclear power plants

ꕥ Refining of plutonium and thorium

ꕥ Preparation of radioactive isotopes.

EFFECTS OF RADIO ACTIVE POLLUTION

Damages at molecular level

ꕥ Damages to macromolecules such as enzymes, DNA, RNA, etc., through ionization.

Damages at sub-cellular level

ꕥ Damages to cell membranes nuclei, chromosomes such as fragmentation, mitochondria,

etc.

Damages to tissues and organs

- Central nervous system
- Loss of sight
- Inactivation of bone marrow and ulceration.
- Death or Shortening of life.

CONTROL OF RADIOACTIVE POLLUTION

- Nuclear devices should never be exploded in air. If these activities are extremely necessary, then they should be exploded underground.
- Leakage of radioactive elements from reactors and laboratories, processing or using them should be totally checked.
- In nuclear and chemical industries, the use of radioactive isotopes may be carried under a jet of soil or water instead of powder or gaseous forms.
- In nuclear mines, wet drilling may be employed along with underground drainage.
- Extreme care should be exercised in the disposal of industries wastes contaminated with radio nuclides.

Disaster Management

Introduction

Disasters have been mankind's constant though inconvenient companion since time immemorial. Natural disasters continue to strike unabated and without notice and are perceived to be on the increase in their magnitude, complexity, frequency and economic impact globally. These disasters pose a threat to people, structures, economic assets and assume disastrous proportions when they occur in areas of dense human habitations. Since 1960, natural disasters have resulted in the loss of more than three million lives and affected many more. The economic costs are on the rise in alarming proportions, which has increased by a factor of 8 presently as compared to the 1960s. At world wide, 90% of the natural disasters and 95% of the total disaster related deaths occur only in developing countries. It is because most of the world's worst disasters tend to occur between the area of Tropic of Cancer and the Tropic of Capricorn. This area is inhabited by the poorer countries of the world, where the problems of disaster management are unique due to the seemingly competing needs between basic necessities for people and economic progress.

SEWERAGE SYSTEM

SEWAGE:

It is a dilute mixture of the wastes of various types from the residential, public and industrial places. It includes sullage water and foul discharge from the water closets, urinals, hospitals, stables, etc.

STORM WATER:

It is the surface runoff obtained during and after the rainfall which enters sewers through inlet. Storm water is not foul as sewage and hence it can be carried in the open drains and can be disposed off in the natural rivers without any difficulty.

SANITARY SEWAGE:

It is the sewage obtained from the residential buildings & industrial effluents establishments. Being extremely foul it should be carried through underground conduits.

DOMESTIC SEWAGE:

It is the sewage obtained from the lavatory basins, urinals &water closets of houses, offices & institutions. It is highly foul on account of night soil and urine contained in it. Night soil starts putrefying & gives offensive smell. It may contain large number of bacteria due to the excremental wastes of patients. This sewage requires great handling & disposal.

INDUSTRIAL SEWAGE:

It consists of spent water from industries and commercial areas. The degree of foulness depends on the nature of the industry concerned and processes involved.

SEWERS:

Sewers are underground pipes which carry the sewage to a point of disposal.

SEWERAGE:

The entire system of collecting, carrying &disposal of sewage through sewers is known as sewerage.

DRY WEATHER FLOW (DWF):

Domestic sewage and industrial sewage collectively, is called as DWF. It does not contain storm water. It indicates the normal flow during dry season.

SLUDGE:

It is the organic matter deposited in the sedimentation tank during treatment.

SEWERAGE SYSTEMS:

1) SEPARATE SYSTEM OF SEWAGE
2) COMBINED SYSTEM OF SEWAGE
3) PARTIALLY COMINED OR PARTIALLY SEPARATE SYSTEM

1. **SEPARATE SYSTEM OF SEWERAGE**

In this system two sets of sewers are laid. The sanitary sewage is carried through sanitary sewers while the storm sewage is carried through storm sewers. The sewage is carried to the treatment plant and storm water is disposed of to the river.

ADVANTAGES:

1) Size of the sewers are small
2) Sewage load on treatment unit is less
3) Rivers are not polluted
4) Storm water can be discharged to rivers without treatment.

DISADVANTAGES

1) Sewerage being small, difficulty in cleaning them
2) Frequent choking problem will be their
3) System proves costly as it involves two sets of sewers
4) the use of storm sewer is only partial because in dry season they will be converted in to dumping places and may get clogged.

2. **COMBINED SYSTEM OF SEWAGE**

When only one set of sewers are used to carry both sanitary sewage and surface water. This system is called combined system. Sewage and storm water both are carried to the treatment plant through combined sewers

ADVANTAGES:

1) Size of the sewers being large, chocking problems are less and easy to clean.
2) It proves economical as 1 set of sewers are laid.
3) Because of dilution of sanitary sewage with storm water nuisance potential is reduced

DISADVANTAGES:

1) Size of the sewers being large, difficulty in handling and transportation.
2) Load on treatment plant is unnecessarily increased
3) It is uneconomical if pumping is needed because of large amount of combined flow.
4) Unnecessarily storm water is polluted.

3. PARTIALLY COMINED OR PARTIALLY SEPARATE SYSTEM

A portion of storm water during rain is allowed to enter sanitary sewer to treatment plants while the remaining storm water is carried through open drains to the point of disposal.

Advantages: -

1. The sizes of sewers are not very large as some portion of storm water is carried through open drains.
2. Combines the advantages of both the previous systems.
3. Silting problem is completely eliminated.

Disadvantages: -

Suitable conditions for separate sewerage systems: -

A separate system would be suitable for use under the following situations:

1. Where rainfall is uneven.
2. Where sanitary sewage is to be pumped.
3. The drainage area is steep, allowing to runoff quickly.
4. Sewers are to be constructed in rocky strata. The large combined sewers would be more expensive. Suitable conditions for combined system: -

1. Rainfall in even throughout the year.
2. Both the sanitary sewage and the storm water have to be pumped.
3. The area to be sewered is heavily built up and space for laying two sets of pipes is not enough.
4. Effective or quicker flows have to be provided.

After studying the advantages and disadvantages of both the systems, present day construction of sewers is largely confined to the separate systems except in those cities where combined system is already existing.

Sources of Sewage: -

Sanitary sewage is produced from the following sources:

1. When the water is supplied by water works authorities or provided from private sources, it is used for various purposes like bathing, utensil cleaning, for flushing water closets and urinals or washing clothes or any other domestic use. The spent water for all the above needs forms the sewage.
2. Industries use the water for manufacturing various products and thus develop the sewage.
3. Water supplied to schools, cinemas, hotels, railway stations, etc., when gets used develops sewage.
4. Ground water infiltration into sewers through loose joints.
5. Unauthorized entrance of rain water in sewer lines.

Nature of Sewage: -

Sewage is a dilute mixture of the various types of wastes from the residential, public and industrial places. The characteristics and composition i.e., the nature of sewage mainly depends on this source. Sewage contains organic and inorganic matters which may be dissolved, suspension and colloidal state. Sewage also contains various types of bacteria, virus, protozoa, etc. sewage may also contain toxic or other similar materials which might have got entry from industrial discharges. Before the design of any sewage treatment plant the knowledge of the nature of sewage is essential.

Quantity of Sanitary Sewage and Storm Water: -

The determination of sanitary sewage is necessary because of the following factors which depend on this:

1. To design the sewerage schemes as well as to dispose a treated sewage efficiently.
2. The size, shape and depth of sewers depend on quantity of sewage.
3. The size of pumping unit depends on the quantity of sewage.

Estimate of Sanitary Sewage: -

Sanitary sewage is mostly the spent water of the community into sewer system with some groundwater and a fraction of the storm runoff from the area, draining into it. Before designing the sewerage system, it is essential to know the quantity of sewage that will flow through the sewer. The sewage may be classified under two heads:

1. The sanitary sewage, and
2. Storm water

Sanitary sewage is also called as the Dry Weather Flow, which includes the domestic sewage obtained from residential and residential and industrials etc., and the industrial sewage or trade waste coming from manufacturing units and other concerns. Storm water consists of runoff available from roots, yards and open spaces during rainfall.

Design Discharge of Sanitary Sewage

The total quantity of sewage generated per day is estimated as product of forecasted population at the end of design period considering per capita sewage generation and appropriate peak factor. The per capita sewage generation can be considered as 75 to 80% of the per capita water supplied per day. The increase in population also result in increase in per capita water demand and hence, per capita production of sewage. This increase in water demand occurs due to increase in living standards, betterment in economical condition, changes in habit of people, and enhanced demand for public utilities. Factors affecting the quantity of sewage flow: -

The quantity of sanitary sewage is mainly affected by the following factors:

1. Population
2. Type of area
3. Rate of water supply
4. Infiltration and exfiltration

In addition to above, it may also be affected by habits of people, number of industries and water pressure etc.

Population: -

The quantity of sanitary sewage directly depends on the population. As the population increases the quantity of sanitary sewage also increases. The quantity of water supply is equal to the rate of water supply multiplied by the population. There are several methods used for forecasting the population of a community.

Type of area covered: -

The quantity of sanitary sewage also depends on the type of area as residential, industrial or commercial. The quantity of sewage developed from residential areas depend on the rate of water supply to that area, which is expressed a litres/ capita/ day and this quantity is obtained by multiplying the population with this factor. The quantity of sewage produced by various industries depends on their various industrial processes, which is different for each industry. Similarly, the quantity of sewage obtained from commercial and public places can be determined by studying the development of other such places.

Rate of water supply: -

Truly speaking the quantity of used water discharged into a sewer system should be a little less than the amount of water originally supplied to the community. This is because of the fact that all the water supplied does not reach sewers owing to such losses as leakage in pipes or such deductions as lawn sprinkling, manufacturing processes etc. However, these losses may be largely be made up by such additions as surface drainage, groundwater infiltration, water supply from private wells etc. On an average, therefore, the quantity of sewage maybe considered to be nearly equal to the quantity of water supplied.

Groundwater infiltration and ex-filtration: -

The quantity of sanitary sewage is also affected by groundwater infiltration through joints. The quantity will depend on, the nature of soil, materials of sewers, type of joints in sewer line, workmanship in laying sewers and position of underground water table.

Infiltration causes increase to the ―legitimate‖ flows in urban sewerage systems. Infiltration represents a slow response process resulting in increased flows mainly due to seasonally-

elevated groundwater entering the drainage system, and primarily occurring through defects in the pipe network.

Exfiltration represents losses from the sewer pipe, resulting in reduced conveyance flows and is due to leaks from defects in the sewer pipe walls as well as overflow discharge into manholes, chambers and connecting surface water pipes. The physical defects are due to a combination of factors including poor construction and pipe joint fittings, root penetration, illicit connections, biochemical corrosion, soil conditions and traffic loadings as well as aggressive groundwater. It is clear that Infiltration and Exfiltration involve flows passing through physical defects in the sewer fabric and they will often occur concurrently during fluctuations in groundwater levels, and particularly in association with wet weather events; both of which can generate locally high hydraulic gradients. Exfiltration losses are much less obvious and modest than infiltration gains, and are therefore much more difficult to identify and quantify. However, being dispersed in terms of their spatial distribution in the sewer pipe, exfiltration losses can have potentially significant risks for groundwater quality. The episodic but persistent reverse pumping effect of hydraulic gain and loss will inevitably lead to long-term scouring of pipe surrounds and foundations resulting in pipe collapse and even surface subsidence.

Design Period

The future period for which the provision is made in designing the capacities of the various components of the sewerage scheme is known as the design period. The design period depends upon the following:

- Ease and difficulty in expansion,
- Amount and availability of investment,
- Anticipated rate of population growth, including shifts in communities, industries and commercial investments,
- Hydraulic constraints of the systems designed, and
- Life of the material and equipment.

Ventilation of Sewer

Sewage flowing in sewer has got lot of organic and inorganic matters present in it. Some of the matters decompose and produce gases. These gases are foul smelling, corrosive and explosive in nature. If these gases are not disposed of properly, they may create a number of difficulties. They may cause air locks in sewers and affect the flow of sewage. They may prove to be dangerous for the maintenance squad working in sewers. They may also cause

explosions and put the sewer line out of commission. For the disposal of these gases, ventilation of sewer line is a must.

Methods of Ventilation

Following are some of the means or fittings which help in the ventilation of sewers,

1. Laying sewer line at proper gradient.
2. Running the sewer at half full or 2/3 depth.
3. Providing manhole with gratings.
4. Proper house drainage.
5. Providing the ventilating columns or shafts.

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