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MB3610 Waste Management

A] Liquid waste management -

I] Principles of Wastewater Treatment -

i) The need for treatment of wastewater -

- wastewater is nothing but used water from residential, commercial, industrial or agricultural operations as well as surface runoffs.
- Waste water is generally termed as sewage or municipal waste water or domestic waste water.
- waste water treatment plays very important role in conserving our environment.
- The main goal of waste water treatment is to eliminate suspended solids & discharge the effluent back to the water bodies.
- complex organic compounds of waste water can be converted to simpler one by using biological tretment (micro organisms) & physico-chemical treatment methods.
- If waste water is not disposed properly, it could lead

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to hazardous effects like -

i) A significant amount of harmful gases are produced when organic things decompose.

ii) If untreated sewage is dumped into the water bodies, it will result into increased Biochemical oxygen demand (BOD). Thus, dissolved oxygen (DO) of water bodies will get depleted & result in adverse effect on aquatic flora.

iii) when water bodies become enriched with nutrients, it results in increase in the amount of plant & algal growth. this increased plant & algal growth is termed as eutrophication.

iv) untreated wastewater contains pathogenic microorganisms & toxic compounds that are present in human intestinal tract or in certain industrial waste.

These may lead to contamination of the land or the water

body, where such sewage is disposed. So waste needs to be treated properly.

v) The treatment of sewage is now essential as it prevents the spread of infection

vi) It helps society to keep water & environment clean.

ii) General characteristics of liquid waste -

i) PH -

- water's acidity or basicity can be determined by its pH.
- The pH range for agricultural water is typically between 6.5 & 8.4, pH levels outside of this range indicate that water's quality is irregular.
- A common test to evaluate the qudlity of irrigation water is pH.

ii) Color / Colour -

- The colour of fresh sewage is a light brownish grey.
- sewage will mature in 2 to 6 hours at a temperature of

20°c or above.
- Anaerobic processes turn the old sewage into a dark grey & black tint that is referred to as the 'stale' or 'septic' colour.
- Domestic wastewater gains colour from some industrial sewage.
- The grey, dark grey & black colours are produced when metals in wastewater interact with the sulphide created under anaerobic conditions.

iii) Turbidity – (गंदलापन)
- The amount of colloidal & domestic suspended matter in waste discharges & natural waterways is assessed using measurements of water's light transmission.
- Based on analysis of the light intensity scattered by a sample & a reference suspension under identical conditions the main reference standard

Total suspended solids (TSS) → clay, silt

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is formazine suspensions.
- Nephelometric turbidity units were used to express the turbidity results (NTU).
- Turbidity & TSS are associated in the secondary effluent from the activated sludge process that has been settled & filtered.
- A high turbidity indicates that the water contains a lot of tiny particles. Low turbidity indicates the water is clean because there aren't many particles in it.
- Treatment procedures aim for a low turbidity, just like with industrial wastewater & the efforts to comply with discharge permit rules for reuse. high turbidity is typically a sign that your wastewater treatment systems require maintance.

iv) odour
- when sewage is fresh, it typicaly has a musty smell

that is not unpleasant but as it ages, it develops an unpleasant smell. After 3 to 4 hours, all the oxygen in the sewage gets depleted & the anaerobic micro organisms that make the sulphur compounds that give off the foul smell of hydrogen sulphide & other gases begin to grow.

- Either wastewater treatment procedures may be present in industrial wastewater.
- The negative effects of offensive odors can include i) decreased appetite, ii) decreased water intake, iii) breathing difficulties, nausea etc. vomiting & iv) mental disturbance.
- An important factor in the design & operation of wastewater collection, disposal facilities & treatment, is now the eradication of odors.

v) Electrical conductivity:-
- The total ionised components of water are commonly determined through electrical conductivity.
- It is directly related to the chemically determined sum of the cations & is closely related to the overall salt content (or anions).
- electrical conductivity may be determined quickly & rather precisely & values are always given at 25°C in order to compare readings obtained under various environmental circumstances.
- It should be remembered that for every 1°C rise in temp. the electrical conductivity of solutions increases by around 2%.

vi) COD - (chemical oxygen demand)

a) oxygen consumed -
- consumed oxygen is the oxygen needed to oxidize carbonaceous material. A specified amount of potassium permanganate & diluted sulphuric acid

are added up to a sample of wastewater to assess the amount of oxygen present.
- At a constant temp of 18°C, the reaction is allowed to carry out for time span of 15 minutes & 4 hours.
- The wastewater consumes the oxygen that the potassium permanganate releases.
- The purpose of this test as opposed to the BOD test, is to determine the sewage's relative potency.
- The amount of oxygen required for the complete or majority biological oxidation of the organic matter is not provided by this test though.

b) Dissolved oxygen - (DO):-
- The volume of oxygen that is dissolved into the waste water is called as dissolved oxygen (DO).
- Despite the fact that untreated wastewater often

does not include DO. its presence suggests that the wastewater is fresh.
- In a similar vein, its presence in treated waste effluent indicates that significant oxidation has occurred during the treatment phases.
- It is crucial to make sure that the treated wastewater contains at least 4 P.P.M. of DO before releasing it into receiving waterways.

⇒ Oxygen demand -
- For living things to exist, there must be oxygen present.
- wastewater only undergoes aerobic activity while oxygen is available. if oxygen is absent, putrefaction results from anaerobic action. In order to oxidize both inorganic & organic materials, wastewater must include oxygen demand of oxygen can be determined in the following ways - like CoD & BoD

vii)- BOD :-

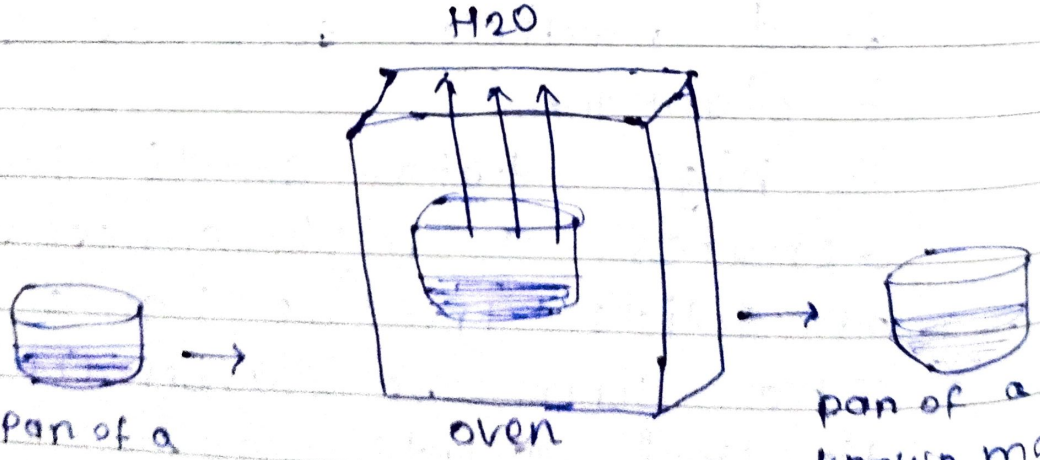
- The biochemical oxygen demand is a measurement of the amount of oxygen needed for a sample's organic matter to be oxidised by the wastewater's sample's microorganisms.
- It is the most often utilised indicator of organic contamination in surface water & wastewater.

- COD-

- usually, 5 days are required for BOD test, and as a result, it is useless for monitoring treatment procedures.
- The COD test is an alternate method for determining the amount of organic matter in both natural waterways & wastewater.
- In contrast to a BOD test that takes five days, COD can only be determined in 3 hours.

- Total solids -
- Total solids describe the matter that is suspended or dissolved in water / wastewater & is correlated to both turbidity & specific conductance.
- Total solids, also known as total residue, is the term used to describe the material that remains in a container after a water sample has evaporated & dried.
- The sample's total solids are made up of all the dissolved, colloidal, & suspended solids.
- This includes dissolved salts such as sodium chloride (NaCl) & solid particles such as silt & plankton.
- A high total solids level denotes a high concentration of solids in the liquid sample.
- The sum of suspended & dissolved solids, as well as organic & inorganic materials, is known as Total solids.

- Average domestic wastewater contains almost equal amounts of organic & inorganic solids, with around two thirds of the total solids being dissolved & the remaining one third being in suspension.
- The amount of solids in a sample with a known volume is weighed to determine the total solids.
- for this, a beaker is weighed a known volume of liquid is added, the water is evaporated in an oven, the residue is totally dried, & finally the beaker is weighed with the liquid.
- Analysis of Total solids ⇒



pan of a known mass (M_{pan}) filled with a known volume of sample

pan of a known mass with the mass of solids from the sample ($M_{pan} + M_{solids}$)

$M_{solids} = (M_{pan} + M_{solids}) - (M_{pan})$

- TDS - (Total dissolved solids) -
- TDS is the amount of inorganic salts & small amounts of organic matter dissolved in water.
- TDS is measured in milligrams per liter (mg/L), also known as parts per million (ppm).
- TDS can affect the taste of water & the drinking water have a maximum of 500ppm TDS.
- water with very low TDS concentration may also be ~~undesi~~ undesirable because it can taste flat.
- Total dissolved solids can originate from a variety of places.
- Sewage, water treatment chemicals, agricultural runoff, & industrial effluent all have the potential to leach materials into water.
- There are several methods for lowering TDS levels in water like Reverse osmosis, water distillation, Deionization.

- Total suspended solids -
- Total suspended solids, (TSS) are waterborne particles larger than 2 microns, on the other hand, every particle less than 2 microns is referred to be a completely dissolved solids (TDS).
- Algae & bacteria can also be categorized as TSS, however inorganic materials make up the majority of TSS due to their floating or suspended nature in water. Sand, silt & plankton are all instances of TSS.
- Most common suspended solids:
  Bacteria → germs that can cause illness.

  clay → May not be hazardous to health when taken in tiny amounts, it is notoriously difficult to remove & may alter the flavor & odor of water.

- Gravel → Another kind of material that makes water appear dead,

$MgCl_2$
NaCl

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muckf or hazy is geared.
- sand and silt.

- Total volatile solids-
- A substance known as a volatile solid is one that may easily transit from its solid phase to its vapor phase without going through a liquid phase.
- The amount of organic solids in water is often represented by volatile solids, which are crucial for the treatment of both water & wastewater.
- waste concentration is typically determined by the amount of volatile solids present in the wastewater.
- wastewater gets stronger when the more volatile solids there are in it.

- Chloride
- The salt compound chloride is produced when a metal & chlorine gas are combined.

- magnesium chloride & sodium chloride are two examples of common salts.
- The biggest sources of chlorides in water are industrial activities including making batteries, pulp mills, refining bullion, electroplating, making pesticides & a lot of small-scale processing facilities.

- sulphates -
- The efficient treatment of wastewater is a major obstale to industrial progress and it has also emerged as a critical issue.
- different methods, including the activated sludge process, membrane sepration, & adsorption, can be used to treat the organic & inorganic contaminants in liquid wastes.
- for impurities like H_2S vapour chemical processes including adsorption, oxidation & biofiltration are used
- Treatment can make use of

membrane technology. Hydrogen sulphide, sulphur dioxide, carbon dioxide, & carbon monoxide are some of the contaminants found in the wastewater.

- Bacteria may incompletely oxidise, H_2S gas in the sewage, to sulphuric acid after it has been absorbed in the thin water film that typically coasts the sewer walls.
- Bacterial colonies grow when urban or industrial wastewater contains bacteria with favorable nutritional dosages & mixed with facultative habitats, or space above the water.

- oil and Grease -
- oil & Grease in liquid waste, also known as fats, oils & grease (FOG) can be found in wastewater & other liquid waste.
- sludge ⇒ The term for fats, grease & oil that float on top of liquid waste water.
- wastewater ⇒ Includes household sewage, industrial wastewater,

runoff waste & more.
- liquid waste ⇒ Includes grease trap waste, septage, chemical toilet waste & hazardous waste.

- oil & grease can cause problems if not removed before waste water is discharged.
- Blockages ⇒ oil & grease can build up in pipes & create blockages that can lead to raw sewage backing up into homes, businesses or neighboring properties.
- Aquatic life ⇒ spilled oil & grease can deplete oxygen in water, which can suffocate aquatic life.
- films ⇒ oil & grease can create unsightly films in surface waters.