

Wastewater and Sewage Treatment

Introduction

- Wastewater is domestic sewage or liquid industrial waste that can't be discarded in untreated form into lakes
- Due to public health, economic, environmental and aesthetic consideration
- Physical, chemical and use of microbe
- Effluent water released into water body

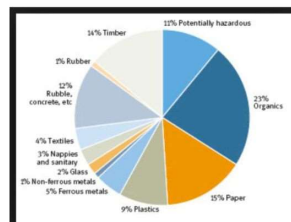
Wastewater and Sewage

- Sewage is liquid effluent contaminated with human or animal fecal materials
- Type wastewater from domestic, commercial and industrial sources carried by sewer
- Waste generated by community;
 - Domestic waste water from bathroom, toilets, kitchen sinks, wash basins ..etc

- Raw or treated industrial waste water discharged in sewage
- Rainwater and urban run off
- Composition vary from place to place
- Suspended solid, soluble organic comp., fecal pathogenic microorganisms
- Heavy metals, trace elements, detergents, solvents, pesticides

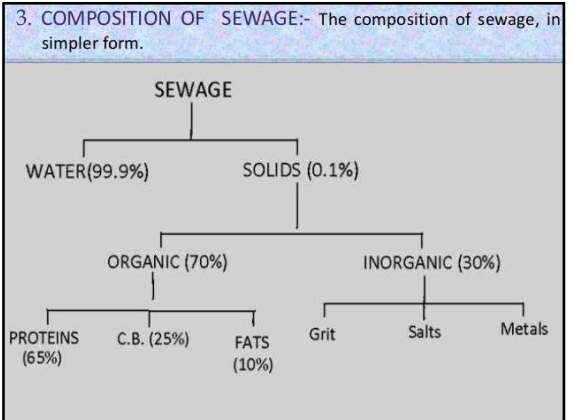
Composition of wastewater

- Water (more than 95 percent)
- Pathogens such as bacteria, viruses, prions and parasitic worms
- Non-pathogenic bacteria
- Organic particles such as feces, hairs, food, vomit, plant materials, humus etc
- Soluble organic material such as urea, sugars, soluble proteins, drugs, pharmaceuticals
- Inorganic particles such as sand, grit, metal particles, ceramics etc



- Pharmaceuticals and Antibiotics
- Toxic compounds, oil from cars through urban run off
- Water = 99.9%
- Solid = 0.01%
 - Organic = 70%
 - Inorganic = 30%

- In organic;
 - Proteins = 65%
 - Carbohydrates = 25%
 - Fats = 10%
- In inorganic;
 - Grit
 - metals

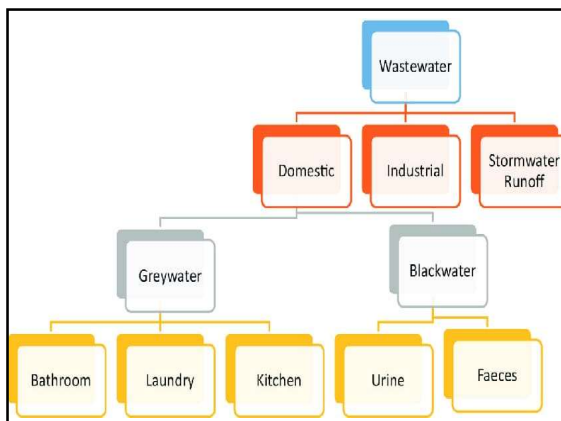


Types of Sewage

- Sewage is classified into three types
 - 1) Domestic Sewage
 - bathroom, kitchen, wash basins
 - Household waste
 - 2) Industrial waste
 - Petrochemical, pesticides, food and dairy, pharmaceutical, metallurgical industry

3) Storm Sewage

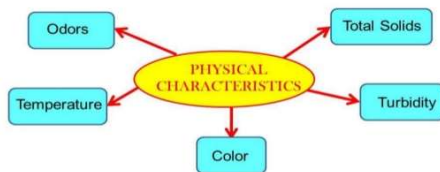
- Rainfall
- Snowfall
- Melted ice



Characteristics OF SEWAGE / Waste water

- The Characteristics of sewage are classified as follows:
 1. Physical characteristics
 2. Chemical characteristics and
 3. Biological characteristics

1. Physical characteristics



A. Color :

Color is due to the suspended and other matters found in wastewater.

If sewage is fresh it has a soap solution color i.e **grey-brown** and decomposed sewage has **dark grey color**.

B. Odour:

Fresh sewage is of **soapy or oily odour** but stale sewage has **offensive odour** due to H_2S , CH_4

• C. Temperature:

Generally sewage has slightly higher temperature than the water which increases the biological activities. 40 degree C.

D . Turbidity :

It is very turbid than water due to the presence of high suspended and other

Turbidity

- Sewage is normally turbid representing dirty dish water or wastewater from baths having other floating matter like fecal matter, pieces of paper, cigarette ends, match sticks, greases, vegetable debris, fruit skins, soaps, etc.. The turbidity depends on the quantity of solid matter present in suspension state. The turbidity depends on the quantity of solid matter present in suspension state. The turbidity can be determined by the turbidity rod or by turbidimeters e.g. Nephelometric

E. Solids : 350-1200 mg/L

- Though sewerage typically contains lower than zero to 0.5 % solids, the remainder being water, still the nuisance caused by the solids cannot be unnoted, as these solids are extremely degradable and so want correct disposal.
- The sewerage solids could also be classified into dissolved solids, suspended solids and volatile suspended solids.

- Data of the volatile or organic fraction of solid, that decomposes, becomes necessary, as this constitutes the load on biological treatment units or resources of a stream once sewerage is disposed off by dilution.
- The estimation of suspended solids, each organic and inorganic, provides a general image of the load on deposit and grit removal system throughout sewerage treatment. Dissolved inorganic fraction is to be thought-about once sewerage is employed for land irrigation or the other utilize is planned.

Chemical Characteristics

- 1) pH
- 2) Gases
- 3) Inorganic compounds
 - Chlorides, Nitrogen compounds
 - P, S, Heavy metals etc
- 4) Organic compounds
- 5) Oxygen demand

• a. pH

- The hydrogen ion concentration expressed as pH scale, could be a valuable parameter within the operation of biological units.
- The pH scale of the contemporary sewerage is slightly quite the water provided to the community. However, decomposition of organic matter might lower the pH scale, whereas the presence of business waste material might manufacture extreme fluctuations typically **the pH scale of raw sewerage is within the vary 5 to 8.0.**

Sulphides, Sulphates and Hydrogen Gas

- Sulphides and sulphates are formed due to the decomposition of various sulphur containing substances in sewage. This decomposition also leads to evolution of hydrogen sulphide gas, causing bad odours, besides causing corrosion of concrete sewer pipes.
- In aerobic digestion of sewage, the aerobic and facultative bacteria oxidizes the sulphur and its compounds present in the sewage to initially form sulphides, which ultimately breakdown to form sulphates ions, which is a stable and unobjectionable end products.
- In an-aerobic digestion of sewage the anaerobic and facultative bacteria reduce the sulphur and its compounds into sulphides, with evolution of H_2S gas along with methane and carbon dioxide, thus causing very obnoxious odours.

Chlorides Contents

- Chlorides are generally found in sewage and are derived from kitchen wastes, human feces and urinary discharges. The normal chloride content of sewage is 120 mg/lit, whereas the permissible limit of chloride content in water is 250 mg /lit.
- However, large amount of chlorides may enter from industries like ice cream plants, meat salting etc.. Hence, when the chloride content of a given sewage is found to be high, it indicates the presence of industrial wastes or infiltration of seawater, thereby indicating strength of sewage.
- It can be determined by titrating the wastewater with standard silver nitrate solution using potassium chromate as indicator.

Nitrogen Content (Nitrogen Compounds)

- The presence of nitrogen in sewage is an indication of the presence of the organic matter and may occur in one or more of the following forms:
- **Free ammonia called ammonia nitrogen**
- **Albuminoid or Organic Nitrogen**
- **Nitrites**
- **Nitrates**

Nitrogen Content (Nitrogen Compounds)

- Nitrites are dangerous but as oxidation of nitrites to nitrates is very fast it is generally not found in water bodies.
- As Nitrates represent fully oxidized matter its presence in sewage is not dangerous. But if the sewage contains higher nitrates and if it is disposed of in a water body then the nitrates content in the water body would increase. Higher quantity of nitrates adversely affects the health of infants, causing a disease called methemoglobinemia (commonly called as blue baby disease). Children suffering from this disease may vomit; their skin colour may become dark and may die in extreme case.
- Nitrites and Nitrates are measured by colour matching techniques.

Toxic

- Copper, lead, silver, chromium, arsenic, phenols, boron, cyanides, etc.. are some of the toxic compounds affecting the microorganisms resulting in malfunctioning from industrial waste.

Fats, Oils and Greases

- Fats, oils and greases are derived in sewage from the discharge of animals and vegetable matter, or from the garages, kitchens of hotels and restaurants, etc..
- Such matter form scum on the top of the sedimentation tanks, clogs the voids of the filter media and affects the diffusion of oxygen. They thus interfere with the normal treatment methods. Hence these detection and removal is important.
- Oils and greases are soluble in ether. Hence for their determination, a sample of sewage, sample is first of all evaporated, leaving behind the oil and grease as a residue, which is then weighed.

Biochemical Oxygen Demand

There are two types of organic matter

- (i) Biodegradable or biologically active
- (ii) Non biodegradable or biologically inactive
- Organic matter is often assessed in terms of oxygen required to complete oxidize the organic matter to CO_2 , H_2O , and other end products of Oxidation.
- **Biochemical Oxygen Demand (BOD)** is defined as the amount of oxygen required by the microorganisms (mostly bacteria) to carry out decomposition of biodegradable organic matter under aerobic conditions.

• DO (Dissolved Oxygen):

It is the amount of oxygen dissolved in waste water. Presence it indicates the sewage is fresh or oxidation has been occurred after treatment. It is necessary to ensure at least 4 ppm of DO in stream in which treated wastewater is disposed otherwise fish are likely to be killed.

• BOD (Biochemical Oxygen Demand)

BOD is defined as the amount of oxygen required for the bacteria to oxidize the *organic* matter present in the sewage.

BOD – 80 mg/L

• COD (Chemical Oxygen Demand)

- It is defined as the amount of oxygen required for chemical oxidation of organic matters readily oxidizable carbonaceous and other matter.
- **COD – 150 mg/L**

3. Biological characteristics

- Domestic sewage consists of various types of plant or animal microorganism and the biological characteristic of sewage is related to the presence of these microorganisms.
- This microorganism whose presence is 22 — 25 millions numbers in a liter of sewage may be pathogenic, indicator organisms etc. The main source of pathogenic microorganism is excreta from sick people and these organisms require living tissues to grow and reproduce and harmful to man.

- The bacterium which needs **free oxygen to survive** is called **aerobic bacteria** and which **survives without free oxygen** is called **anaerobic bacteria** and which **survives in presence or absence of free oxygen** is called **facultative bacteria**.
- The decomposition of sewage is possible due to these bacteria.