AI 3010 WASTE AND BY PRODUCT UTILIZATION

UNIT II NOTES

Wastewater characteristics

Wastewater is characterized according to its physical, chemical and biological composition. Depending on the level of pollutants and local regulations, physical, chemical and/or biological treatment will be used. Most of the time, the three treatments are combined to obtain the best water quality. Wastewater characteristics vary considerably from industry to industry. Therefore, the specific characteristics will determine the treatment techniques to be used to satisfy the compliance discharge requirements. Due to the large number of pollutants, characteristics are generally not considered for each substance. Materials with similar pollution effects are grouped into pollutant or characteristic classes.

characteristics of waste water

- **Temperature:**

The temperature has an effect on the biological activity of bacteria present in the sewage and it also affects the solubility of gases in sewage. It also affects the viscosity of sewage (more is the temperature, lesser is the viscosity of sewage). • The normal temperature, of sewage is slightly higher than the temperature of the water supply because of the additional heat due to utilization of water. Also when the wastewater flows in a closed pipes, its temperature future increases. • The average temperature of sewage in India is about 20 0 C which is near about ideal temperature of sewage for biological activities. At higher temperature coupled with the lower dissolved oxygen activities can cause serious problems in disposal of waste water.

- **Color:**

The colour of the sewage indicates the freshness of sewage. If it's colour is greyish brown or yellowish, it indicates fresh sewage. With passage of time, as putrefaction starts it begins to get black. The colour of stale and septic sewage is black(When all the oxygen has disappeared from sewage, it becomes septic). Other colors may also be formed due to presence of some specific industrial waste. The color of the sewage can normally be detected by the naked eye.

- **Odor:**

The odour of a fresh sewage is not offensive or practically it can be considered odourless, but as it starts to get stale, it begins to give offensive odour. Within 3 to 4 hours, all oxygen

present in the sewage gets exhausted and it starts emitting offensive odour by hydrogen sulphide gas which is formed due to anaerobic decomposition of sewage.

- **Turbidity:**

Turbidty in wastewater treatment describes the clarity or haziness of a wastewater sample. **The level of cloudiness or the presence of suspended particles in the wastewater sample is usually measured in FTU.** FTU stands for Formazin Turbidity Unit. Samples with less than 20 FTU are very clear whereas samples with 500FTU and more become completely opaque.

One common method to measure wastewater turbidity is called **Nephelometry** which uses scattered light. ISO 7027 and E-P-A 180.1 allow only infra-red 860nm or white light 500nm as light sources for the test.When the light source hits the wastewater sample, suspended particles will reflect the incoming light.

Depending on the shape, density and size of the particles the light will be scattered in different directions. Smaller particles tend to reflect light into perpendicular direction whereas bigger particles scatter light in more directions.

Sensors around the wastewater sample can measure how much light was reflected and in which direction it was scattered. This allows to determine the sample turbidity but it also provides information on amount of total suspended solids and particle sizing.

Turbidity in wastewater is caused when small particles mix with the water stream and stay in suspension due to the motion of the water (colloids). Suspended particles in river water are for example soil, biological solids, or decaying organic matter. Suspensions are different from emulsions where two liquids are combined that usually don't mix which each other like fat and water.

Chemical Characteristics

• Organic matter consists of Carbohydrates like cellulose, cotton, starch, sugar, etc..

• Fats and oils received from kitchens garages, etc..

• Nitrogenous compounds like protein and their decomposed product, including wastes from animals, urea, fatty acids etc.

• Generally presence of inorganic solids in sewage is not harmful. They can be removed by mechanical units in treatment plants. But the suspended and dissolved organic solids are responsible for creating nuisance if disposed of without treatment.

Total suspended solids (TSS)

It is the dry-weight of suspended particles, that are not dissolved, in a sample of water that can be trapped by a filter that is analyzed using a filtration apparatus known as sintered glass crucible. TSS is a water quality parameter used to assess the quality of a specimen of any type of water or water body, ocean water for example, or wastewater after treatment in a wastewater treatment plant.

Total Solids = Total Suspended Solids + Total Dissolved Solids

TSS is measured by filtering the water sample through a particular type of filter and comparing the filter's weight before and after filtration. The TSS is then calculated as:

$$\frac{(\text{Dry Weight of Filter and Trapped Material} - \text{Dry Weight of Filter})}{\text{Volume of Water Sample}}$$

TSS measurements are used in various industries. It can be associated with the amount of water pollution in a body of water. For industrial situations, measuring TSS is important because suspended solids can cause blockage and pipe damage.

Total dissolved solids

"Dissolved solids" refer to any minerals, salts, metals, cations or anions dissolved in water. Total dissolved solids (TDS) comprise inorganic salts, principally calcium, magnesium, potassium, sodium, bicarbonates, chlorides, and sulfates and some small amounts of organic matter that are dissolved in water.

TDS in drinking-water originate from natural sources, sewage, urban run-off, industrial wastewater, and chemicals used in the water treatment process, and the nature of the piping or hardware used to convey the water, i.e., the plumbing. In the United States, elevated TDS has been due to natural environmental features such as mineral springs, carbonate deposits, salt deposits, and sea water intrusion, but other sources may include: salts used for road de-icing, anti-skid materials, drinking water treatment chemicals, stormwater, and agricultural runoff, as well as point/non-point wastewater discharges.

In general, the total dissolved solids concentration is the sum of the cations (positively charged) and anions (negatively charged) ions in the water. Therefore, the total dissolved solids test provides a qualitative measure of the amount of dissolved ions but does not tell us the nature or ion relationships. In addition, the test does not provide us insight into the specific water quality issues such as hardness, salty taste, staining, odors, corrosiveness, or the presence of trace metals and microbiological contaminants. Therefore, the total dissolved solids test is used as an indicator test to determine the general quality of the water. The sources of total dissolved solids can include all of the dissolved cations and anions.

PH

- The pH value of sewage indicates the logarithm of reciprocal of hydrogen ion concentration present in the sewage. It is thus an indicator of the acidity or the alkalinity of sewage. If the pH value is less than 7, the sewage is acidic and if the pH vale is more than 7, the sewage is alkaline.
- The fresh sewage is alkaline, with passed of time pH tends to fall due to production of acid by bacterial action in anaerobic or nitrification processes. However with treatment of sewage the pH tends to rise.
- Determination of pH is important because efficiency of certain treatment methods depends on it. Especially the biological treatment, for better result the pH of sewage should be around 7.0 in biological treatment as microorganisms can flourish in that pH range. • pH can be determined using pH meter (Potentiometer)

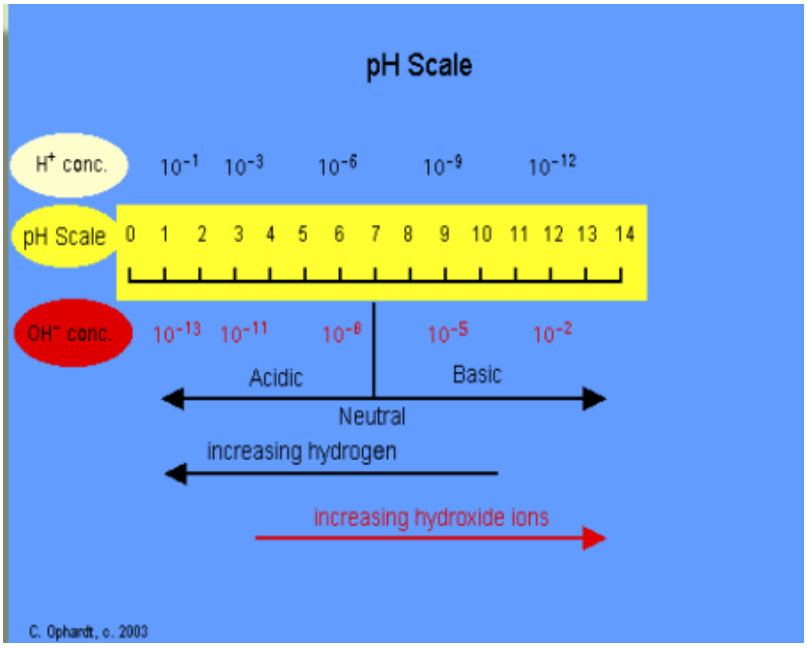


Figure:PH scale

Alkalinity in Water

Alkalinity is a measure of water's ability to resist pH changes that lead to acidity, or to neutralize acids, and maintain a fairly stable pH. This ability is usually referred to as water's "buffering capacity".

The presence of certain chemicals, including hydroxides, carbonates, and bicarbonates, affects water's alkalinity. In simple terms, water with high alkalinity is less prone to becoming more acidic if it is contaminated with acidic water, such as acid rain

Nitrogen Content

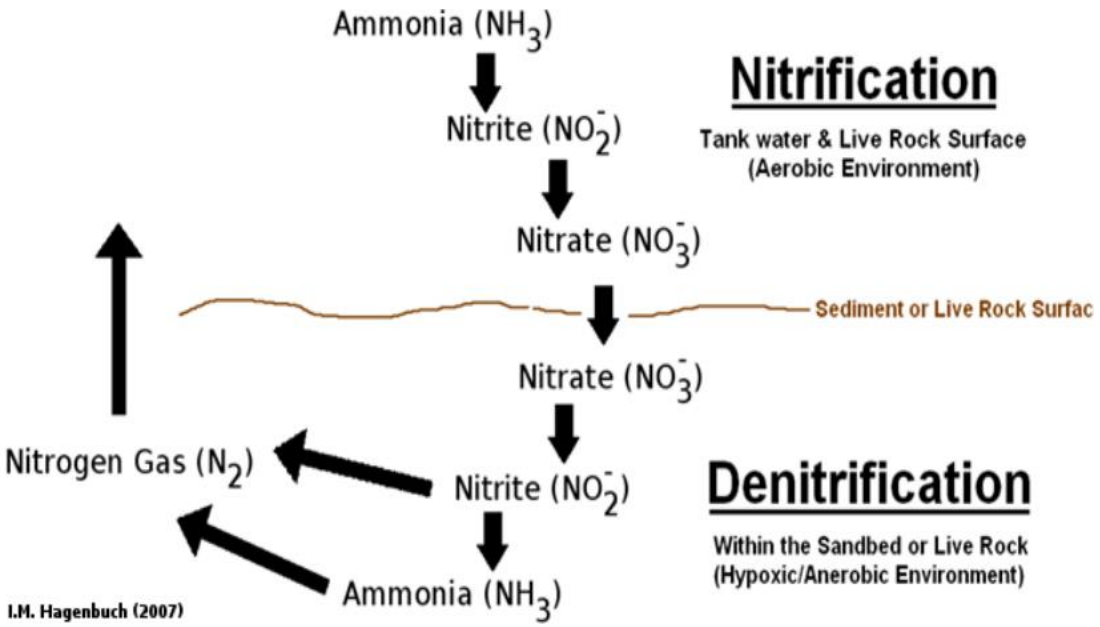
- The presence of nitrogen in sewage is an indication of the presence of the organic matter and may occur in one or more of the following forms:
- Free ammonia called ammonia nitrogen
- Albuminoid or Organic Nitrogen
- Nitrites
- Nitrates

The free ammonia indicates the very first stage of decomposition of organic matter (thus indicating recent pollution); albuminoid nitrogen indicates the quantity of nitrogen in sewage before the decomposition of organic matter. Nitrates indicates the presence of fully oxidized organic matter in sewage.

The nitrites thus indicates the intermediate stage of conversion of organic matter of sewage into stable forms, thus indicating the progress of treatment. Their presence shows that the treatment given to the sewage is incomplete, and sewage is stale. Whereas, the presence of nitrates indicates the well oxidized and treated sewage. Organic nitrogen can be measured by adding strong alkaline solution of KMn04 to already boiled water sample and again boiling the same. Ammonia gas thus liberated is measured which gives the quantity of organic nitrogen. The sum total of ammonia nitrogen is called kjedahl nitrogen.

Nitrites are dangerous but as oxidation of nitrites to nitrates is vey fast it is generally not find 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 the health of infants, causing a disease called mathemoglobinemia (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.



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.

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 H2 S gas along with methane and carbon dioxide, thus causing very obnoxious odours.

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