L.No: 02

Topic: Water quality Parameters

Water Quality Parameters:

* Colour
* Tastes and Odours
* Turbidity and Sediments
* pH
* Alkalinity
* TDS
* Fluoride
* Arsenic
* Chemical Oxygen Demand (COD)
* Biological Oxygen Demand (BOD)
* Hardness of water

→ The quality of water is a very important parameter to be determined in order to decide the type of treatment required.

Colour:

* Colour is a shade imparted by organic or inorganic material, which change the appearance of the water.
* Colour is found mostly in Surface water
* The Colours of natural water range from pale straw through yellowish-brown to dark brown.

* The Colour of natural waters is mainly due to the presence of dissolved or Colloidal organic or inorganic materials.

Sources

→ Organic Sources ⇒ Algae, tannins, humic Compounds organic dyes

→ Inorganic Sources ⇒ Fe and Mn Compounds, Chemicals and inorganic dyes from various industries

Sanitary Significance:

✓ The Colours and the materials which produce Colour are often objectionable in which the water and the manufactured product Come into Contact.

eg: Dyeing, Scouring and Laundering

✓ Variation in Colour of water from the Same Source with time Serves as index of quality of the water.

eg:

a) Yellowish tinge → Indicates the presence of Chromium and Organic matter.

b) Yellowish red → Indicates the presence of iron

c) Red-brown → Indicates the presence of peaty matter

Removal of Colour

• Colour and colour producing materials are removed by Coagulation, Settling, adsorption and filtration.

Tastes and Odours

Taste:

Taste is the sensation of flavour perceived in the mouth and throat on contact with a substance

Odour:

Odour is a smell (or) scent caused by one (or) more volatilized chemical compounds that are generally found in low concentration.

Sources

* Organic Sources → Algae and decaying vegetation
* Inorganic Sources → Mercaptans, amines and Sulphides

The tastes and odours observed in chlorinated waters are due to chloro-organic compounds formed by the reaction between chlorine and organic matter present in the water.

How to evaluate the odour?

It is impossible to isolate and identify clearly the odour causing materials.

Evaluation of odour depends on the olfactory senses of the tasting person and on his ability to distinguish between different types of odours.

Significance:

* Disagreeable odours and tastes are objectionable for various industrial processes such as food products, beverages, textiles, paper

* Taste helps us to decide what to eat and influences how efficiently we digest these foods.
* Senses of smell and taste are vital in identification of valuable nutrients in the environment.
* Taste enables the evaluation of foods for toxicity.

Removal of Tastes and Odours:

* Organic tastes and odours may be removed by aeration (or) activated carbon treatment
* Inorganic tastes due to H_2S (or) Iron may be removed by chemical methods like oxidation, chlorination (or) precipitation.

Turbidity and Sediments:

Turbidity is the reduction of clarity of natural water due to the presence of finely divided, insoluble impurities suspended in water.

Sources

→ Inorganic Sources

Clay, Silt, Silica, ferric hydroxide, Calcium Carbonate, Sulphur etc

→ Organic Sources

Finely divided vegetable or animal matter, oils, fats, micro organisms etc.

Problems caused by Turbidity

* Presence of turbidity and sediments in boiler water and Cooling water System cause problems.

* Water Softening processes cannot be carried out

* Due to deposition of these organic impurities, disinfection efficiency gets reduced.

Significance

* Turbidity affects the taste and odour of drinking water.

* As turbidity affects the disinfection process, it must be removed.

* Turbidity block light to aquatic plants, aquatic organisms.

* Turbidity affects the growth rate of algae.

* It increases water temperature because Suspended particles absorbs more heat.

Removal of Turbidity and Sediments

* Coagulation and filtering
* Coagulation and Settling
* Coagulation, Settling and filtering

pH

The hydrogen ion Concentration is represented by the pH value, which is defined as

$$pH = -\log_{10}[H^+]$$

pH is defined as negative logarithm of hydrogen ion concentration.

0 ⟷ 7 ⟷ 14

Acidic Neutral Basic

* For drinking water pH: 6.5-8.5

* For irrigation pH, 6.0-9.0

* The rain water contaminated by the dissolved gases such as SO_2 & NO_x will have acidic pH

Significance of pH

- ✓ pH determines the solubility (amount that can be dissolved in water)
- ✓ It also determines the biological availability (amount that can be utilized by aquatic life).
- ✓ A rise (or) fall in pH can indicate chemical pollution (or) Acid rain.
- ✓ Many animals cannot live in water at a pH level below 5.

Alkalinity

Alkalinity of water is a measure of its acid neutralising ability.

The natural alkalinity in water is imparted by the hydroxides, carbonates & bicarbonates.

Sources:

Hydroxides, carbonates and bicarbonates of alkalimetal, borates, silicates, phosphates = Industries like fertilizer, detergent, leather and paint

Significance

* Very high values of alkalinity are harmful to aquatic organisms.

* Alkalinity in boiler feed water causes caustic embrittlement of pipes.

Removal

→ Adding limited amount of HCl

TDS (Total Dissolved Solids)

It is defined as the measure of all inorganic and organic substances present in water

Significance

→ TDS impacts the salinity of water.

→ TDS in water may not be ideal for your health & must be filtered out before intake.

→ Water with TDS level higher than 300ppm may not be potable as it can taste salty.

→ Water with high level of TDS (>1200ppm) impacts the colour, odour & taste dramatically

Fluoride:

Fluoride is found in ground water as a result of dissolution from geologic formulations

Sources

Fluoride Containing minerals cryolite ⇒ Fluorapatite

Contaminated domestic sewage, run-off from agricultural lands ⇒ phosphate fertilizers

Significance:

* Optimum fluoride concentrations, prescribed in public water supplies, are in the range of 0.7 - 1.2 mg/lit

* If the fluoride concentration is high it causes fluorosis.

* If the fluoride concentration is low in drinking water it causes dental caries in children.

Removal (Defluoridation)

* Using strongly basic anion exchange resin.

* By adsorption on activated carbon

Arsenic

Arsenic is a metallic element that forms a number of poisonous compounds.

It is found in nature at low levels.

Mostly in compounds, with oxygen, chlorine and sulfur.

Source

* Arsenic can get into drinking water from natural deposits (or) runoff from agriculture, mining and industrial processes.

Significance

* Long term intake of arsenic contaminated water leads to arsenic poisoning with cancer of skin, bladder, kidney

* Association of arsenic contaminated water produces diabetes, hypertension and reproductive disorders.

* Children may have more exposure to arsenic in drinking water.

* As a result, children may be at greater risk of illness when higher levels of arsenic are present.

Chemical Oxygen Demand (COD)

COD is defined as, "the measure of amount of oxygen required to chemically oxidise all the oxidisable impurities present in the sewage using an oxidising agent like acidified $K_2Cr_2O_4$.

Significance of COD

* It measures both the biologically oxidisable and biologically inert organic matter.

* COD test is used to monitor water treatment plant efficiency.

* COD is used to measure pollutants in water waste water and aqueous hazardous wastes.

Biological Oxygen Demand (BOD)

BOD is defined as, "the amount of free oxygen required by bacteria for the biological oxidation of the organic matter under aerobic conditions at 20°c for a period of 5 days.

Significance of BOD

* It indicates the amount of decomposable organic matter present in the Sewage.

* It enables us to determine the degree of pollution at any time in the Sewage Stream.

* Lesser the BOD, better is the quality of water.

Hardness of water

Hardness is the property (or) characteristic of water which does not produce lather with Soap.

Types of hardness

* Temporary hardness
* Permanent hardness

Temporary Hardness (or) Carbonate Hardness (or) Alkaline Hardness

→ This is due to the presence of bicarbonate of Calcium and Magnesium.

→ It can be removed by a) boiling the water b) adding lime to the water.

Permanent Hardness (or) Non-Carbonate Hardness (or) Non-alkaline Hardness

* This is due to the presence of Chlorides and Sulphates of Calcium and Magnesium.

* It cannot be removed by boiling

* Removed by i) Lime Soda process ii) zeolit