LABORATORY PROCEDURE TO FIND OUT PHYSICAL, CHEMICAL, BIOLOGICAL:

CHARACTERISTICS OF WATER:

Characteristics of water are physical, chemical and bacteriological which defines water quality.

Physical Characteristics

- Turbidity
- Colour
- Taste and Odour
- Temperature

Turbidity:

If a large amount of suspended solids are present in water, it will appear turbid in appearance. The turbidity depends upon fineness and concentration of particles present in water. Originally turbidity was determined by measuring the depth of column of liquid required to cause the image of a candle flame at the bottom to diffuse into a uniform glow. This was measured by Jackson candle turbidity meter. The calibration was done based on suspensions of silica from Fuller's earth. The depth of sample in the tube was read against the part per million (ppm) silica scales with one ppm of suspended silica called one Jackson Turbidity unit (JTU). Because standards were prepared from materials found in nature such as Fuller's earth, consistency in standard formulation was difficult to achieve. These days turbidity is measured by applying Nephelometry, a technique to measure level of light scattered by the particles at right angles to the incident light beam. The scattered light level is proportional to the particle concentration in the sample. The unit of expression is Nephelometric Turbidity Unit (NTU). The IS values for drinking water is 10 to 25 NTU.

Colour:

Dissolved organic matter from decaying vegetation or some inorganic materials may impart colour to the water. It can be measured by comparing the colour of water sample with other standard glass tubes containing solutions of different standard colour intensities. The standard unit of colour is that which is produced by one milligram of platinum cobalt dissolved in one litre of distilled water. The IS value for treated water is 5 to 25 cobalt units.

Taste and Odour:

Odour depends on the contact of a stimulating substance with the appropriate human receptor cell. Most organic and some inorganic chemicals, originating from municipal or industrial wastes, contribute taste and odour to the water. Taste and odour can be expressed in terms of odour intensity or threshold values. A new method to estimate taste of water sample has been developed based on flavor known as' Flavour Profile Analysis' (FPA). The character and intensity of taste and odour discloses the nature of pollution or the presence of microorganisms.

Temperature:

The increase in temperature decreases palatability, because at elevated temperatures carbon dioxide and some other volatile gases are expelled. The ideal temperature of water for drinking purpose is 5 to 12 °C - above 25 °C, water is not recommended f or drinking.

Chemical Characteristics:

- pH (Power or Percentage of Hydrogen)
- Acidity
- Alkalinity
- Hardness
- Chlorides
- Sulphates
- Iron
- Solids
- Nitrates

pH (Power or Percentage of Hydrogen):

pH value denotes the acidic or alkaline condition of water. It is expressed on a scale ranging from 0 to 14, which is the common logarithm of the reciprocal of the hydrogen ion concentration. The recommended pH range for treated drinking water is 6. 5 to 8.5.

Acidity:

The acidity of water is a measure of its capacity to neutralise bases. Acidity of water may be caused by the presence of un-combined carbon dioxide, mineral acids and salts of strong acids and weak bases. It is expressed as mg/ Lit in terms of calcium carbonate. Acidity is nothing but representation of carbon dioxide or carbonic acids. Carbon dioxide causes corrosion in public water supply systems.

Alkalinity:

The alkalinity of water is a measure of its capacity to neutralise acids. It is expressed as mg/Lit in terms of calcium carbonate. The various forms of alkalinity are (a) hydroxide alkalinity (b) carbonate alkalinity (c) hydroxide plus carbonate alkalinity (d) carbonate plus bicarbonate alkalinity, and (e) bicarbonate alkalinity, which is useful mainly in water softening and boiler feed water processes. Alkalinity is an important parameter in evaluating the optimum coagulant dosage.

Hardness:

If water consumes excessive soap to produce lather, it is said to be hard. Hardness is caused by divalent metallic cations. The principal hardness causing cations are calcium, magnesium, strontium, ferrous and manganese ions. The major anions associated with these cations are sulphates, carbonates, bicarbonates, chlorides and nitrates. The total hardness of water is defined as the sum of calcium and magnesium concentrations, both expressed as calcium carbonate in mg/L. Hardness are of two types, temporary or carbonate hardness and permanent or non carbonate hardness.

Temporary hardness is one in which bicarbonate and carbonate ion can be precipitated by prolonged boiling. Non- carbonate ions cannot be precipitated or removed by boiling, hence the term permanent hardness. IS value for drinking water is 300 mg/L as CaCO3.

Chlorides:

Chloride ion may be present in combination with one or more of the cations of calcium, magnesium ,iron and sodium. Chlorides of these minerals are present in water because of their high solubility in water. Each human being consumes about six to eight grams of sodium chloride per day, a part of which is discharged through urine and night soil. Thus, excessive presence of chloride in water indicates sewage pollution. I.S value for drinking water is 250 to 1000 mg/L.

Sulphates:

Sulphates occur in water due to leaching from sulphate mineral and oxidation of sulphides. Sulphates are associated generally with calcium, magnesium and sodium ions. Sulphate in drinking water causes a laxative effect and leads to scale formation in boilers I. t also causes odour and corrosion problems under aerobic conditions. Sulphate should be less than 50 mg/L, for some industries. Desirable limit for drinking water is 150 mg/L. May be extended u pt o 400 mg/L.

Iron:

Iron is found on earth mainly as insoluble ferric oxide. When it comes in contact with water, it dissolves to form ferrous bicarbonate under favourable conditions. This ferrous bicarbonate is oxidised into ferric hydroxide, which is a precipitate. Under anaerobic conditions, ferric ions reduced to soluble ferrous ion.Iron can impart bad taste to the water, causes discolouration in clothes and incrustations in water mains. I.S value for drinking water is 0.3 to 1.0 mg/L.

Solids:

The sum of total foreign matter present in water is termed as' total solids'. Totalsolids are the matters that remains as residue after evaporation of the sample and its subsequent drying at a defined temperature (103 to 105 °C). Total solids consist of volatile (organic) and non-volatile(inorganic or fixed) solids. Further, solids are divided into suspended and dissolved solids. Solids that can settle by gravity are settleable solids. The others are non-settleable solids. I.S acceptable limit for total solids is 500 mg/L and tolerable limit is 3000 mg/L of dissolved limits.

Nitrates:

Nitrates in surface waters occur by the leaching of fertilizers from soil during surface run-off and also nitrification of organic matter. Presence of high concentration of nitrates is an indication of pollution. Concentrations of nitrates above 45 mg/L cause a disease methemoglobinemia. I. S value is 45 mg/L.

Bacteriological Characteristics:

Tests to indentify bacteria

- Standard plate count test
- Most probable number
- Membrane filter technique

Standard plate count test:

In this test, the bacteria are made to grow as colonies, by innoculating a known volume of sample into a solidifiable nutrient medium (Nutrient Agar), which is poured in a petridish. After incubating (35°C f) or a specified period (24 hours), the colonies of bacteria (as spots) are counted. The bacterial density is expressed as number of colonies per 100 ml of sample.

Most probable number:

Most probable number is a number which represents the bacterial density which is most likely to be present. E.Coli is used as indicator of pollution. E.Coli ferment lactose with gas formation with 48 hours incubation at 35°C. Based on this E.Coli density in a sample is estimated by multiple tube fermentation procedure, which consists of identification of E.Coli in different dilution combination. MPN value is calculated as follows:

Five 10 ml (five dilution combination) tubes of a sample are tested for E.Co li. If out of five only one gives positive test for E.Coli and all others negative. From the tables, MPN value for one positive and four negative results is read which are 2.2 in present case. The MPN value is expressed as 2.2 per 100 ml. These numbers are given by Maccardy based on the laws of statistics.

Membrane filter technique:

In this test, a known volume of water sample is filtered through a membrane with opening less than 0.5 microns. The bacteria present in the sample will be retained upon the filter paper. The filter paper is put in contact of a suitable nutrient medium and kept in an incubator for 24 hours at 35°C. The bacteria will grow upon the nutrient medium and visible colonies are counted. Each colony represents one bacterium of the original sample. The bacterial count is expressed as number of colonies per 100 ml of sample.