WATER QUALITY ANALYSIS

Presentation By
Dr. P. Siva Kumar, M.Sc., B.Ed., Ph.D.,
Guest Faculty

Department of Geography
Bharathidasan University
Tiruchirappalli - 620 024

- The health concerns associated with chemical constituents of drinking-water arise mainly from the ability of chemical constituents to cause adverse health effects after extended exposure time.
- There are few chemical constituents of water that can lead to health problems resulting from even a single exposure.
- An appreciable number of serious health concerns may occur as a result of the chemical contamination of drinking-water.

pH:

- pH is a measure of how acidic or basic (alkaline) the water is. It is defined as the negative log of the hydrogen ion concentration. The pH scale is logarithmic and ranges from 0 (very acidic) to 14 (very alkaline).
- For each whole number increase (i.e. 1 to 2) the hydrogen ion concentration decreases tenfold and the water becomes less acidic. The range of natural pH in fresh waters extends from around 4.5, for acid, peaty upland waters, to over 10.0 in waters where there is intense photosynthetic activity by algae.
- However, the most frequently encountered range is 6.5-8.0. The range of pH apt for fisheries is considered to be 5.0-9.0, though 6.5-8.5 is preferable. At the extreme ends of the pH scale, (2 or 13) physical damage to gills, exoskeleton and fins occurs.
- Changes in pH may alter the concentrations of other substances in water to a more toxic form. Ammonia toxicity, chlorine disinfection efficiency, and metal solubility are all subjective to changes in pH value.

Electrical Conductivity:

- The conductivity of water is an expression of its ability to conduct an electric current as a result of breakdown of dissolved solids into positively and negatively charged ions.
- The major positively charged ions are sodium (Na^{+}), calcium (Ca^{+}_{2}), potassium (K^{+}) and magnesium (Mg^{+2}).
- The major negatively charged ions in water include chloride (Cl^{-}), sulfate (SO_4^{-2}), carbonate (CO_3^{-2}), and bicarbonate (HCO_3-).
- (NO_3^{-2}) and phosphates (PO_4-3) are minor contributors to conductivity, although they are very important biologically.
- Conductivity in itself is a property of little interest but it is an invaluable indicator of the range of hardness, alkalinity and the dissolved solids content of the water.
- Conductivity will vary with water source: ground water, water drained from agricultural fields, municipal waste water, rainfall. Therefore, conductivity can indicate groundwater seepage or a sewage leak

Alkalinity:

- The alkalinity of natural water is generally due to the presence of bicarbonates formed in reactions in the soils through which the water percolates.
- is a measure of the capacity of the water to neutralize acids and it reflects its buffer capacity. It may also be attributed to the presence of carbonates and hydroxides.
- Alkalinity is important for fish and aquatic life because it protects or buffers against rapid pH changes. Living organisms, especially aquatic life, function best in a pH range of 6.0 to 9.0. Higher alkalinity levels in surface waters can buffer the acid rain and other acid wastes. This inhibits harmful pH changes for the protection of aquatic life.
- Alkalinity in streams is influenced by rocks and soils, salts, certain plant activities, and certain industrial wastewater discharges. Low nutrient (oligotrophic) lakes tend to have lower alkalinity while high nutrient (eutrophic) lakes have a tendency of higher alkalinity.

Hardness:

- Hardness is a natural characteristic of water which can enhance its palatability and consumer acceptability for drinking purposes. The hardness of water is due to the presence of calcium and magnesium minerals that are naturally present in the water. The common signs of a hard water supply are poor lathering of soaps and scum. The hardness is made up of two parts: temporary (carbonate) and permanent (non carbonate) hardness. The temporary hardness of water can easily be removed by boiling the water.

The following is a measure of hardness (expressed in mg/l as CaCO3):

Soft: 0 - 100 mg/l as $CaCO_3$

Moderate: 100 - 200 mg/l as $CaCO_3$

Hard: 200 - 300 mg/l as $CaCO_3$

Very hard: 300 - 500 mg/l as $CaCO_3$

Extremely hard: 500 - 1,000 mg/l as $CaCO_3$

Major ions in Water

Major Cations	Major Anions
Sodium ($Na^{+)}$	Chloride (Cl^{-})
Potassium (K^{+})	Sulphate (SO_4^{2-})
Calcium (Ca^{2+})	Carbonates/Bicrabonates (CO_3^{2-}/HCO_3^{-})
Magnesium (Mg^{2+})	Nitrates (NO_3^{-})

Cations

- Sodium may be of health significance to individuals. Sodium salts are generally highly soluble in water and are leached from the terrestrial environment to groundwater and surface water.
- Potassium is an essential nutritional element in drinking water supplies but in its excessive quantities, it acts as a laxative.
- Calcium is essential to human nutrition and a key element in the formation of teeth and bones. It is also known as limestone and is a cause of water hardness.
- Magnesium is one of the most common elements in the earth's crust. Sulfates of magnesium at very high concentrations may have a laxative effect on some people. It also give an unpleasant taste at high concentration

Anions

- Chloride in drinking water is generally not harmful to human health except when present in high concentrations. The high concentration may be injurious to heart and kidney patients. The restriction on chloride concentrations in potable water are determined by taste requirements.
- Water with objectionable Sulfate content may have a bitter taste. It also contributes to odor problems.
- Excessive bicarbonate adds to the salinity and total solid content of water while Carbonate content of water can also be considered as the temporary water hardness as it can easily be removed by boiling.
- Nitrates: Nitrates even at low concentrations can cause health problem to infants of six months of age or less and pregnant women by affecting the oxygen carrying capacity of the blood

Heavy Metals

- Heavy metal refers to any metallic chemical element that has a relatively high density and is toxic or poisonous at low concentration.
- The some major examples of heavy metals are mercury (Hg), cadmium (Cd), arsenic (As), chromium (Cr), nickel (Ni), copper (Cu), cobalt (Co) and lead (Pb) etc.
- These are the natural components of geological environment. They enter the human body via food, drinking water and air to small extent. Some heavy metals (e.g. copper, selenium, zinc) are necessary to keep up the metabolism of the human body as trace elements. However, they can be poisonous at higher concentrations leading to various serious diseases.