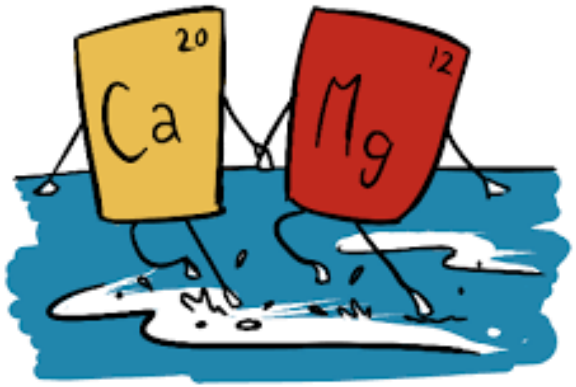
b. Chemical Parameters

i. Hardness

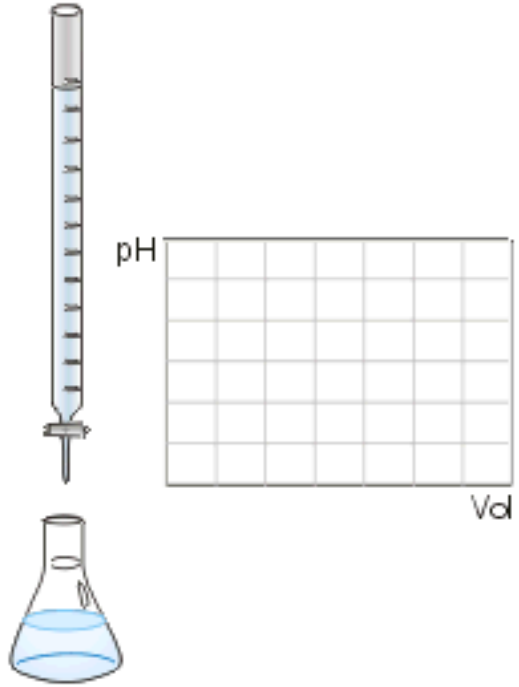
The presence of multivalent cations, most notably calcium and magnesium ions are referred to as water hardness. Soap does not produce lather with hard water instead it forms a sticky and gummy deposit called scum or soap curd. On the other hand, soft water has moderate to low levels of ions and is considered safe for drinking.



- **Water hardness** is the concentration of calcium carbonate that is equivalent to the total concentration of all the multivalent cations in the sample.
- Complexometric titration is one of the best ways of measuring total water hardness. At pH around 10 EDTA easily reacts with both calcium and magnesium in the same molar ratio (1:1).
- Eriochrome Black T is used as indicator.
- As water hardness is usually reported in terms of mg/L of calcium carbonate (even if water contains both calcium and magnesium), we will use for calculations slightly strange reaction equation:

$$CaCO_3 + EDTA^{4-} \rightarrow CaEDTA^{2-} + CO_3^{2-}$$

That allows direct calculation of calcium carbonate mass for known amount of titrant used.



Water Hardness Scale		
mg $CaCO_3$/L (ppm)	French Degrees	Classification
< 75	< 7.5	Very Soft
75 - 125	7.5 – 12.5	Soft
125 - 250	12.5 – 25.0	Moderately Hard
250 - 375	25.0 – 37.5	Hard
> 375	> 37.5	Very Hard

ii. Salinity

- Salinity is a measure of the amount of salts in the water. Because dissolved ions increase salinity as well as conductivity, the two measures are related.
- The salts in sea water are primarily sodium chloride (NaCl). However, other saline waters, owe their high salinity to a combination of dissolved ions including sodium, chloride, carbonate and sulfate.
- Salts and other substances affect the quality of water used for irrigation or drinking. They also have a critical influence on aquatic biota, and every kind of organism has a typical salinity range that it can tolerate. As salinity increases, it may become toxic to native freshwater organisms.
- High salinity in water makes it unsuitable for drinking and other usages such as agriculture and industry. High salinity may be caused by natural sources such as the geological structure of soil or by man-made pollutants.

iii. Alkalinity

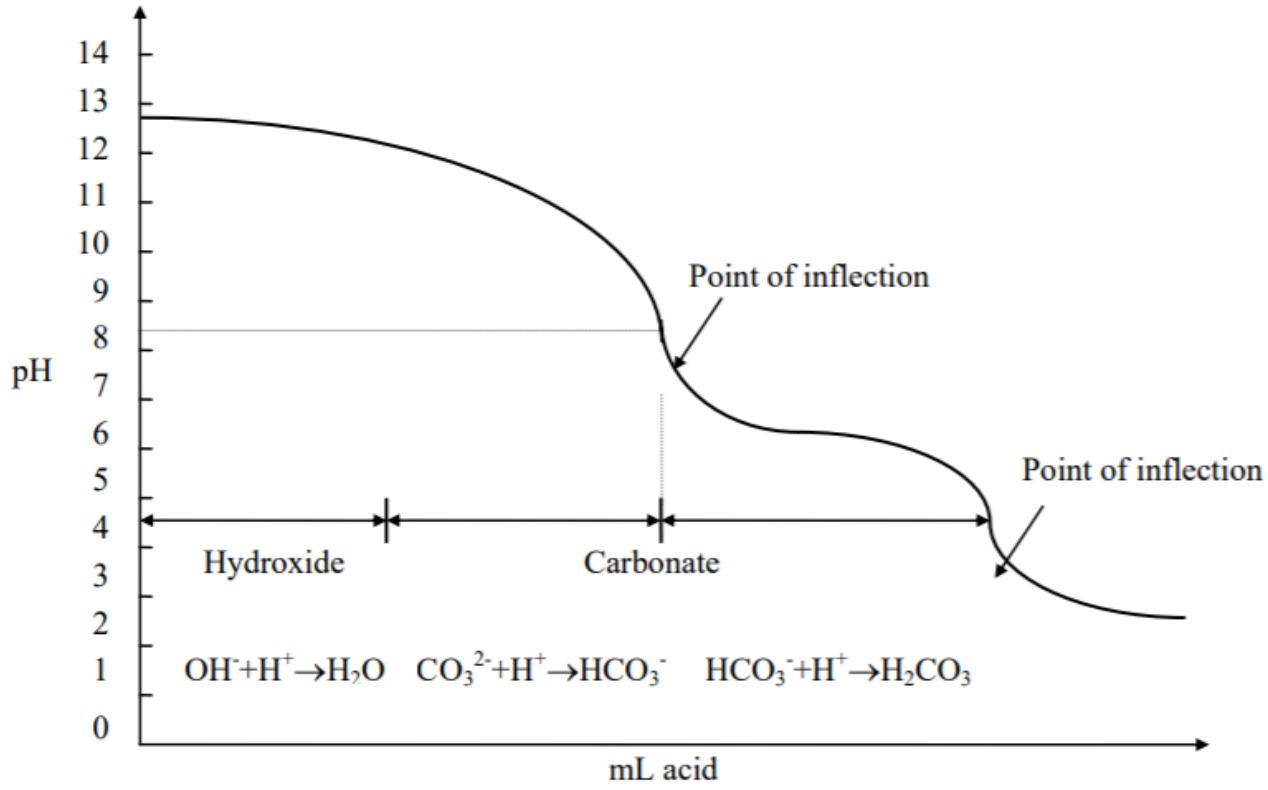
- Alkalinity is a measure of the buffering capacity of water, or the capacity of the water to neutralise acids and resist pH change. Alkalinity within water bodies is consumed as acid is released from acid sulfate soils. Adding limestone contributes alkalinity to waters, helping to neutralise any acid released from the sediments.

iv. pH

- pH is a way of expressing the hydrogen-ion concentration of a solution. As acids and bases in solution dissociate to yield hydrogen ions [H^+] and hydroxyl ions [OH^-] respectively, pH is used to indicate the intensity of the acidic or alkaline condition of a solution.

- pH and alkalinity are key water quality parameters in environmental engineering practice.
- In the water supply and treatment fields, these parameters have great influence on the chemical coagulation, disinfection and softening processes, and corrosion control for water distribution pipe networks.
- Effective chemical coagulation of water, for instance, occurs only within a specific pH range. Chemicals used for coagulation release, as a by-product of their reactions with water to form insoluble hydroxide precipitates, hydrogen ions (acid-causing). If unchecked, these hydrogen ions could lower the pH of the water sufficiently to render the coagulants ineffective.
- The presence of sufficient amount of alkalinity in the water can react and remove the hydrogen ions released by the coagulants, thus buffering the water in the pH range where the coagulant can be effective.

- Alkalinity of waters is measured by means of titration with a standard solution of a strong acid (usually H_2SO_4) to designated pHs, and is reported in terms of equivalent $CaCO_3$. Alkalinity depends on the end-point pH or indicator used. Either titration curve technique or colour indicators can be used for the determination. The alkalinity measurement is based on the titration curve for a hydroxide-carbonate-bicarbonate mixture, as shown in Figure.



v. Total dissolved solids (TDS)

- Total Dissolved Solids, also known as TDS, are inorganic compounds that are found in water such as salts, heavy metals and some traces of organic compounds that are dissolved in water.

- Excluding the organic matters that are sometimes naturally present in water and the environment, some of these compounds or substances can be essential in life. But, it can be harmful when taken more than the desired amount needed by the body.

- The total dissolved solids present in water are one of the leading causes of turbidity and sediments in drinking water. When left unfiltered, total dissolved solids can be the cause of various diseases.

- A total dissolved solid (TDS) is a measure of the combined total of organic and inorganic substances contained in a liquid. This includes anything present in water other than the pure H_20 molecules. These solids are primarily minerals, salts and organic matter that can be a general indicator of water quality.