SNS COLLEGE OF TECHNOLOGY

Coimbatore – 641 029

An Autonomous Institution

DEPARTMENT OF CIVIL ENGINEERING

ENVIRONMENTAL ENGINEERING

II YEAR / IV SEMESTER

UNIT 1 : SOURCES, QUALITY AND DEMAND OF WATER

Topic 6 :Chemical Test

UNIT 1 : SOURCES, QUALITY AND DEMAND OF WATER

1. Importance and necessity of water supply Engineering – Sources of water – Suitability of water –Choice of source
2. Types of demand –– Computation of quantity of water
3. Fluctuation in demand –Factors affecting demand
4. Population forecast
5. Population forecast - Methods
6. Impurities in water– Collection of water sample
7. Physical test
8. Chemical test
9. Biological test and Standards of quality of water

Chemical test of water

(i) Total solids

(ii) Chlorides

(iii) Hardness

(iv) pH value

(v) Metals and other chemical substances

(vi) Nitrogen and its compounds.

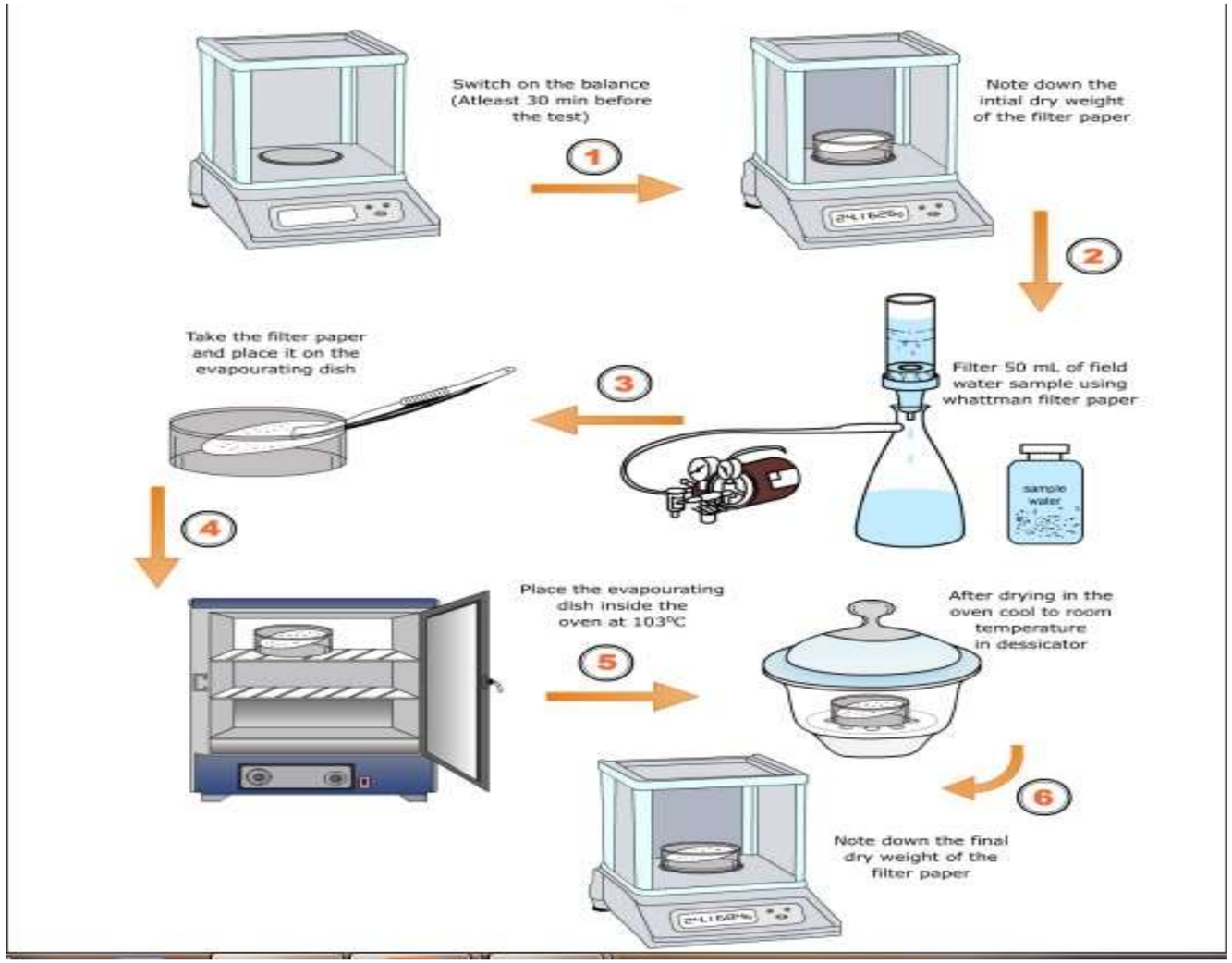
(vii) Dissolved gases.

Total Solids

Suspended Solids + Dissolved Solids = Total Solids

ACTIVITY

Determination of Suspended Solid



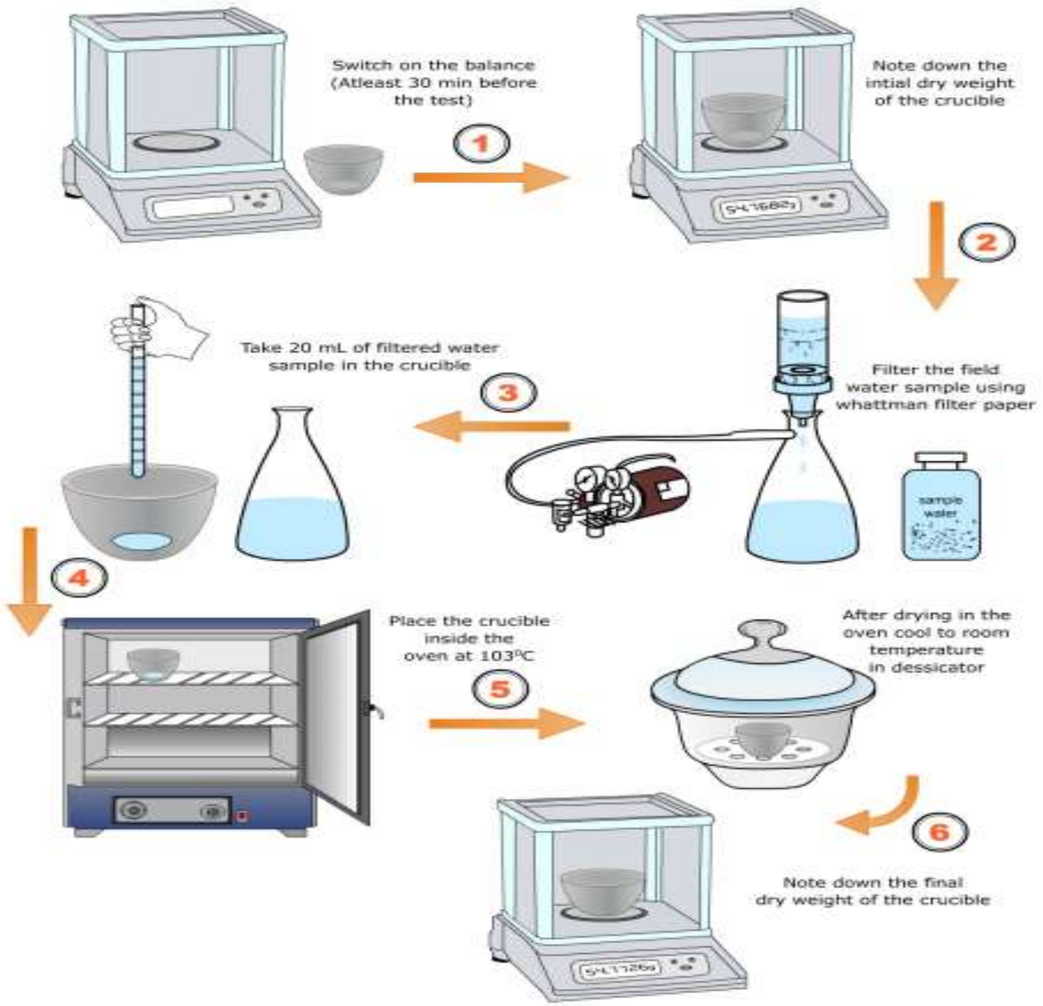
Suspended Solid (mg/L) = [(W_2-W_1) x 1000] / volume of sample

Where:

W_2 = weight of filter paper + suspended matter

W_1= weight of filter paper

Determination of Total Dissolved Solid



Total dissolved Solid (mg/L) = [(W_2-W_1)x 1000] / volume of sample

Where:

W_1= Empty weight of crucible

W_2= weight of crucible + weight of residue

Determination of fixed Solid

The total solids obtained by filtering and evaporating are kept in the platinum dish and held over a Bunsen flame

Every part of solids is raised to a bright red heat.

The organic matter is burnt off in this process and only inorganic matter left behind.

The dish is cooled, and weight of the matter remaining behind give the amount of 'fixed solids' which can be expressed in p.p.m.

pH

- If H+ concentration increases, pH decreases and then it will be acidic.
- If H+ concentration decreases, pH increases and then it will be alkaline.
- pH + pOH = 14
- If the pH of water is more than 7, it will be alkaline and if it is less than 7, it will be acidic.
- The alkalinity is caused by the presence of bicarbonate of calcium and magnesium or by the carbonates of hydroxides of sodium, potassium, calcium and magnesium.

$$pH = -\log[H^+] = \log\left[\frac{1}{H^+}\right]$$

Measurement of pH

- The pH value of water can be measured quickly and automatically with the help of a **Potentiometer.**
- The pH can also be measured by indicators as given below:

Indicator	pH range of indicator dye	Original color	Final color produced
Methyl orange	2.8 – 4.4	Red	Yellow
Methyl red	4.4 – 6.2	Red	Yellow
Phenol red	6.8 – 8.4	Yellow	Red
Phenolphthalein	8.6 – 10.3	Yellow	Red

Chloride

Chlorides are estimated by titration with standard silver nitrate solution using potassium chromate as indicator

25 ml of water sample and distilled water is taken in a separate conical flask

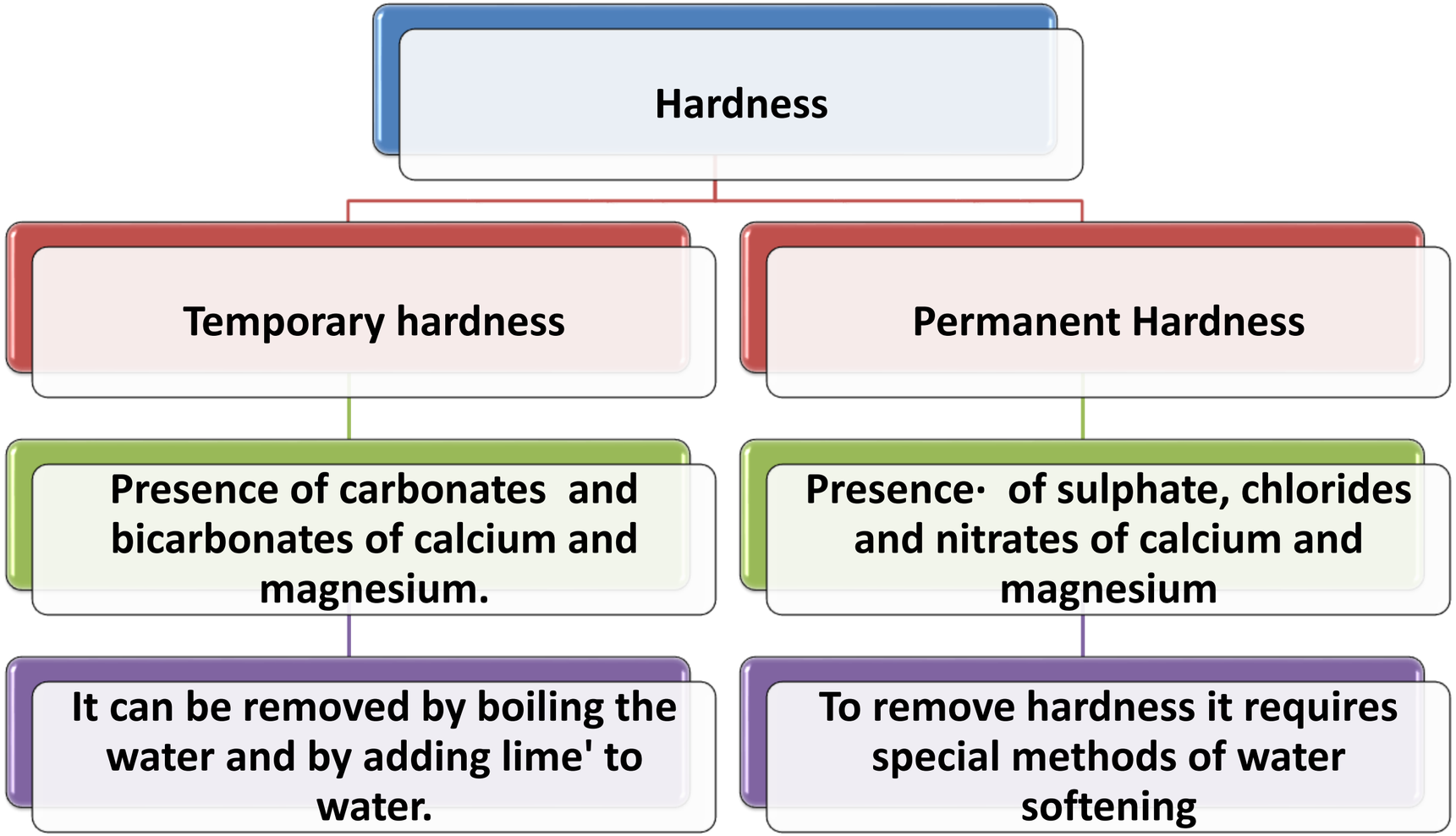
10 drops of potassium chromate solution is added to both the conical flask

The water sample is then titrated with standard solution of silver nitrate.

Note the amount of titrant is used for colour change from yellow to red

250 PPM

Hardness


Hardness
Temporary hardness
Permanent Hardness
Presence of carbonates and bicarbonates of calcium and magnesium.
Presence· of sulphate, chlorides and nitrates of calcium and magnesium
It can be removed by boiling the water and by adding lime' to water.
To remove hardness it requires special methods of water softening

Hardness

- **Carbonate hardness** = Total hardness or Alkalinity (which ever is less)
- Non-carbonate hardness = Total hardness – Alkalinity
- One French degree of hardness is equal to 10mg/l of CaCO3.
- One British degree of hardness is equal to a hardness of 14.25mg/l.
- Water with hardness upto 75 ppm are considered soft and above 200 ppm are considered hard and in between is considered as moderately hard.
- The prescribed hardness limit for public supplies range between 75 to 115 ppm.

Determination of Hardness

Take 100ml of water sample in a conical flask

Add 1 ml of ammonia buffer to the flask

Add 6 drops of Eriochrome Black T indicator

Titrate with EDTA solution

Colour will change from wine red to blue

Nitrogen

- The presence of nitrogen in water may occur in one or more of the following reasons:

1. **Free ammonia:** It indicates very first stage of decomposition of organic matter. It should not exceed 0.15mg/l
2. **Albuminous or Organic Matter:** It indicates the quantity of nitrogen present in water before the decomposition of organic matter has started. It should not exceed 0.3mg/l
3. **Nitrites:** Not fully oxidized organic matter in water.
4. **Nitrates:** It indicates fully oxidized organic matter in water (representing old pollution).

Nitrogen

- Nitrites is highly dangerous and therefore the permissible amount of nitrites in water should be nil.
- Ammonia nitrogen + organic nitrogen = kjeldahl nitrogen
- Nitrates in water is not harmful. However the presence of too much of nitrates in water may adversely affect the health of infants causing a disease called **methemoglobinemia** commonly called **blue baby disease.**
- The nitrate concentration in domestic water supplies is limited to 45 mg/l.

Metals and other chemical substance

- Iron – 0.3ppm, excess of these cause discolouration of clothes.
- Manganese – 0.05ppm
- Copper – 1.3ppm
- Sulphate – 250 ppm
- Fluoride – 1.5 ppm, excess of this effects human lungs and other respiratory organs.
- Fluoride concentration of less than 0.8 – 1.0 ppm cause dental cavity (tooth decay). If fluoride concentration is greater than 1.5ppm, causing spotting and discolouration of teeth (a disease called fluorosis).

Dissolved gases

1.Methane – Explosive tendency

2. Hydrogen sulphide gas – bad taste and odour

3. Carbondioxide - corrosion, bad taste and odour

4. Oxygen – indicates presence of organic matter

- BOD – Biochemical oxygen demand

Biological characteristics

- Presence of bacteria and micro organism
- Size of bacteria – length(1-10µm), width or diameter(0.2-2.5µm)
- Largest bacteria – 100 to 750 µm
- Pathogenic bacteria and non-pathogenic bacteria
- Aerobic bacteria - require oxygen for survival
- Anaerobic bacteria – survive in the absence of oxygen
- Facultative bacteria – survive with or without free oxygen

DRINKING WATER STANDARDS

S.No.	Type of characteristics	Type of impurity	Permissible limit	Absolute maximum limit	Remarks
1	Physical	Turbidity	5	25	On silica scale
		Colour	5	50	Colour number on cobalt scale
		Taste and odour	1	3	Threshold odour number
2	Chemical	pH value	7 – 8.5	6.5 – 9.2	
		Hardness	75 mg/l	110 mg/l	Hardness expressed as $CaCO_3$
		Total solids	500 mg/l	1500 mg/l	As per WHO standards
		Magnesium and sodium	500 mg/l	1000 mg/l	As per WHO standards
		Chlorides	200 mg/l	600 mg/l	As per WHO standards
		Sulphates	200 mg/l	400 mg/l	As per WHO standards
		Calcium	75 mg/l	200 mg/l	As per WHO standards
		Zinc	5 mg/l	15 mg/l	As per WHO standards
		Copper	1 mg/l	1.5 mg/l	As per WHO standards

DRINKING WATER STANDARDS

S.No.	Type of characteristics	Type of impurity	Permissible limit	Absolute maximum limit
2	Chemical	Copper	1 mg/l	1.5 mg/l
		Iron	0.3 mg/l	1.0 mg/l
		Manganese	0.1 mg/l	0.2 mg/l
		Arsenic	Nil	0.2 mg/l
		Lead	Nil	0.1 mg/l
		Selenium	Nil	0.05 mg/l
		Chromium	Nil	0.05 mg/l
		Phenolic compounds as phenol	0.001 mg/l	0.002 mg/l
		Cynide	Nil	0.01 mg/l
		Fluoride	0.5 mg/l	1.5 mg/l
		Cadmium	–	0.05 mg/l
3	Biological and micro-organic	Coliform bacteria	Nil coliform per 100 ml or MPN of B coli 1 per 100 ml	1 coliform

References

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- https://nptel.ac.in/courses/106/106/106106158/