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Estimation of Hardness of Water in Selected Areas in East Godavari Dist. Andhra Pradesh, India

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Abstract:- Water is most essential thing than after the air, sustained on the earth surface of living things and non living things based on the availability of water. This concludes no water – no life. Availability of water depends on the type of source water. Source water is useful for all purposes are called drinking water, not useful for domestic, industrial and agricultural is called waste water. It may classify based on the purpose of use and containing compounds into two types i.e. 1) Soft water 2) Hard water. Salts of magnesium and calcium is present in the water is the reason for hardness. Hardness water again two types permanent hard water and temporary hard water based on the presence of salts. So need to estimate the hardness of water is fit or not according to the standard guidelines by BSI, ICMR. In this experimental Titrimetric analysis, concludes the hardness of the testing sample water in the selected area, containing industrials so my experimental / analytical study may help to study the type of water hardness to be determine. Titrimetric method is used to determine the hardness by using EDTA (Ethylene Diamine Tetra Acetic acid) complexometric compound. For this study to be observe different types of water like ground (bore / well) water, surface (river) water, drinking water.

Keywords:- *Living-Non Living Things, Hard Water, Soft Water, Titrimetric Method, EDTA*

I. INTRODUCTION:

Water classified into two types is
1) soft water
2) hard water

Determined by the presence or lack of salts in the water. Hardness of Water (Slats of Ca, Mg) is caused separately the existence of carbonates ($-CO_3$)$^-$, bicarbonates and chloride ions $(Cl)^-$ and sulfates of Calcium-20 (Ca) and Magnesium-12 (Mg). Under the presence of CO_2 in the water insoluble salts are reacted with water turns into soluble salts. Water gains hardness.

$CaCO_3$ (s) + H_2O (l) + CO_2 (g) → Ca $(HCO_3)_2$

$MgCO_3$ (s) + H_2O (l) +CO_2 (g) → Mg $(HCO_3)_2$

Neutral water flow over through the rocks contains chloride and sulfates salts of Calcium and Mg, easily dissolved in water. Water gets hardness.

➢ *Types of Hardness:*

1) Alkaline Hardness (Temporary Hardness):

Bicarbonates of Ca and Mg presence in water are the reason for the Temporary hardness of the water.
Salts are,
Ca $(HCO_3)_2$ (M.Wt -162) - Calcium Bicarbonate
Mg $(HCO_3)_2$ (M.Wt -146) – Magnesium Bicarbonate

Bicarbonates of Calcium and Magnesium salts are easily removed by the boiling, in this heating soluble salts decomposed in to insolvable carbonate and hydroxides.

Ca $(HCO_3)_2$ → $CaCO_3$↓(s) + H_2O (l) + CO_2↑ (g)

Mg $(HCO_3)_2$ → Mg $(OH)_2$↓(s) + 2 CO_2↑ (g)

2) Non Alkaline Hardness (Permanent Hardness):

Sulfates and Cl^- ions of Ca and Ma salts are incharge for the permanent hardness of the water.

Salts are,
$CaSO_4$
$MgSO_4$
$CaCl_2$
$MgCl_2$

It cannot remove by the boiling process, removed by the processes of Lime-Soda method or zeolite process ($Na_2Al_2Si_2O_8$).

$CaCl_2$ + $NaCO_3$ → $CaCO_3$↓ + 2NaCl

$CaSO_4$ + Na_2Ze → CaZe + $NaSO_4$

➢ *Hardness Expression:*

Hardness constructing salts conveyed in the terms of total equivalent mass weight of $CaCO_3$

Choosing Lime because,

A. Calcium Carbonate mass molecular weight: 100
B. Calcium Carbonate mass equivalent weight: 50 calculations in analysis of water easily simplified.
C. Insoluble salt, it gives precipitation treating with water.

It's expressed in mg/l,

Amount of equivalent $CaCO_3$ =

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$$\frac{amount\ of\ hardness\ producing\ salt\ x\ M.Wt\ of\ CaCO3}{M.Wt\ of\ hardness\ producing\ salt.}$$

(OR)

Equivalent $CaCO_3$ =

$$\frac{weight\ of\ the\ salt\ x\ M.Wt\ of\ CaCO3}{M.Wt\ of\ hardness\ producing\ salt.}$$

➢ *Hardness causing salts Molecular weights:*

Hardness producing salt	M.Wt	Hardness producing salt	M.Wt
Cal.Bicarbonate	162	Mag. Carbonate	84
Mag.Bicarboante	146	Mag. Chloride	95
Cal. carbonate	100	Cal. Chloride	111
Cal. Sulfate	136	Ca^{+2}	40
Mag. Sulfate	120	Mg^{+2}	24

Table 1:- Hardness causing salts Molecular weights

➢ *Hard Water Disadvantages:*

Undesirable effects observed due to the diffused salts present in the water.

➢ *Domestic Usage:*

1) **Washing & Bathing:** using more soap
2) **Cooking:** more time and more fuel required for cooking due to hard water.
3) **Drinking:** creates to health problems

➢ *Industrial usage:*

1) **Paper industry:** affect the quality of the water. Due to Ca, Mg salts present in the water.
2) **Sugar industry:** affects the crystallization of sugar while water consisting sulfates, nitrates and carbonates.
3) **Dyeing Industry:**
4) spoil the desired shade of the cloths presents Ca, Mg salts in the water.
5) **Textile industry:** destroy the fabrics
6) **Boiler effects:**

a. Scale formations occurred in the boilers due to the salts present water boiled in the boilers. The scales adhere to the walls of the boilers; due to this more fuel is required for boiling the water.
b. Boilers walls contact with the salt water or hard water, which creates cracks in the walls of the boilers, may lead to boiler explosion increase the pressure in the boilers.

➢ *Corrosion:*

Ca and Mg salts in the water which give acids by the hydrolysis reaction. Acid contact with boilers metal creates the cracks decrease the life time of the steamers boilers.

$MgCl_2 + H_2O \rightarrow Mg(OH)_2 + 2HCl$

$Fe + HCl \rightarrow FeCl_2 + H_2$

➢ *Units of Hardness of Water:*

Degree of hardness is expressed in the unit's are four types

1. Parts per million
2. Milligrams per liter
3. Clarke's Degree
4. French Degree

➢ *Relationship in between the degrees of water Hardness:*

PPM = mg/lit = 0.1 ° Fr = 0.07° Cl

II. LITERATURE REVIEW

Both calcium & magnesium are crucial components that are useful to human health in a slew of ways. Both nutrients can have negative health effects if not consumed in sufficient amounts. Each element has recommended daily intakes that are set at the national and international levels. The amount of these elements that human beings need and consume varies greatly.

According to its equivalent CaCO3 concentration, drinking water hardness has been categorized in the following ways (APHA 1995).

1. Soft: less than 60 mg/l. (0-60 mg/l)
2. Moderately hard: between 60-120 mg/l
3. Hard: range 120-180 mg/L
4. Very hard: greater than 180 mg/L

Rohit Sharma, et.al. 2020, according to their study water pollution analyze with different chemical parameters in Yamuna River, the water samples analyzed with WHO and WQI. The river Yamuna was drastically polluted due to the activities of the climatic conditions.

The analysis of the water samples pH and DO not increasing year by year, and temperature, TDS, Hardness and total Coli form raised yearly.

P.Ramya et.al 2015, Only 4.16% of the samples in this study had excessive hardness levels, which may not be detrimental to people.

Abbasi, 1998, Magnesium hardness exerts a gastrointestinal impact on people who are new to it, particularly when combined with the sulphate ion

According to statistics (**Tebbutt 1998**), increased water hardness up to 175 mg/L is strongly correlated with a lower incidence of several types of heart disease.

Yang CY, 1998, The data regarding a statistically significant correlation between the levels of calcium and magnesium and the risk of stomach cancer

III. RESEARCH METHODOLOGY

Testing samples are taken from the different areas in the East Godavari Dist. And Kakinada Dist. in Andhra

Pradesh state, India.

➢ *Temperature of the Selected Areas:*

The selected areas temperature is very low in the current (winter) season, 20°C minimum temperature were found in the winter season and observed temperature moderately in this season.

Hardness of the water sample is estimated by using EDTA complexometric methodology. Salts of Ca, Mg are reason for the hardness of the water.

Hardness is II types

1) Permanent hardness of water (Chlorides and Sulfates of Calcium and Magnesium
2) Temporary Hardness of water (Carbonates and bicarbonates of Calcium (Ca) and Magnesium (Mg).

Calcium and Mg salts are estimated by using Std. EDTA solution with the help of indicator ErioChrome Black – T.

Chemicals for this Experiment: EDTA solution, Sample water, Buffer solution, EBT Indicator.

➢ *Principle:*

Ca, Mg salts in water + EBT indicator → [Ca^{+2}, Mg^{+2} EBT Ind.] .Wine Red Color

Ca, Mg salts in water + EBT indicator + EDTA → [Ca^{+2}, Mg^{+2} EDTA] complex Blue Color + EBT Ind.

➢ *Procedure:*

1) Burette filled with EDTA Solution.
2) 20 ml sample water pipette out in the conical flask.
3) 1-2 drops of EBT indicator and add 1ml Buffer solution to the conical flask solution.
4) Titrate against the burette EDTA complex solution
5) Till get the solution Wine red color to Blue color.
6) Repeat the titration until get the two concordant readings. Noted in the following table and estimate the total hardness for the given water sample.

Burette: EDTA Solution (0.02N)
Pipette: sample water (20ml)
Indicator: EB -T Indicator
End point: Wine red color to Blue color.

S. No	Sample water Volume in (ml)	Burette readings		Consumed EDTA volume (V_o)
		Initial	Final	
1	20 ml			
2	20 ml			
3	20 ml			

Table 2 Sample Table

➢ *Calculations:*

Total Hardness of the water sample:

$$= \frac{Vo\ X\ EDTA\ Normality\ X\ 50\ X\ 1000}{volume\ of\ sample\ (water)} \text{ mg/l.}$$

= …….. Mg/l

➢ *Result*:

Total Hardness of the water sample: …… mg/l.

IV. RESULTS AND DISCUSSIONS

S. No	Sample water Location	Type of water	Total Hardness (in ppm)
1	Gollaprolu	Well water	290 ppm
2	Suranpalem	Tap water	310 ppm
3	Samrlakota	UG water	205 ppm
4	Thalluru	Pond Water	100 ppm
5	Rangampeta	Ground water	251 ppm
6	Peddapuram	Ground water	321 ppm
7	Gandepalli	underground water	220 ppm
8	Mallepalli	Surface water	151 ppm
9	Kondapalli	Bore water	214 ppm
10	Anuru	Ground water	138 ppm

Table 3 :- Results

➢ *Graph:*

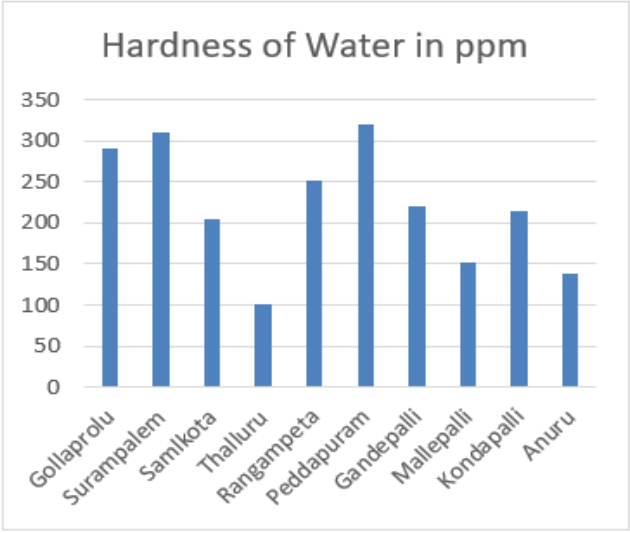

Fig 1 Hardness of Water in PPM

The total ten samples collected from the different areas & tested in the chemical laboratory followed by titrimetric analysis with the help of EDTA. Water samples collected in purified bottles and stored In a container temperature maintained to room temperature. In this season (winter) water temperatures observed very low.

V. CONCLUSION

The study concludes total hardness of the tested samples. Sample water types are different, their values

compared with the standards of the BSI and ICMR. All the samples are with hardness. Sample water tested in the laboratory highest hardness found in the water sample (Ground water) collected from the village peddapuram i. e. 321ppm and lowest moderate hardness 100 ppm recorded in the pond water sample collected from the village Thalluru. The results, analysis to aware the people who are used this water in their places.

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