CHEMISTRY RESEARCH PAPER ON HARDNESS OF WATER

Abstract: Water hardness is a common issue that affects the quality and usability of water in many regions worldwide. This abstract provides an overview of the causes, effects, and treatment methods associated with water hardness. Water with high concentration of minerals is hard water. Water is essential for life. But water with very high degrees of hardness is harmful to health. Hardness of water can be determined by EDTA titration method. Extreme degree of hardness is dangerous to health. The minerals that are supplemented to body through water will be beneficial to health in several ways. Water hardness is important to fish culture and is a commonly reported aspect of water quality. It is a measure of the quantity of divalent ions such as calcium, magnesium and/or iron in water. These minerals enter water sources through the natural leaching of rocks and minerals as well as from human activities such as industrial processes and the use of certain detergents. So public should be educated about degrees of hardness and its effects.

Introduction: Hardness, a physio chemical property of water, is generally a measure of calcium and magnesium ions in water. Zinc, iron, strontium, aluminium, and manganese can also contribute to water hardness; however, they are generally present in very low concentrations. These ions enter a water supply by leaching from minerals of rocks and soil. Initially, water hardness was understood to be a measure of the capacity of water to precipitate soap, it has been generally accepted that hardness is defined as the sum of the Ca and Mg concentrations, determined by the EDTA titration method, and expressed in ppm of sodium carbonate. The extreme degrees (very soft and very hard) are considered as undesirable concordantly from the technical and health points of

view, but the optimum Ca and Mg water levels are not easy to determine since the health requirements may not coincide with the technical ones. Health significance of water hardness was directly evidenced in the late 1950's.

The World Health Organization says that "there does not appear to be any convincing evidence that water hardness causes adverse health effects in humans" (WHO, 2003). In fact, the United States National Research Council has found that hard water can actually serve as a dietary supplement for calcium and magnesium. Hard drinking water is generally not harmful to one's health, but can pose serious problems in industrial settings, where water hardness is monitored to avoid costly breakdowns in boilers, cooling towers, and other equipment that handles water. In domestic settings, hard water is often indicated by a lack of suds formation when soap is agitated in water, and by the formation of lime scale in kettles and water heaters. Wherever water hardness is a concern, water softening is commonly used to reduce hard water's adverse effects. Keeping in view of all these things the present study was carried out to estimate the amount of hardness in the ground water of those areas.

Water hardness is important to fish culture and is commonly reported aspect of water quality. Calcium has an important role in the biological processes of fish. It is necessary for bone formation, blood clotting and other metabolic reactions. Fish can absorb calcium for these needs directly from the water or food. Sodium and potassium are the most important salts in fish blood and are critical for normal heart, nerve and muscle function. Hardness is commonly confused with alkalinity.

Hardness in water is due to the presence of dissolved salts of calcium and magnesium. It is unfit for drinking, bathing, washing and it also forms scales in boilers. Hence it is necessary to estimate the amount of hardness producing substances present in the water sample. Once it is estimated, the amount of chemicals required for the treatment of water can be calculated. The estimation of hardness is based on complexometric titration. Hardness of water is determined by titrating with a standard solution of ethylene diamine tetra acetic acid (EDTA) which is a complexing agent. Since EDTA is insoluble in water, the disodium salt of EDTA is taken for this experiment. EDTA can form four or six coordination bonds with a metal ion. Two type of hardness is present in water first is temporary hardness and second is permanent hardness. Temporary hardness is due to the presence of bicarbonates of calcium and magnesium ions. It can be easily removed by boiling. Permanent

hardness is due to the presence of chlorides and sulphates of calcium and magnesium ions. This type of hardness cannot be removed by boiling.

Experimental Procedure:

1. Add EDTA salt to the weighing tube and transfer the salt to the flask. Proceed to weight the empty weighing tube and note the values.
2. Add 3 – 4 ml of ammonia and distilled water to the flask and mix thoroughly and fill the flask with 250 ml of distilled water. Transfer this standard solution into the burette.
3. In a conical flask take 25 ml of hard water, 3 ml of buffer solution and a pinch of Eriochrome black – T indicator. Wine red colour is observed when mixed.
4. Note the initial reading.
5. Titrate this standard solution against the hard water. At the end point colour changes from wine red to pale blue colour.
6. Note the final reading and record it. Repeat the process till we get concordant value.

Results and Discussion:

1. **Preparation of standard Na_2EDTA solution**:

Weight of weighing bottle + Na_2EDTA	5.4150
Weight of empty weighing bottle	3.5154
Weight of Na_2EDTA salt transferred	1.8996

$$Molarity\ of\ Na_2EDTA\ solution = \frac{Weight\ of\ Na_2EDTA\ dissolved\ in\ 250\ ml\ *\ 4}{Gram\ molecular\ weight\ of\ Na_2EDTA}$$

$$= \frac{1.8996 * 4}{372.14}$$

= 0.0204 (A)

2. **Estimation of hardness**:

'B' mL of 'A' M Na_2EDTA = $\frac{100 * A * B}{1000}$ (C) g of $CaCO_3$

25 mL of hard water contains 'C' g of $CaCO_3$

Therefore, 10^6 mL of hard water contains $\frac{C * 10^6}{25}$ g of $CaCO_3$

($g/10^6$ ml hard water = mg/dm^3 = ppm)

S. No.	Location	Coordinates	Volume of Na_2EDTA consumed (B)	(C) g of $CaCO_3$	ppm	pH
1.	Jayanagar 3rd block	12.9333065, 77.5833574	3.7	0.007548	301.92	6.98
2.	Amaatra Hostel	12.894954, 77.673466	5.6	0.011424	456.96	7.25
3.	HSR Layout	12.9131341, 77.6485911	3.6	0.007344	293.76	6.99
4.	Jayanagar 1st block	12.940252, 77.587465	3.1	0.006324	252.96	6.91
5.	P.G Electronic city	28.519890, 77.202777	8.3	0.016932	677.28	6.8

Hard drinking water is generally not harmful to one's health, (WHO, 2003) but can pose serious problems in industrial settings. Most of the people especially housewives dislike hard water because it does not lather well or does not taste good, but they may not be knowing that it may prolong their lives, and more especially their husband. Calcium, one of the components of hard water, can be protective because it makes water less corrosive and less likely to leach toxic trace minerals, such as cadmium and lead, out of metal pipes. According to the U.S. National Academy of Sciences by 1977 there had been more than 50 studies, in nine countries, that had indicated an inverse relationship between water hardness and mortality from cardiovascular disease. Most of the scientists have indicated a negative statistical association of various types of cancer morbidity/mortality with the hardness of water and calcium. Some studies correlate domestic hard water usage with increased eczema in children.

Conclusion: Most of the people dislikes to use hard water, magnesium and calcium are having some protective effect on cardiovascular mortality, the evidence being debated and does not prove causality and also the drinking

water is the source of calcium and magnesium intake which are essential for the body. Hence it would be better if we bring awareness among the public.

Reference:

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