

## Determination of hardness in ground water samples of Moradabad by titrimetric method

### Abstract

The water which contain high concentration of calcium, magnesium chlorides, sulfates and bicarbonates is hard water. Water is the essence of life . But water with high degree of hardness is of no use for domestic and industrial applications. Twenty samples of ground water have been collected from district Moradabad and two different villages. The hardness of water is determined by EDTA titrimetric method. Out of all the samples tested 39 (32.5%) samples were moderately hard, 76 (63.33%) samples were hard water and 5(4.16%) samples were of very hard water . Very hard water is dangerous to health. The present Study did not revealed any soft water. There is a false notion that hard water is harmful to health , it's not hard water , it is very hard water (> 180ppm) . It has been noticed that minerals may be beneficial for good health to some extent .So public should be educated about degrees of hardness and its effects.

**Keywords:** Titrimetric method, Ground water, Hardness, samples, calcium

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Received on 22.09.2022

Accepted on 25.12.2022

### Introduction

Hardness of water is a physic- chemical property of water . The concentration of calcium and magnesium ions is determined in water samples. Some time presence of Aluminium, Zinc , Iron , Strontium , also contribute to hardness of water. However they are generally present in very low concentrations(NRC, 1974). These ions

reach the water supply by leaching from minerals of rocks and soil. The calcium is obtained from lime stone (calcium carbonate ) and chalk ( calcium sulfate). The magnesium is obtained from dolomite which also gives calcium ions (Gumashta et al., 2012). Water hardness is the soap consuming capacity of hard water. When hard water is rubbed with hard water. It produce sticky substance as calcium /magnesium stearate or palmitate. Initially the presence of polyvalent cations like Ca, Mg, Sr, Ba, Fe, Al, Mn etc. were considered, as hardness producing cations but later on hardness was defined as the sum of the calcium and magnesium concentrations, determined by EDTA titrimetric method, and expressed in ppm or mg/l( Standard Methods , 1998).The presence of anions classify the types of hardness e.g. temporary hardness and permanent hardness. The temporary hardness can be removed by simply boiling the water while permanent hardness can not be removed by boiling the water. The temporary hardness is also known as carbonate hardness while non carbonate hardness is known as permanent hardness. The total hardness means both temporary hardness and permanent hardness.

Based on the types of calcium and magnesium salts in water, it is categorized as soft or hard and very hard water (Sengupta, 2013). From the technical point of view, multiple different scales of water hardness have been suggested ( eg. Very soft- soft-medium hard –very hard). It is expected that both extreme degrees i.e 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 (Kosisek, 2003).

The awareness about the hardness of water evidenced in late 1950's. The relationship between water hardness and the incidence of vascular disease was first described by a Japanese chemist Kobayashi(Kobayashi, 1957), who showed , based on epidemiological analysis , higher mortality rate from cerebrovascular diseases (Stroke) in the areas of Japanese rivers with more alkaline (i.e harder) water used for drinking purposes .

The WHO 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 State National Research Council has found that hard water can actually serve as a dietary supplement for calcium and Magnesium (NRC,1974).It has been found that generally hard water is not harmful to one's health. But can pose serious problems in industrial applications. The hard water produce scales, sludges, corrosion, priming, foaming and caustic embrittlement including cooling towers and other equipments that handles hard 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. The hard water is soften by various methods for the proper use in domestic and industrial usage. Keeping in view of all adverse effect of hard water the present study was carried out to estimate the amount of hardness in the ground water of Moradabad and nearby villages of Sambhal and Amroha.

## Experimental Section

### Material and Method

One hundred and twenty (120) ground water samples were collected from district Moradabad Uttar Pradesh and two adjacent villages . All the water samples were collected aseptically in a sterilized screw capped glass bottles and brought to the laboratory. The hardness of all water samples was tested by using EDTA titrimetric method by taking 50 ml of water sample into a conical flask along with 100ml of ammonia buffer solution and 100-200mg of Eriochrome Black –T indicator followed by titration with EDTA solution present in burette .End point is noted down by changing of the water solution colour from wine to blue and expressed as CaCO<sub>3</sub>equivalent in mg/l ( Standard Methods, 1998).amount of hardness in water was calculated by using the formula:

Hardness as mg/l CaCO<sub>3</sub> =ml of EDTA solution x1000/ volume of water sample taken.

### Hard and soft water, as per the table below

Classification	Hardness in mg/l	Hardness in ppm
Soft (S)	0-60	less than 60
Moderately hard (MH)	61-120	60-120
Hard (H)	121-180	120-180
Very hard (VH)	≥181	≥180

### Table showing the results for hardness of different ground water samples

S. No	Place of sample	No of samples	Showing degree of hardness	% of sample
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1	Moradabad	40	S-0	S-0
			MH-17	MH-42.5
			H-21	H-52.5
			VH-02	VH-5
2	Village sambhal	40	S-0	S-0
			MH-12	MH—30
			H-27	H-67.5
			VH-01	2.5
3	Village Amroha	40	S-0	S-0
			MH-10	2.5
			H-28	70
			VH-02	0.5

**S=Soft water, MH=Moderately hard water, H=Hard water, VH= Very hard water**

## RESULTS AND DISCUSSION

The present studies have revealed that out of three places, the two villages have shown high level of hardness as compared to the town. In Moradabad town, out of 40 water samples collected, almost all the samples were moderately hard (42.5%) and hard water samples (52.5%). Only few samples were very hard water (5%).

The results of villages were different from the results of town. Forty each number of samples were collected from two villages.

In Sambhal village, more number of samples have shown hardness between 150-300mg/l of  $\text{CaCO}_3$  (67.5%) i.e hard water. Some of the samples have shown moderate hardness (30%) and very few of them have shown extreme hardness (2.5%). Similar type of results was found in the study of samples of Amroha village also. The results are Hard water (70%), Moderately hard water (2.5%), and very hard water (5%). Finally

No soft water sample was found in all the 120 samples (Table). Altogether out of 120 samples, most of the samples are found hard water (63.33%). There are only 5 samples (4.16%) which are found to be very hard water. According to Kozisek (2003) both the extreme degrees of hardness are dangerous to human health i.e very hard and very soft water. The present study did not find any soft water. But it has been reported that there are few samples (4.16%) which are very hard and can be ignored. Water intake of cattle and milk production have been found unaffected by water containing up to 290 ppm of hardness (NRC, 1974). Hence The water is safe for cattle in the town and villages. Hard drinking water is generally not harmful to human health (WHO, 2003) but can pose serious problems in industrial settings. Most of the people especially House wives dislike hard water because it is useless for washing the clothes. Calcium is the element which reduces the corrosion and less likely to leach toxic trace minerals, such as cadmium and lead, out of metal pipes (Seelig, 1977). According to the US National Academy of Sciences, 1977, there had been more than 50 studies, in nine countries that it has inverse relationship between water Hardness and mortality from cardiovascular disease (Harold and Foster, 1994).

Most of the scientists have indicated a negative statistical association of various types of cancer morbidity /mortality with the hardness of water and calcium (Yang, 1998). Some studies showed increased eczema in children (Miyake et al, 2004) and Arnedo –Pena, 2007).

## CONCLUSION

The present study has proved that extreme degree of hardness is only 4.16% of the samples which may not be harmful to the people. Although majority of people dislike the use of hard water. It has been found that concentration of Ca and Mg ions show some protective effect on cardiovascular mortality. The use of hard water does not give any evidence to prove casualty among those people who are using hard water. The required concentration of Ca and Mg are good for sound health but excess of Ca is not good for bones as it causes extra growth of bones specially in the back bone and become a big problem. Some people think that hard water is harmful to health. It has been found that extremely hard water creates exosmosis of blood cells . This is important to bring awareness among the people about soft, moderately hard , hard and very hard water.

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