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STUDY OF HARDNESS OF GROOUNDWATER IN DARBHANGA TOWN

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ABSTRACT

People use groundwater in different part of area for drinking and to fulfil their daily needs. Almost 33% of the world population use ground water for irrigation. In Darbhanga district apart from plenty of surface water, still groundwater is used by 90% of the population for drinking, irrigation and to fulfil their daily needs. In this region, groundwater is used by the population with varying levels of total hardness. The study was performed for the assessment of concentration of Calcium and Magnesium and total hardness of the drinking water. Total 50 samples of groundwater were collected from Darbhanga Town of Ten different places. The hardness of water was determined by the use of Lenntech Calculator. Extreme degree of harness is dangerous to health. The present study did not revealed any soft water in that area. Very hard water determined by the calculation of $CaCo_3$ with the measurement greater than 180 mg/l . But as per the BIS standard the $CaCo_3$ level of water should be up to 300mg/l. So we determined that in most of the sample the water is very hard water but that is not harmful as it is suitable for drinking. The minerals that are supplemented to body through water will be beneficial to health in several ways. So public should be educated about water hardness and its effects.

KEYWORDS :-*Calcium, Magnesium, water hardness, Lenntech Calculator.*

1. INTRODUCTION

Water is the most important compound on earth which is needed for the survival of life. Water hardness is caused by compounds of Calcium and Magnesium with another different metals. General guidelines used for classification of water are : If we found Calcium Carbonate with level 0 - 60 mg/l (milligrams per Liter) then it is classified as Soft Water, if Calcium Carbonate found in water with level 61 – 120 mg/l then it is classified as Moderately Hard Water, , if Calcium Carbonate found in water with level 121 – 180 mg/l then it is classified as Hard Water and if Calcium Carbonate found more than 180 mg/l it is classified as very hard water.

The hardness of groundwater is because of soluble bicarbonates, chlorides, and sulfates of calcium and magnesium present in water. Hard water is checked with the lather of Soap, if water does not give lather with soap is called hard water.

For survival of life on Earth, water is the most important compound. Water is present everywhere, mainly it is seen in the oceans, rivers, ponds, lakes, glaciers, etc. Among all the sources of water, Rainwater is considered as pure water, because it does not contain any salt dissolved in it. Permanent hardness of the water is usually caused by presence of Calcium Sulphate or magnesium sulphate in water and it cannot be removed by boiling and the temporary hardness of the water is caused by presence of dissolved calcium bi-carbonate and magnesium bi-carbonate.The presence of metal Cations make water hard and can be removed by boiling.

Water hardness is directly affect the health was evidenced in 1950s. In 1957,Japanese Chemist Kobayashi, based on his Epidemiological Analysis, firstly described the relationship between water hardness and the incidence of vascular diseases. His area of study was Japanese River and during study he found higher mortality rates from cerebrovascular diseases (stroke) with more acid in soft water compared to those with moreAlkalinein hard water which was been used for drinking purposes.In 2003, The World Health Organization describes that "there does not appear to be any convincing evidence that water hardness is because of adverse health effects in humans". The research of NRC in 1974 in USA, revealed 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.

2. MATERIALS AND METHODS

Total 100 One hundred samples were collected from twenty different place of darbhanga town. The thesis was on “Study on Assessment of Groundwater Quality of Darbhanga Town with Reference to Seasonal variation in some Physico-Chemical Properties and its impact on human”. For present study we have taken the same data of Fifty (50), Samples from ten different places of darbhanga. We have taken the calcium hardness and magnesium hardness from that sample and calculated Calcium Carbonate with the help of LENNTECH CALCULATOR.

Water Hardness Calculator

TOTAL PERMANENT HARDNESS = CALCIUM HARDNESS + MAGNESIUM HARDNESS

The calcium and magnesium hardness is the concentration of calcium and magnesium ions expressed as equivalent of calcium carbonate. The molar mass of $CaCO_3$, Ca^{2+} and Mg^{2+} are respectively 100,1 g/mol, 40,1 g/mol and 24,3 g/mol.

The ratio of the molar masses are:

$$\frac{M_{CaCO_3}}{M_{Ca}} = \frac{100,1}{40,1} = 2,5 \qquad \frac{M_{CaCO_3}}{M_{Mg}} = \frac{100,1}{24,3} = 4,1$$

So total permanent water hardness expressed as equivalent of $CaCO_3$ can be calculated with the following formula:

$$\left[CaCO_3\right] = 2,5 \cdot \left[Ca^{2+}\right] + 4,1 \cdot \left[Mg^{2+}\right]$$

United States Geological Survey had classified the water into hard and soft water, as per thetable below

Classification	hardness in mg/L	hardness in mmol/L	Hardnessind GH/°dH	hardness in gpg	hardness in ppm
Soft	0-60	0-0.60	0-3.37	0-3.50	Less than 60
Moderately	61-120	0.61-1.20	3.38-6.74	3.56-7.01	60-120
Hard	121-180	1.21-1.80	6.75–10.11	7.06-10.51	120-180
Very Hard	≥181	≥1.81	≥ 10.12	≥10.57	≥180

With the help of above formula, and above table, we have prepared the table of all 50 samples collected from thesis and calculated the amount of water hardness. The table is given below :-

Table showing the results for hardness of different ground water samples from different place of Darbhanga

Table 1

Name of Place	Qadirabad Bus Stand, Darbhanga				
Parameters	sample 1	sample 2	sample 3	sample 4	sample 5
Cal. Hard (mg/l)	70	73	72	70	74
Mg (mg/l)	27	29	28	29	29
CaCo3	286	301	295	294	304
Hardness of Water	very hard water	very hard water	very hard water	very hard water	very hard water

Table 2

Name of Place	DarbhangaTower,Darbhanga				
Parameters	sample 1	sample 2	sample 3	sample 4	sample 5
Cal. Hard (mg/l)	70	72	65	67	73
Mg (mg/l)	28	26	25	29	28
CaCo3	290	287	265	286	297
Hardness of Water	very hard water	very hard water	very hard water	very hard water	very hard water

Table 3

Name of Place	Hospital Road ,Darbhanga				
Parameters	sample 1	sample 2	sample 3	sample 4	sample 5
Cal. Hard (mg/l)	68	70	72	73	65
Mg (mg/l)	28	25	27	25	29
CaCo3	285	278	291	285	281
Hardness of Water	very hard water	very hard water	very hard water	very hard water	very hard water

Table 4

Name of Place	Kabirchak ,Darbhanga				
Parameters	sample 1	sample 2	sample 3	sample 4	sample 5
Cal. Hard (mg/l)	72	70	72	74	70
Mg (mg/l)	28	22	25	26	29
CaCo3	295	265	283	292	294
Hardness of Water	very hard water	very hard water	very hard water	very hard water	very hard water

Table 5

Name of Place	Dharmpur ,Darbhanga				
Parameters	sample 1	sample 2	sample 3	sample 4	sample 5
Cal. Hard (mg/l)	69	68	67	65	70
Mg (mg/l)	28	26	24	22	29
CaCo3	287	277	266	253	294
Hardness of Water	very hard water	very hard water	very hard water	very hard water	very hard water

Table 6

Name of Place	Laxmisagar ,Darbhanga				
Parameters	sample 1	sample 2	sample 3	sample 4	sample 5
Cal. Hard (mg/l)	70	72	68	73	72
Mg (mg/l)	25	28	27	29	26
CaCo3	278	295	281	301	287
Hardness of Water	very hard water	very hard water	very hard water	very hard water	very hard water

Table 7

Name of Place	Kathalbari,Darbhanga				

Parameters	sample 1	sample 2	sample 3	sample 4	sample 5
Cal. Hard (mg/l)	70	72	73	70	74
Mg (mg/l)	29	28	25	26	27
CaCo3	294	295	285	282	296
Hardness of Water	very hard water	very hard water	very hard water	very hard water	very hard water

Table 8

Name of Place	Sunderpur, Darbhanga				
Parameters	sample 1	sample 2	sample 3	sample 4	sample 5
Cal. Hard (mg/l)	72	73	70	72	74
Mg (mg/l)	28	29	28	25	26
CaCo3	295	301	290	283	292
Hardness of Water	very hard water	very hard water	very hard water	very hard water	very hard water

Table 9

Name of Place	KagwaGumti, Darbhanga				
Parameters	sample 1	sample 2	sample 3	sample 4	sample 5
Cal. Hard (mg/l)	73	72	70	72	73
Mg (mg/l)	29	28	25	26	28
CaCo3	301	295	278	287	297
Hardness of Water	very hard water	very hard water	very hard water	very hard water	very hard water

Table 10

Name of Place	ShivdharaDarbhanga				
Parameters	sample 1	sample 2	sample 3	sample 4	sample 5
Cal. Hard (mg/l)	72	70	71	70	72
Mg (mg/l)	28	26	25	29	28
CaCo3	295	282	280	294	295
Hardness of Water	very hard water	very hard water	very hard water	very hard water	very hard water

Table showing the results of hardness of ground water as per BIS (Bureau of Indian standards: IS :10500:1991)

NAME OF PLACE	<,=300	>300
QADIRABAD	3	2
DARBHANGA TOWER	5	0
HOPITAL ROAD	5	0
KABIRCHAK	5	0
DHARAMPUR	5	0
LAXMISAGAR	4	1
KATHALBARI	5	0
SUNDERPUR	4	1
KAGWAGUMTI	4	1
SHIVDHARA	5	0

3. RESULT AND DISCUSSION

It is specified that the total hardness of water depends upon the calculation of $CaCo_3$ in groundwater. As per the specification of Bureau of Indian Standards IS:10500:1991, the desirable limit of $CaCo_3$ in ground water should be below (<,=) 300 mg/l.

The present analysis revealed that in all ten places the hardness of water is very high and as per United States Geological Survey classification it falls under the category of VERY HARD WATER. Further we have analyse that in Qadirabad area, out of five samples two sample found the content of $CaCo_3$ is more than 300mg/l. It shows the hardness of water is increasing. In Darbhanga Tower area, Hospital Road, Kabirchak,Dharampur,Kathalwari&Shivdhara, we found all the samples qualify the BIS standard and is fit for drinking water. In Laxmisagar, Sunderpur and Kagwagumti we found that out of five samples, four are qualified the criteria of desirable limit of BIS Standard but one sample fails the desirable criteria.

According to Kozisek (2003) both the extreme degree to hardness are dangerous to human health i.e. very hard and very soft water. The present study did not revealed the presence of any soft water, but reported very hard water. Accordingly to WHO, 2003 hard drinking water is generally not harmful to health but can pose serious problem in Industrial Set up. According to U.S. National Academy of Science 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 (Harold and Foster,1994). Some Studies correlate domestic hard water uses with increased eczema in children(McNally,1998,Miyake et al, 2004 and Arnedo-Pena,2007.

4. CONCLUSION

The present study had revealed extreme degree of hardness is hundred percent but maynot be harmful to people for drinking. Although, most of the people dislike to usehardwaterbecause Most of the people are in false opinion that hard water is harmful to health, it’s not hard Water(extreme degrees of Hardness).So it would be better to educate the people regarding hardness of water.

REFERENCE

1. APHA,AWWA,WPCE,1998 standard method for water and waste water.20th Ed. Am. Public Hlth. Assoc…Washington USA.
2. Romeo, M.S.Beeteshwari, K. And Gupta A 2009, Water quality status of Iril river, Manipur. Journal of Current Science. 14(1):173-180.
3. Ashbin K, Mishap O and Shah SB 2008 Seasonal periodicity and pollution level of LNMU Campus Pond Darbhanga. 2nd J. Env. Ecoplann. 15(1-2):369-371
4. Drinking Water Hardwater Hardness Calcium Magnesium Scale Stained Laundry. Water-research.net. Retrieved 2013-01-26.
5. Kobayashi, J. 1957. On geographical relations between the chemical nature of river water and death rate from apoplexy. Ber. OharaInstlandwirt. Biol., 11: 12-21.
6. Kožišek, F. 2003. Health significance of drinking water calcium and magnesium. National Institute of Public
7. Seelig M.S. 1989. Cardiovascular Consequences Of Magnesium Deficiency And Loss: Pathogenesis, Prevalence And Manifestations- Magnesium and Chloride Loss In Refractory Potassium Repletion. The American Journal of Cardiology., 63(14): G4-G21
8. Standard Methods for the Examination of Water and Wastewater (1998). – #2340 Hardness. 20th ed. American Public Health Association / American Water Works Association / Water Environment Federation, Washington, DC. [19] Time, Medicine: Hard Water, Soft Arteries? (Monday, May. 02, 1960) VOL LXXV NO.18 Available at http://www.time.com/time/magazine/0,9263,760160050 2,00.html . accessed on December 30th, 2011.
9. World Health Organization. (2003). Hardness in drinking water. [21] Yang, C.Y. 1998.
10. Calcium and magnesium in drinking water and risk of death from cerebrovascular disease.Stroke., 29: 411-4.
11. R. P. Singh and P. Mathur. Investigation of variation in Physico-chemical characteristics of a fresh water reservoir of Ajmer city, Rajasthan. Ind. J. Env. Sci. 2005, 9: 57-61
12. Kumar P. and Sharma H. B. Physico-chemical characteristics of lentic water of Radhakund, district Mathura. Ind. J. Env. Sci.2005, 9: 21-22.
13. Mathur P., Agarwal and Nag M. Assessment of physicochemcial characteristics and suggested restoration measures for Pushkar Lake, Ajmer Rajashthan India, Proceeding of Taal 2007: The 12th world lake conference. 2008, 1518-1529.