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PHYSICO – CHEMICAL ANALYSIS OF BORE WELL WATER OF GANGASANDRA VILLAGE, TUMKUR DISTRICT, KARNATAKA, INDIA

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ABSTRACT
Getting pure water for drinking and domestic purposes is a basic requirement for healthy life. Due to increase in water and soil pollution, availability of pure water has become a big challenge. Municipal wastes are dumped in surrounding areas and as a result, ground water is getting polluted even in rural areas in the vicinity of big cities. The present study was conducted to assess the quality of ground water in a small village and help to create the awareness among villagers and to prevent the ground water from getting polluted. The physico – chemical parameters like Temperature, pH, Alkalinity, Total Dissolved Solids, Total hardness, Temporary and Permanent hardness, Mg^{2+} and Ca^{2+} ions of bore well water were studied and analysed. The results were compared with the WHO and ISI standards to draw the final conclusion on the quality of bore well water.

KEY WORDS: Standard methods, Total hardness, Alkalinity, Electrical conductivity, p^H.

INTRODUCTION
Water is one of the most fundamental and essential component to all living beings. The water which is used for drinking and domestic purposes should possess high degree of purity and should be free from the pollutants. Groundwater is a natural resource and is the major source for drinking and domestic purposes in both urban and rural areas. Growing population and its necessities have lead to the deterioration of surface and sub surface water. Since groundwater moves through rocks and subsurface soil, it has opportunity to dissolve substances. Many areas of ground water and surface water are now contaminated with toxic metals, organic pollutants that can effect on health of living beings. Contamination of water can cause water borne diseases. Gangasandra village people depend completely on bore well water for their water needs. Majority of the houses have dig their own bore wells for water supplies. The average depth of the bore wells is around 183m. The aim of this study is to assess the quality of bore well water and its suitability for consumption. Many authors have studied the quality of water [1, 2, 4, 5, 6], but the major studies have restricted to urban areas and not the rural areas [8–20]. The present study is to have a detailed picture of the impurities in the water.

MATERIALS & METHODS
Samples were collected from different bore wells from the village Gangasandra as per standard procedure. The various physico – chemical parameters were studied and results were compared with the WHO and ISI standards [7]. All the chemicals used were of AR grade and double distilled water was used to prepare the reagents and solutions. p^H and Electrical Conductivity were determined using Digital Systronics pH – meter and Systronics – Conductometer respectively. The water quality parameters studied were pH, Electrical Conductivity, Alkalinity, Total dissolved solids, Calcium and Magnesium ions, Total hardness, Temporary and Permanent hardness. Temperature of the samples was noted at their sampling points. Standards methods were employed for the determination of the various parameters [3]. The WHO and ISI standards are listed in Table 1.

RESULTS & DISCUSSION
All the water samples from different bore wells were collected in the month of January 2016. The samples were clear, colourless and odourless.

Temperature
Temperature is an important parameter because it affects the chemical and biochemical reactions. The temperature of the water samples was found to be in the range of 19^0C to 21^0C, shown in table 2.

p^H
p^H is defined as the negative logarithm of hydrogen ion concentration. The pH of natural water is between 6 and 8. Variations in pH values are due to the hydrolysis of salts of strong bases and weak acids or vice versa. The pH in all the samples was found to be in the range of 7.1 to 7.4 which was well within the permissible limit. (Table 2, Fig 1).

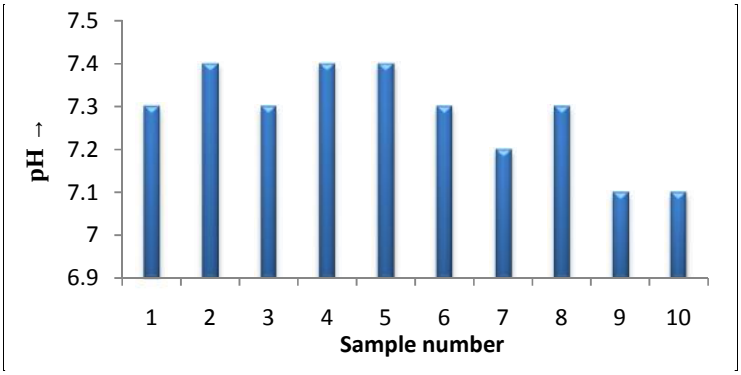

FIGURE 1: Graphical representation of pH

Alkalinity

Alkalinity is a measure of capacity of water or any solution to neutralize acids. Alkalinity in water is due to the presence of bicarbonates, carbonates and hydroxides ions. The desirable limit of alkalinity in potable water is 120 mg/L in WHO and 200 mg/L in ISI standards. All the water samples in this area exceeded the desirable limit. The increased alkalinity in water is may be extensively use of fertilizers for agriculture. (Table 2, Fig 2).

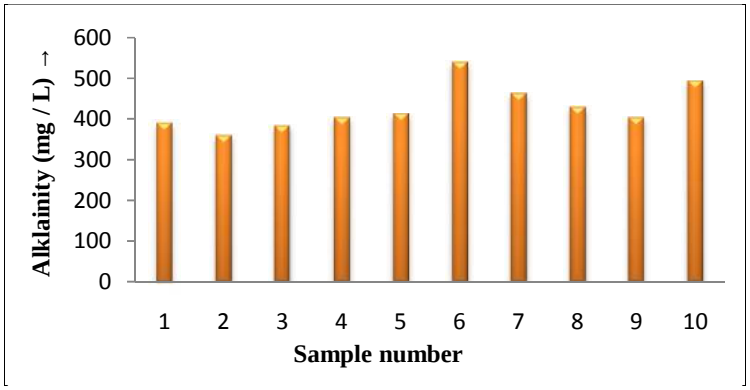

FIGURE 2: Graphical representation of Alkalinity

Electrical Conductivity (EC)

Electrical Conductivity is the measure of water capacity to conduct electrical current. Conductivity in water is affected by the presence of inorganic dissolved solids such as chloride, nitrate, sulphate and phosphate ions or sodium, magnesium, calcium, iron and aluminium ions. Electrical conductivity values were in between 1020 to 1640 micro mho/cm. Except for the sample 6 and 10, other samples show the values in the permissible limit. (Table 2, Fig 3).

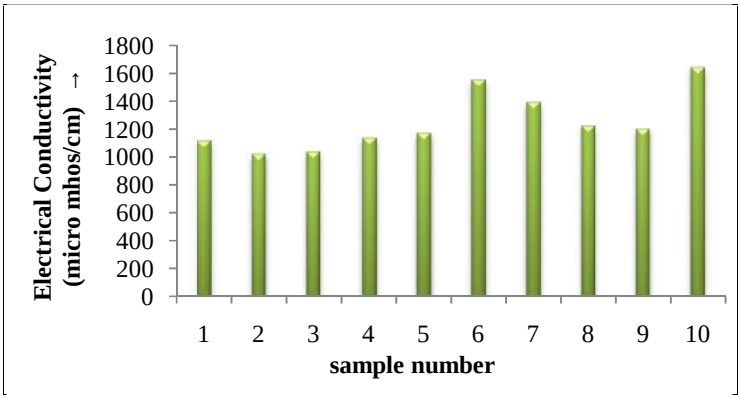

FIGURE 3: Graphical representation of Electrical Conductivity

Total Dissolved Solids (TDS)

Total dissolves solids is the sum of all the chemical ions dissolved in the water, *i.e*. carbonates, bicarbonates, sulphates, chlorides, nitrates, phosphates, iron, calcium, magnesium, sodium etc. Total dissolved solids in all samples were found in the range of 410 to 710 ppm which is little high according to ISI standards but is within WHO standards. (Table 2, Fig 4).

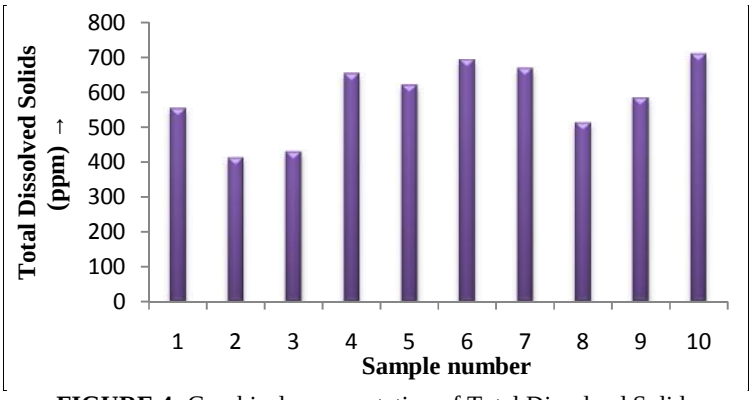

FIGURE 4: Graphical representation of Total Dissolved Solids

Total, Temporary and Permanent hardness

The total hardness is the sum of temporary and permanent hardness. Hardness is expressed in terms of $CaCO_3$ equivalents. The desirable limit for total hardness is 300 ppm according to ISI standards. Total hardness values in all the samples were found to be higher in the range of 376 to 580 mg / L indicates the water is very hard in this area. Permanent hardness is due to the presence of calcium and magnesium of chlorides and sulphates, cannot be removed by boiling the water. Temporary hardness is due to the presence of calcium and magnesium of bicarbonates, can be removed by boiling the water. The results in the table shows the temporary hardness in the range of 184 to 356 mg / L and permanent hardness is in the range of 144 to 240 mg / L. This further suggests that the water in this area is very hard. (Table 2, Fig 5).

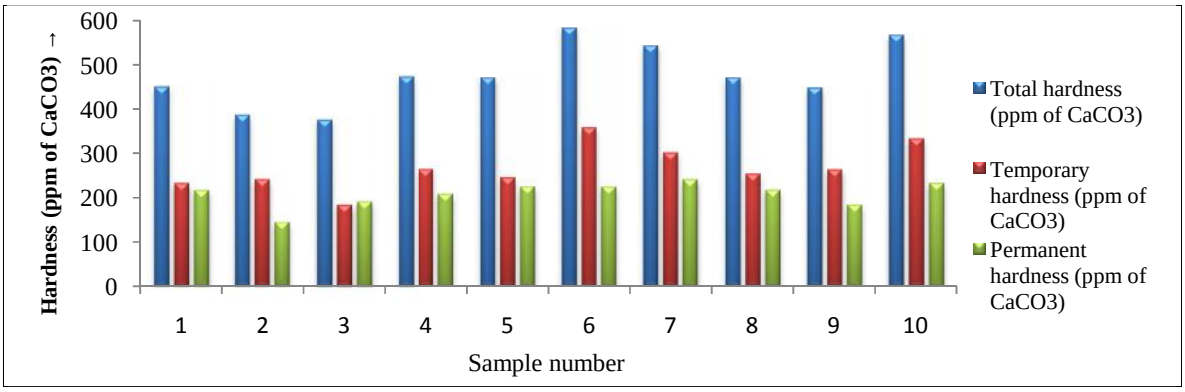

FIGURE 5: Graphical representation of Total, Temporary and Permanent hardness

Calcium and Magnesium ions

The presence of calcium and magnesium ions causes hardness of water. Its excess may lead to deposition of these minerals in the soft tissues of the living bodies and causes various kinds of illnesses such as stone formation in gall bladder, irritation in digestive tract, even cancer, etc. Calcium content in all samples was found to be in the range of 200 to 322 ppm of $CaCO_3$. The results show all samples exceeded the desirable limit. Magnesium content in all samples was found in the range of 116 to 258 ppm of $CaCO_3$. The results shows all the samples exceeded the desirable limit, except sample 2 and 3 is higher compared to ISI standards but is within the WHO standards. (Table 2, Fig 6).

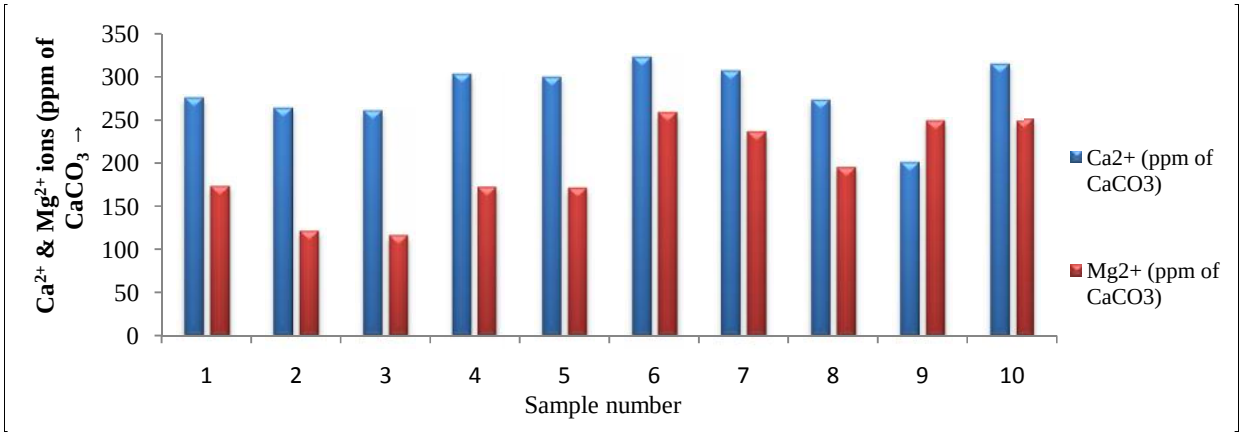

FIGURE 6: Graphical representation of Calcium and Magnesium ions

TABLE 1. Water Quality Parameters and Their WHO & ISI Standards

SL.No	Parameters	Method	WHO Standards	ISI Standards
1	Temp.	Thermometric	-----	-----
2	pH	pH meter	7.0 – 8.0	6.5 – 8.5
3	Electrical Conductivity	Conductometry	1400	-------
4	Total Dissolved Solid	Filtration Method	1000	500
5	Total Hardness	EDTA titration	100	300
6	Temporary hardness	EDTA titration	-----	-----
7	Permanent hardness	EDTA titration	-----	------
8	Calcium	EDTA titration	75	75
9	Magnesium	EDTA titration	150	30
10	TA	Titration Method	120	200

TABLE 2. Water Quality Parameters of water samples

Parameters	Sample number									
	1	2	3	4	5	6	7	8	9	10
pH	7.3	7.4	7.3	7.4	7.4	7.3	7.2	7.3	7.1	7.1
EC (micro mhos/cm)	1110	1020	1030	1130	1160	1540	1380	1210	1190	1640
TDS (ppm)	550	410	430	650	620	690	670	510	580	710
Alkalinity (mg / L)	390	360	380	400	410	540	460	430	400	490
Total hardness (ppm of $CaCO_3$)	448	348	376	472	468	580	540	468	448	564
Temporary hardness (ppm of $CaCO_3$)	232	240	184	264	244	356	300	252	264	232
Permanent hardness (ppm of $CaCO_3$)	216	144	192	208	224	224	240	216	184	232
Ca^{2+} (ppm of $CaCO_3$)	275	263	260	301	298	322	305	273	200	315
Mg^{2+} (ppm of $CaCO_3$)	173	121	116	171	170	258	235	195	248	249

CONCLUSION

After careful study of analysis of bore well water suggests that most of the collected samples from area contain high concentration of calcium, magnesium, hardness and alkalinity. Total dissolved solids and Electrical conductivity in some samples are found to be little higher according to WHO and ISI standards. pH is in the standard limits. Therefore the water should be subjected to softening methods before it is used for drinking and domestic purposes.

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