International Journal of Future Generation Communication and Networking
Vol. 13, No. 4, (2020), pp. 3145–3155

Assessment of Heavy Metals in Water of Rajajinagar, Bangalore

Prashanth N,
Assistant Professor, School of Civil Engineering,
REVA University, Bangalore, India.

Dr Y. Ramalinga Reddy ,
Dean and Director, School of Civil and Mechanical Engineering,
REVA University, Bangalore, India.

VidyaSagar J,
PG Student, School of Civil Engineering,
REVA University, Bangalore, India.

Nayanika S
Student, School of Civil Engineering,
REVA University, Bangalore, India.

Abstract

Water is the source of life, although earth contains 71% of water only 3% is fresh and potent which includes ground water, groundwater is the principle source of drinking water in most parts of urban areas and metropolitans. Rajajinagar, Bangalore has a huge valley of industries which are the source of wastewater generation , heavy metals like(Pb, Cr, Ni, Fe, Cu) from the waste water pollute the groundwater directly or indirectly that have and adverse effect on human and animal life .A study was conducted in and around Rajajinagar and from the various stations set across Rajajinagar to test pH, electrical conductivity, TDS (Total Dissolved Solids) ,Chlorides ,Sulphates and heavy metals such as Copper, Zinc, Nickel, Cadmium, Lead in groundwater. Around 21 samples of groundwater were taken in polythene containers of 1 litres capacity for the chemical analysis and it was concluded that the groundwater of Rajajinagar has pH, Calcium, Sulphates, Carbonates and Bicarbonates, Sodium, TDS and Copper within the permissible limit , while Magnesium, Chloride, Nickel and Iron are not within the permissible limits according to the BIS standards. The Lead and Copper levels are above the WHO standards for heavy metals in groundwater. Hence, effective treatment methods can be determined to treat the wastewater before supplying it for domestic and other purposes.

Keywords: *Groundwater, Heavy Metals, Lead, wastewater.*

1. Introduction

Groundwater has been the major source of drinking water in rural areas and urban areas in India. These days its a primary source used for industrial as well as agricultural sector. The characteristics of ground water changes with the change in geology of the particular area, depth of water table,seasonal changes , composition of dissolved solids based on sources of salt and surface of environment. The circumstances of industrialization and urbanization leads to spoiling of water. It is recognised that ground water gets polluted due to increase in human population, domestic sewage, industrial effluents, agricultural run off, and of various kinds of pollutants and human activities. Resulting to use of contaminated drinking water ,spike in cases of water borne diseases has been seen which can further lead to health hazards. It is up to the people and authorities to provide security and quality of the water.

Though heavy metals Cu, Fe, Zn, Ni and Mn are essential and provide micro nutrients to plants and microorganisms, other metals Cd, Pb and Cr are seen to be ineffective beyond certain limit. Through

ISSN: 2233-7857 IJFGCN

sufficient surface water infiltration, soil contaminants like heavy metals can effect or drainthe underlying groundwater. Results of heavy metals effects on groundwater are differ for different kinds of soil .The rate of movement of the groundwater regulates the occurance of these heavy metals in groundwater

2.Methodology

Bangalore which is above mean sea level at an altitude of 921 metres. Domestic sewage Industrial pollutants along Bangalore-Mysore State Highway (both treated and untreated) directly discharged to part of area. Rajajinagar is located on the west of the Bangalore city between 12.989174 latitude 77.55266 longitudes.

Meticulous planning and composing of a groundwater- sampling trip was carried out to save time and help overcome the difficulties that frequently occur with fieldwork. Precise sampling procedure starts with thorough preparation before sample collection. Each sample bottle is to be thoroughly cleaned and protected from any contamination during sample collection, preservation, and shipment to assure a high quality sample. Filtering instruments should be rinsed thoroughly to remove any mineral deposits in container vessels. The sample container vessels for organic analyses are to be acid-washed and rinsed several times with deionized water.

Grab sampling was adopted to collect groundwater samples. 21 and the samples were collected in polythene containers of 1 litres capacity to conduct chemical analysis after pumping out sufficient quantity of water from the source such that, the sample collected served as a representative sample. The samples thus collected were transported to the laboratory condition

The fundamental resolutions regarding the strategic positioning of the road transport enterprise are developed by the top management and are very general in nature. The specification of the strategic choices with respect to the real competitive situation in the market segment, the actual resource and organizational capabilities of the road transport enterprise is carried out by the middle management within the formation of functional strategies.

In a market economy, the following functional strategies are generally developed by the road transport enterprise: the marketing strategy, the financial strategy, the quality strategy, the manufacturing strategy, the social strategy, the strategy of technological and organizational change, the environmental strategy [12].

The groundwater quality was assessed by the analysis of chemical parameters such as pH, Electrical Conductivity, Total Dissolved Solids, Chlorides, Calcium Hardness, Nitrates, Sulphates and Heavy metals such as Iron. Copper, Zinc, Cadmium, Lead, Chromium and Nickel. The Bureau of Indian Standards (BIS) and world health organization for drinking water quality The analytical methods used to to determine the chemical parameters of groundwater samples collected from different sampling stations are listed in the table 1. The water samples were tested using standard methods in the Environmental engineering Laboratory, School of Civil Engineering, REVA University, Bangalore.

ISSN: 2233-7857 IJFGCN

Table 1: Techniques Used for analysis of Groundwater (Laboratory analytical methods)

Sl. No	Physic-chemical Parameter	Method
1	pH	Potentiometry (pH meter)
2	Chloride	Argentometry (Titration)
3	Total Hardness	EDTA titration
4	Calcium	Titration
5	Magnesium	Titration
6	Total Dissolved Solids	TDS Probe
7	Nitrate	Spectrophotometry
8	sodium	Spectrophotometry
9	Potassium	Spectrophotome

To assess the groundwater quality of the study area, the groundwater samples collected were analyzed for 11 physic-chemical parameters. The physic-chemical parameters were assessed within 24 hrs of sample collection. The water samples were analyzed adopting Standard Methods in the Environ5t mental Laboratory, School of Civil Engineering, REVA University, Bangalore.

The results of all the parameters for groundwater samples collected from existing 21 bore wells are presented in the Table 2. One of the purposes of the study is to understand the quality of groundwater around Rajajinagar, Bangalore

Sample No	Type	Latitude	Longitude	pH	E.C	Corbonates	Bicorbonates	Chlorides	Sulphates	Calcium	Magnesium	Sodium	Potassium	TDS
1	Commercial	13°0'17.5"	77°32'56.04"	7.1	0.12	0	334.96	78.1	16.27	1835	314.9	47.38	0.0332	2626.643
2	Commercial	12°59'59.64"	77°32'59.2"	8	0.09	1.98	200.12	74.19	6.37	2224	12.9	52.44	0	2570.02
3	Residential	12°59'23"	77°32'29"	7.8	0.29	0	215.37	82	27.72	4465	154.4	42.09	0.0913	4986.671
4	Commercial	12°59'2.69"	77°32'58.49"	8.1	0.09	0	245.27	91.94	7.83	4154	147.8	49.45	0.1162	4696.406
5	Industrial	12°58'57.47"	77°33'31.57"	7.7	0.57	0	305.06	91.94	68.4	4426	188.3	54.28	0	5133.98
6	Industrial	12°58'43.35"	77°33'6.29"	8	0.08	0	359.97	134.19	7.98	2627	119.6	76.36	0.0415	3325.142
7	Commercial	12°58'35.41"	77°32'55.01"	8.1	0.33	0	370.34	140.22	68.66	5087	148.1	78.89	0.116	5893.326
8	Residential	12°58'33.73"	77°32'23.85"	8.2	0.09	0	280.04	102.24	2.87	4572	537.1	55.43	0	5549.68
9	Commercial	12°59'3.45"	77°32'23.02"	7.7	0.12	0	259.91	116.08	7.57	4271	233.2	65.55	0	4953.31
10	Residential	12°58'55.55"	77°32'34.24"	8.1	0.15	0	276.38	91.94	29.02	3840	144.7	56.35	0	4438.39
11	Industrial	12°58'55.32"	77°32'49.3"	8	0.11	0	325.19	136.32	5.66	3789	304.5	95.45	0	4656.12
12	Residential	12°59'21.33"	77°32'39.51"	6.9	0.17	0	300.18	100.11	14.96	1443	326.6	65.32	0	2250.17
13	Residential	12°59'7.92"	77°32'17.96"	7.9	0.12	0	205	82	8.72	5636	228.4	50.6	0	6210.72
14	Residential	12°59'6.42"	77°32'2.35"	8.1	0.12	0	4.43	102.24	7.5	3037	92.68	64.4	0.1328	3308.383
15	Industrial	12°58'40.89"	77°32'3.48"	7.9	0.19	4.44	190.35	53.96	15.39	3662	161.3	50.37	0.0664	4133.436
16	Residential	12°59'0.18"	77°31'31.3"	8.1	0.15	0	325.19	124.36	9.56	3695	142.4	71.99	0.1411	4368.641
17	Residential	12°59'7.16"	77°31'14.87"	8.2	0.43	0	630.26	316.3	51.75	2989	260.5	184.46	0.2573	4432.527
18	Industrial	12°59'15.16"	77°31'18.92"	7.5	0.11	0	535.08	314.17	8.09	1917	123.9	132.71	0.166	3031.116
19	Residential	12°59'28.02"	77°31'29.63"	8.1	0.23	2.46	270.28	90.17	21.39	3050	436.7	64.63	0.1909	3933.361
20	Industrial	12°59'50.05"	77°31'52.44"	9.2	0.17	3.93	265.4	102.24	44.03	3499	112.6	67.16	0.36	4090.79
21	Residential	13°0'10.9"	77°32'5.36"	8.1	0.17	3.45	205	97.98	11.93	3081	209	68.31	0.2966	3673.517

ISSN: 2233-7857 IJFGCN

Table 2: Characteristics of Groundwater in study area

2.1 pH

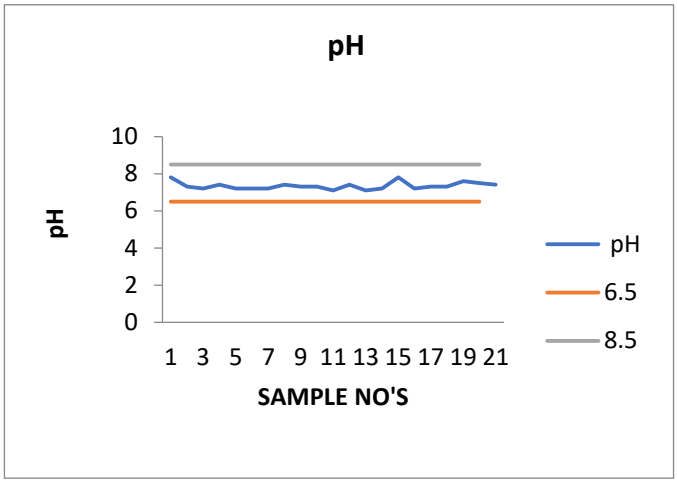

Figure 1: pH of the samples

In the study area, assessment of groundwater quality status indicates that all the values of pH levels are within the advisable limits of BIS for portability (drinking). The pH values in the study site were found to be in the range of 7.1-7.8 well within the desirable limit and above 7 indicates that water is alkaline in nature.

2.2 Electrical Conductivity

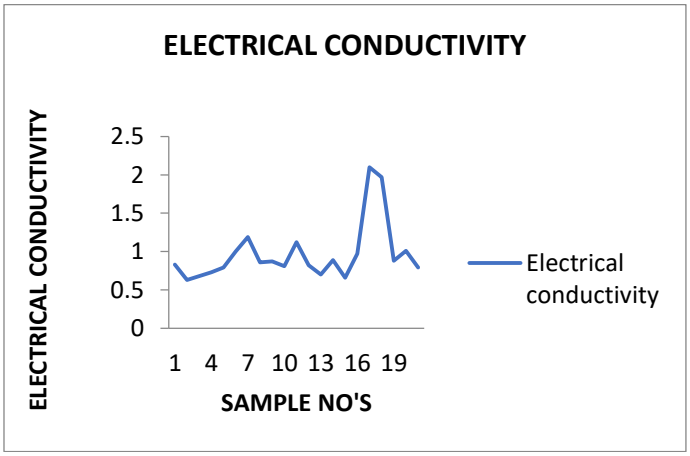

Figure 2: Variations of Electrical Conductivity in Groundwater of Study area

Most metals are extremely good conductors, Due to the availability of free or empty energy state and more number of excited electrons . The variation of electrical conductivity in ground water of study area as shown in figure.

2.3 Carbonate and Bicarbonate

ISSN: 2233-7857 IJFGCN

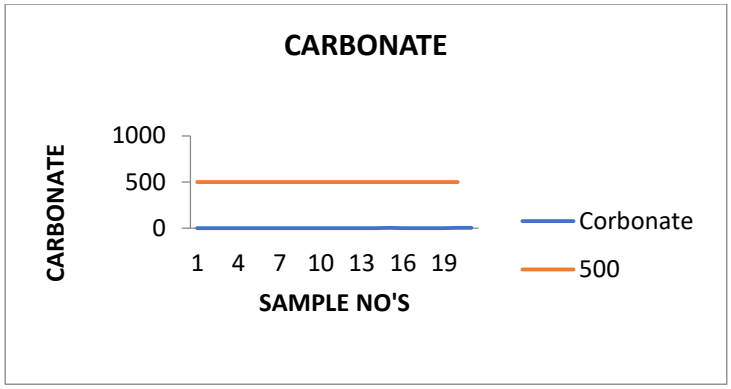

Figure 3: Variations of carbonates in Groundwater of Study area

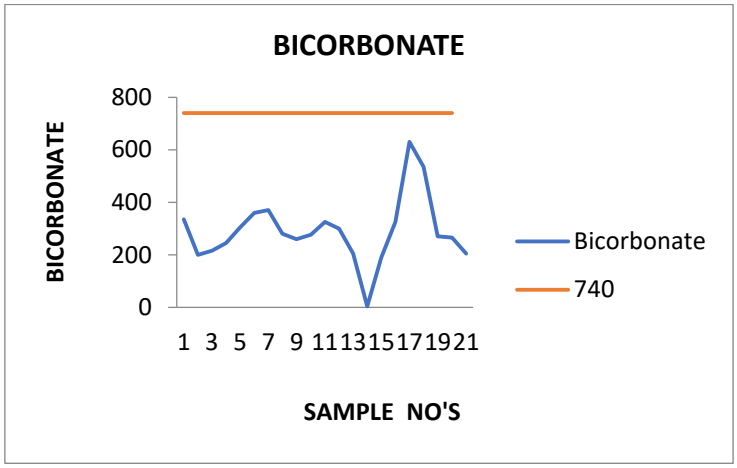

Figure 4: Variations of Bi-carbonates in Ground water of Study area

2.4 Chlorides

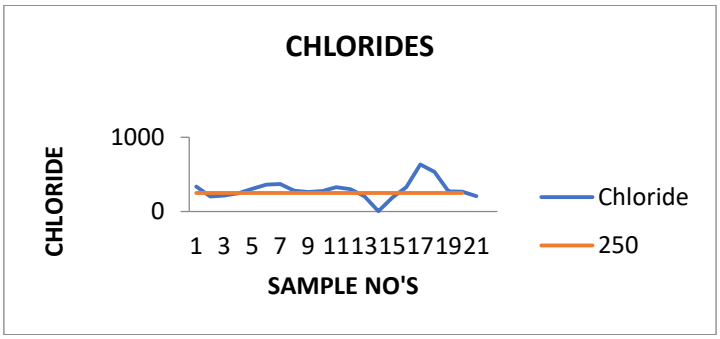

Figure 5: Variations of Chloride in Groundwater of Study area

Chloride content of groundwater samples in the study area were in the range of 53.96-316.13 mg/l. The sampling stations 17& 18 are not well within the permissible limit and The other sampling stations are well within the limit.

2.5 Sulphate

ISSN: 2233-7857 IJFGCN

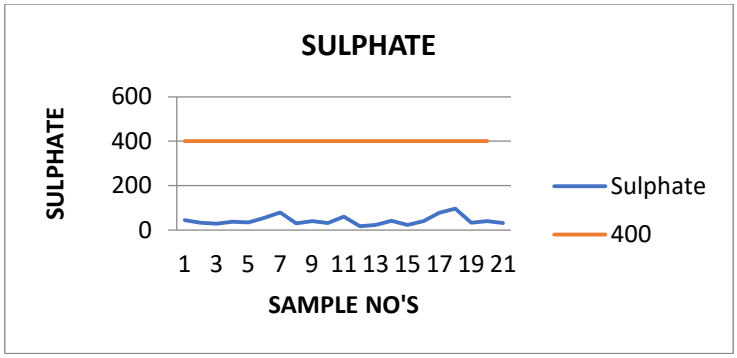

Figure 6: Variations of Sulphates in Groundwater of Study area

The variation of sulphates in ground water of study area as shown in figure

2.6 Calcium

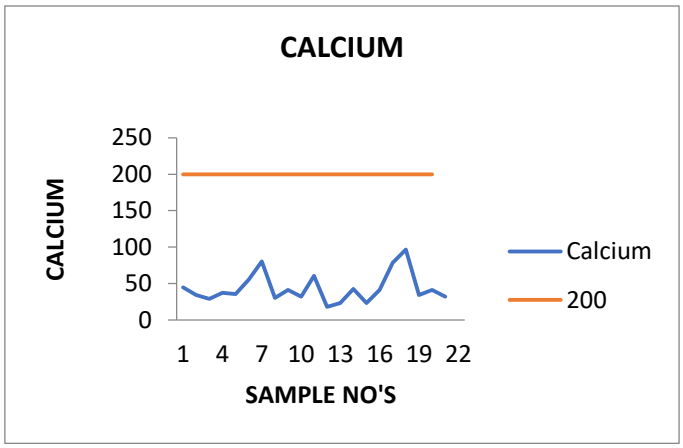

Figure 7: Variations of Calcium in Groundwater of Study area

In accordance to BIS and WHO standards, the acceptable limit for calcium is 200 mg/l. The present review, the groundwater samples have calcium concentration ranging 26.8-94.8 mg/l. The sampling stations 1 to 21 are well within the permissible limit.The disparity of calcium in area under study is shown in the above figure

2.7 Magnesium (Mg^{2+})

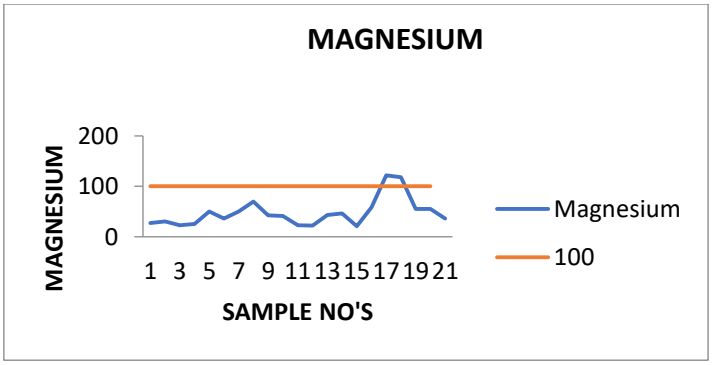

Figure 8: Variations of Magnesium in Groundwater of Study area

In the current study, the groundwater samples contain magnesium levels ranging between 21.12–122.04. The samples are within permissible limit excluding sample no 17 & 18. These two are not within the permissible limit & causes temporary hardness. The disparity of Magnesium in study

ISSN: 2233-7857 IJFGCN

region is shown in above figure

2.8 Sodium

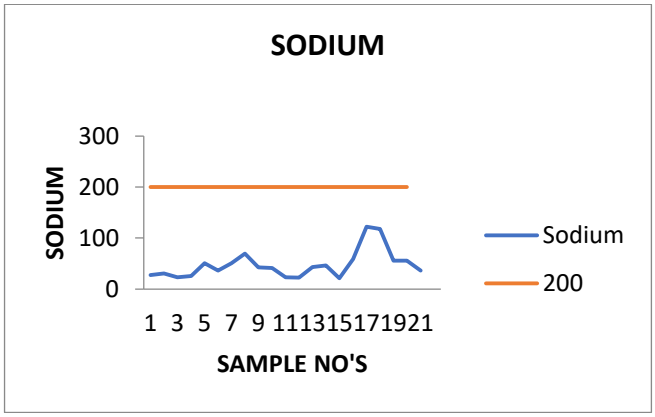

Figure 9: Variation of Sodium in Groundwater of Study area

In the present study, the groundwater samples have sodium concentrations varying from 42.09-184.6 which does not produce odour it can be used for domestic purposes and all the samples are under the permissible limit. The disparity of sodium levels in study area is shown in the above figure

2.9 Potassium

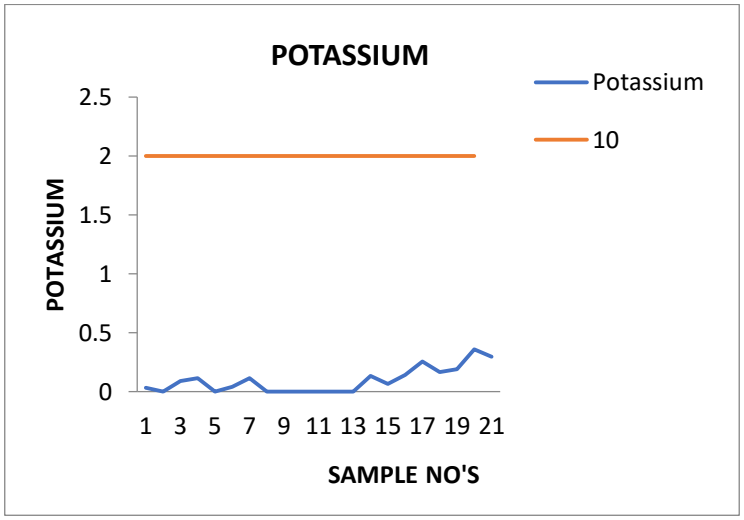

Figure 10: Variations of Potassium in Groundwater of Study area

In the current study, the groundwater samples contain Potassium concentrations varying from 0-0.2573.The disparity of Potassium in the area of inspection are shown in figure.

2.10 TDS

ISSN: 2233-7857 IJFGCN

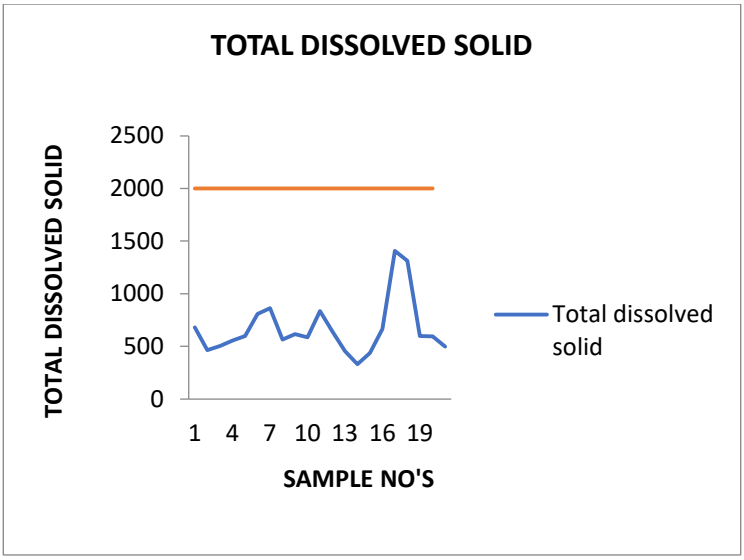

Figure 11: Variations of Total dissolved solids in Groundwater of Study area

From the analysis of the groundwater samples it is found that TDS value of all the samples were in the range of 330.76-1406.03 mg/l which is well within the permissible limit.

2.11 Heavy Metals in Groundwater

Table 3: Heavy Metals in Groundwater of Study area.

Sample No	Type	Latitude	Longitude	Iron	Nickel	Copper
1	Commercial	13°0'17.5"	77°32'56.04"	0.37	0.042	0.0245
2	Commercial	12°59'59.64"	77°32'59.2"	0.424	0.046	0.0368
3	Residential	12°59'23"	77°32'29"	0.173	0.011	0
4	Commercial	12°59'2.69"	77°32'58.49"	0.412	0.043	0.0462
5	Industrial	12°58'57.47"	77°33'31.57"	0.611	0.064	0
6	Industrial	12°58'43.35"	77°33'6.29"	0.592	0.061	0.0762
7	Commercial	12°58'35.41"	77°32'55.01"	0.392	0.0048	0.0463
8	Residential	12°58'33.73"	77°32'23.85"	0.192	0.025	0
9	Commercial	12°59'3.45"	77°32'23.02"	0.023	0	0.0542
10	Residential	12°58'55.55"	77°32'34.24"	0	0.029	0
11	Industrial	12°58'55.32"	77°32'49.3"	0.632	0.063	0.0652
12	Residential	12°59'21.33"	77°32'39.51"	0.162	0.027	0.03
13	Residential	12°59'7.92"	77°32'17.96"	0	0.021	0
14	Residential	12°59'6.42"	77°32'2.35"	0.174	0	0
15	Industrial	12°58'40.89"	77°32'3.48"	0.164	0.026	0
16	Residential	12°59'0.18"	77°31'31.3"	0.621	0.0613	0.0682
17	Residential	12°59'7.16"	77°31'14.87"	0.615	0.067	0.0656
18	Industrial	12°59'15.16"	77°31'18.92"	0.632	0.0627	0.0681
19	Residential	12°59'28.02"	77°31'29.63"	0	0.0262	0
20	Industrial	12°59'50.05"	77°31'52.44"	0.176	0.0282	0
21	Residential	13°0'10.9"	77°32'5.36"	0	0.0262	0

2.12 Iron

ISSN: 2233-7857 IJFGCN

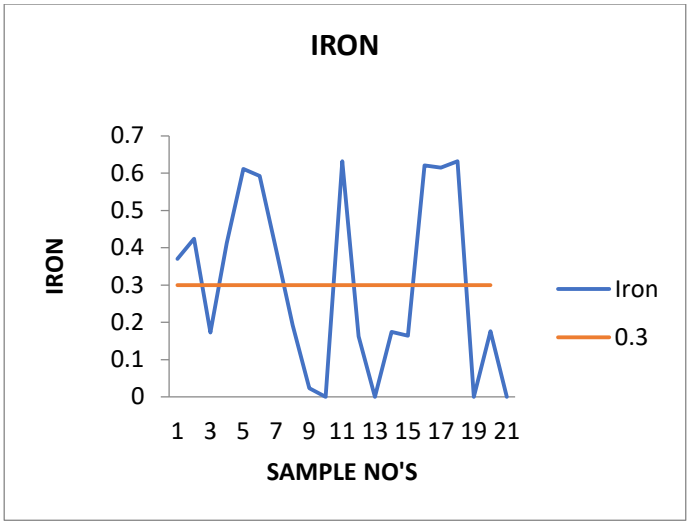

Figure 12: Variations of Iron Concentration (mg/l) in Groundwater of Study area

Concentration of iron in mg/l is high at station 1, 2, 4, 5, 6, 7, 11, 16, 17, 18 and low at station 3, 8, 9, 10, 12, 13, 14, 15, 19, 20 and 21. Concentration of iron in mg/l is not well within the permissible limit as standards prescribed by WHO for heavy metals in groundwater

2.13 Nickel

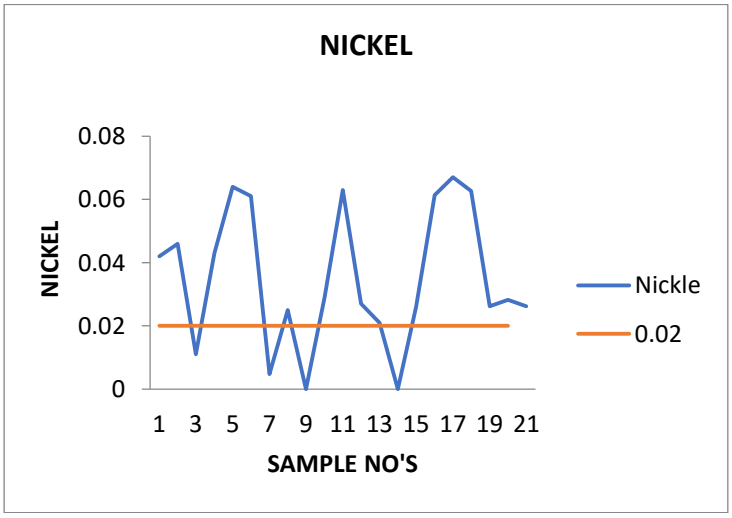

Figure 13: Variations of Nickel Concentration (mg/l) in Groundwater of Study area

The concentration of nickel in mg/l is high at the station 1, 2, 4, 5, 6, 8, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20 & 21 and low at station 3, 7, 9, and 14,. The high occurrence of nickel in the water samples makes them unsuitable for drinking as most of values exceed the limit of 0.02 set by the WHO

2.14 Copper

ISSN: 2233-7857 IJFGCN

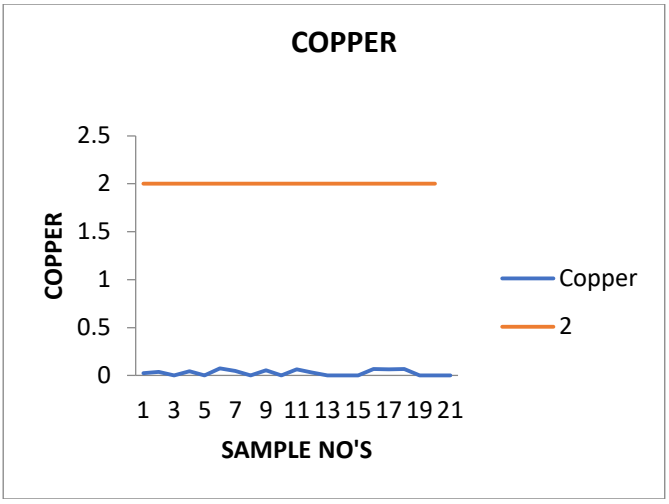

Figure 14: Variations of Copper Concentration (mg/l) in Groundwater of Study area

The concentration of copper in mg/l is present at station are negligible amount. The value of copper concentration is within the permissible limit.

3. Results

The study reveals that pH, Calcium, sulphates, Carbonates and bicarbonates, sodium, TDS, and copper are well within the permissible Magnesium, Chloride, Nickel and iron are not well within the permissible limit prescribed by BIS standards in most of Groundwater samples. The pH higher than 7 indicates the water is slightly alkaline. The Concentration of copper and lead is well within the permissible limit whereas the iron and nickel exceed the permissible limit according to the WHO standards for Heavy metals in groundwater sample

4. Discussion

The area where the soil is contaminated more than the standards should be remediated using various physic-chemical or biological treatment methods or processes. Treatment methods should be determined for treating the groundwater which contains heavy metals and other parameters so as to suit Water standards as per WHO or BIS.

5. Conclusion

The study reveals that pH, Calcium, sulphates, Carbonates and bicarbonates, sodium, TDS, and copper are well within the permissible Magnesium, Chloride, Nickel and iron are not within acceptable limit prescribed by BIS standards in most of Groundwater samples. The pH higher than 7 indicates the water is slightly alkaline.

The Concentration of copper and lead is well within the permissible limit whereas the iron and nickel exceed the permissible limit according to the WHO standards for Heavy metals in groundwater sample.

References

1. Dr.C.R.Ramakrishnaiah. and N.Manasa. conducted the study on distribution and migration of heavy metals in peenya industrial area Bangalore Karnataka
2. Kavyashree H.A and Dr. S Suresh conducted an investigation of heavy metals contamination in soil around Bathi Lake. Davangere.
3. Yong ji. Jie Zhang. Xuepin. Huang. Chengrog Bai, and Xing Chen. Conducted an investigation on arrangement of heavy metals in surface sediments of ganjang river, China .

ISSN: 2233-7857 IJFGCN

4. N. S. Sonawane, C.P. Sawant. R.V Patil conducted a study on Soil quality assessment and heavy metal contamination in agricultural soil in and around toranmal (triable region) of Maharashtra.
5. L. R. Varalakshmi and A. N. Ganeshamurthy, "Heavy metal contamination of water bodies, soils and vegetables in peri urban areas of Bangalore city of India" ,© 2010 19th World Congress of Soil Science, Soil Solutions for a Changing World 39, 1 – 6 August 2010, Brisbane, Australia.
6. R. K. Sharma and M. Agrawal, Effects of wastewater irrigation on heavy metal accumulation in soil and plants around Varanasi. In: Fiona M. Marshall (Ed.), Proceedings of National Seminar, New Horizons in Environmental Sciences and Engineering in India, 17-19 November 2004, Bangalore, abstract no.7: 8, 2004.
7. Mingorance, M.D.; Valdes, B.; Oliva-Rossini, S. Strategies of heavy metal uptake by plant growing under industrial emissions. Environ. Int. 2007, 33, 514–520.
8. Alam, M.G.M.; Snow, E.T.; Tanaka, A. Arsenic and heavy metal concentration of vegetables grown in Samta village, Bangladesh. Sci. Total Environ. 2003, 111, 811–815.
9. Arora, M.; Kiran, B.; Rani, A.; Rani, S.; Kaur, B.; Mittal, M. Heavy metal accumulation in vegetables irrigated with water from different sources. Food Chem. 2008, 111, 811–815.
10. Bhuiyan, M.A.H.; Suruvi, N.I.; Dampare, S.B.; Islam, M.A.; Quraishi, S.B.; Ganyaglo, S.;Suzuki, S. Investigation of the possible sources of heavy metal contamination in lagoon and canal water in the tannery industrial area in Dhaka, Bangladesh. Environ. Monit. Assess. 2011, 175,633–649.

ISSN: 2233-7857 IJFGCN