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SURVEY OF PHYSIOCHEMICAL PARAMETERS AND HEAVY METALS CONTENT BOREHOLE WATER IN GEIDAM TOWN, YOBE STATE, NIGERIA

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ABSTRACT

Twenty-six (26) samples of Boreholes water at random from various locations including their coordinate location in Geidam and its environs of Yobe State Nigeria were collected and analyzed for Assessments of physicochemical elements and parameters including pH, turbidity, dissolved oxygen, cadmium, chromium, hardness, conductivity, lead, TDS, iron, and nickel were analyzed. The samples were drawn with 750ml containers and transport to the research laboratory and stored in refrigerator for preservation, a five (5) different device has been used when the physical parameter was physically observed like colour, odour and test of the sample while temperature, Turbidity, conductivity and pH was determined using thermometer, Turbid meter, conductivity meter and pH scale respectively, while digital spectrophotometer was used for the determination of lead, iron and chromium. The heavy metal concentrations were then extrapolated from the standard calibration curve. The results obtained of dissolved oxygen DO (mg/L) content at higher rate is 29.67mg/l in sample A8 and lowest content rate is 4.39mg/L at sample K5 that are all conformity with the W.H.O standard. The amount of chromium content in the samples A3 has the highest rate of 0.034 mg/L while sample K3 borehole water has the lowest rate of 0.00mg/L are all accordance with the standard. The iron concentration of 0.168 mg/L at higher rate from sample A6 borehole water and 0.004m/L at lowest rate from Sample K6, almost all the samples has higher value than the W.H.O specification of drinking water. The turbidity concentration is 22.75m/L at higher rate follow by H1 borehole of 17.37mg/L and lowest rate from sample K8, with 0.55ml/g indeed sample A3 has higher values of turbidity that are above the standard which can cause health impact to humans. The hardness of the water was found to be of 47.93mg/L is above the limit of W.H.O specification of drinking water while 1.17mg/l hardness is from K8 sample which lowest and acceptable limit of W.H.O. TDS content in drinking water from A3 is 221.23mg/l, has lower limit W.H.O level, K8 has lowest value of 5.19mg/. conductivity content is very high with 1007.58 ms/cm from A3 location with is not acceptable for drinking water furthermore electrical conductivity is high and other minerals deposited in the location while K8 sample has lowest value of 24.73 ms/cm. Nickel contents was found to be all the water samples are slightly lower than W.H.O standard except for A3 with 0.432mg/l as highest range while 0.001mg/l from K6 has lowest range value. Cadmium content sample K7 has 0.008mg/L is greater than the standard and samples H10, K4 and K5 has 0.001mg/l while the rest borehole has 0.000mg/L equally which is below the limits. The pH content range, sample A7 water borehole has a pH range of 9.89mg/L as the highest range and A4 borehole water has the lowest range of pH range of 2.93mg/L, pH values of difference water samples analysis are in accordance with the W.H.O standard. At turbidity was lower in all the borehole water samples, D.O of the water sample is also below the standard and TDS are also below the W.H.O standard. The parameters analyzed most generally conform to the W.H.O standard for drinking water.

Key words: Physicochemical, Heavy metal, Dissolved oxygen, Spectrophotometer, Drinking water.

INTRODUCTION

Water is one of the most important natural commodities and there is high demand for it. Water supply is an important element of growth and development of any settlement. A skilful management of water is required for diverse purposes. Man uses water for domestic and industrial purposes, crops irrigation, transports, sport commercial fishing and power generation etc., water pollution like other environmental concerns has been the focus of widespread public interest seems to be increasing.

The most sources of water supply within the Geidam area of Yobe state Nigeria can be classified into four major sources namely; pipe borne, well water, bore hole and river water, Despite the much more availability of water, it becomes less optimistic and un purified for both human and animals consumption because of been contaminated with poisonous chemicals as a results industrial wastes, pulping waste, petroleum and refinery wastes, food processing wastes, mining wastes, agricultural wastes and toxic wastes etc., more often contain some of pollutants as a result of the materials used in generating the waste thereby adding to the level of water pollution if they enter water bodies It is based on scientific research, which concludes that consumptions of greater concentrations of this contaminated water could cause serious health problems in humans This necessitates the World health organization (WHO) to come up with a system called water quality assessment to make a necessary screening the water to meet up with level of national and international guideline Limits, like standard organization of Nigeria (SON) and world health organization (WHO)

This research work therefore entails laboratory analysis with materials that had been used in the work include (26) water samples from the specified target area, reagents almost from Mai Idris Alooma Polytechnic Laboratory Geidam and Apparatus/equipment from Research laboratory Yobe State University Damaturu Nigeria. The research completed within four (4) months.

The goal of this research work is to use the result for the improvement of the overall health and wellbeing of the people of Geidam through the provision of clean water. By knowing the level of the physiochemical concentration of heavy metals in drinking water such as mercury (Hg), cadmium (Cd), lead (Pb) Chromium (Cr) and arsenic (As). And also to evaluate the level of conductivity, resistivity, temperature, pH and chemical parameters in the water. Results obtained of this research has compared with the global standard and values of drinking water guideline limits and has make necessary suggestion/recommendations based on the findings of this work. The work should derive a means of screening water to human consumption and meet the WHO recommendation level of heavy elements in water.

STUDY AREA

Geidam Local Government Area is located in the Northwest of Yobe State and at a region between longitudes 80 12º 〖53〗^' 49"N 11º55'49" E / 128969ºN11.93028ºE. It has an area of 4,357km2 and a population of 157,295 as of (2006 census). Geidam share a boundary with of Borno state to the Northwest and Bursari Local Government from Yobe state to the West and also to the North by Yunusari Local government area and only fifty (50) kilometers far from Niger Republic.

GEIDAM WATER SUPPLY

Water supply within the area can be classified into four major sources namely; pipe borne, well water, bore hole and river water. The pipe born water is supplied to the Geidam Town and is environments from the Geidam Water Works. However, the erratic and inconsistencies associated with the water supply led to the emergence of water vendors who supply household with water directly either from the river or from the open wells. Thus, water venturing is a very big business in the town with a plastic jerry can sold at between N10 to N15 for well and tap water respectively.

It is not only vendors that supply water to the town residents. Water tankers are usually used to convey water to neighboring town and rural settlement that rely on steam and well for domestic use. Indeed, field observation shows that the residents of this area suffer seriously from acute water shortage and had to trek to about 4km to river to collect water daily for household use. Presently, there is a collaborative effort between World Bank, Yobe state Government and the surrounding local government's areas to supply portable water teeming for populace.

METHODOLOGY

Materials and Methods

The materials used in this research work include (26) water samples from the water from the different location, reagents included Buffered Ammonia, Sodium Ascorbate powder, Sodium Cyanide Nacl, Dilute zinc indicator, Formaldehyde solution, Phosphate reagent PO^{3-} 4, Sulphate reagent SO^{2-} 4, Sodium hydroxide, Pan indicator, Stabilizing reagent, Sodium citrate, Zinc buffered powder and Chromium reagents (Cr) while Apparatus/equipment from Research laboratory of Yobe State University Damaturu. Included Digital colorimeter, Digital spectrophotometer, Atomic Absorption Spectrophotometer (AAS), PH Meter, conductivity meter, thermometer and GPS while Secondary Information for this research was obtained from online sources on the Yobe state university database which includes peer reviewed papers, online journals, web sites, book sections, books and related journals from Science Direct, etc.

SAMPLE COLLECTION

Plastic container of 2 litres plastic (bottle) capacity had been used for collecting the water sample from 26 different locations, it had been first clean by washing with detergent solution and later thoroughly rise with distil water to avoid with contamination solution, The container will be label according to the area where the sample water is collected three wards in the Geidam metropolitan will consider

which include, Ashekri, Hausari and Kolori ward among others. And their respective coordinate as well. Before the sample collection in the borehole there is need the water to allow pumping for fifteen (15) minutes, so that water with uniform or even distribution of constant temperature and PH is taken into the container, the container will be covered to prevent contamination and contact with air so as to retain the homogenous/physiochemical properties of the sample then the sample was taken to the laboratory for analysis.

METHOD

The water samples were taken to laboratory for the determination of the following parameters;

Determination of Temperature

The temperature of the water sample was measured using thermometer of (0, 00 – 100 ^{0}C range) the sample was poured into 100ml of clean beaker and the equipment has been immersed into the beaker and allow to stabilize for at least 2 minute and read the value and record. The thermometer has been raised with distil water before taking reading another sample.

Determination of pH

The pH (Janway) (manufacture type) of the water sample was measured using a digital pH meter. The pH meter is to switch ON and allow to stabilize in distil deionized water. The knob is adjusted to pH, the electrode immerses into 60cm^3 of water sample in a beaker and allow the reading to stabilize the pH of water sample then the value was being read and recorded on each of the measurement, the electrode is to be raise with distil water before measuring another sample.

Determination of conductivity

The conductivity of each water sample was measured using a conductivity meter. The conductivity meter is to be switch ON and allow to stabilize in distil water. The knob is to adjust to conductivity in MS/CM 60cm^3 of the water sample is then taken into 100ml beaker, the electrode immerses into the water sample and allow the reading to stabilize for at least 1 minute, the conductivity of the water sample was then read and recorded. After each measurement the electrode is to be raising with distils deionize water before measuring another sample.

Determination of heavy metals /ions

The samples have been investigated using AAS/digital colorimeter instrument at Yobe state university research laboratory for the determination of metal like cadmium (Cd), chromium (Cr), zinc (Zn), manganese (Mn) and ions like sulphide (S^{2-}), phosphate (PO_3^{-4}), chloride (Cl^-) and nitrate (NO_3^-), with digital spectrophotometer. Various calibration Standards had been prepared, whose absorbencies has been taken from the spectrophotometer and a calibration curve plotted. The heavy metals concentrations are then extrapolated from the standard calibration curve.

Table: the distribution of locations of water sample and coordinates collected from and boreholes in Geidam metropolis.

S/N	Location of Borehole	Labelling	Latitude (S^0)	Longitude (N^0)	S/N	Location of Borehole	Labelling	Latitude (S^0)	Longitude (N^0)
	ASHEKRI WARD	A			14	Samu naka borehole	H_6	12.891060N	11.208313E
1	Ajiyari borehole	A_1	12.8986967N	11.9268700E	15	Rimi borehole	H_7	12.890061N	11.928331E
2	Isah Na Market borehole	A_2	12.8998667N	11.9224383E	16	Polytechnic borehole	H_8	12.882903N	11.92 0500E
3	Filto borehole	A_3	12.9012835N	11.9287690E	17	Jibwis Eid Ground borehole	H_9	12.889619N	11.929281E
4	Mai Ngazargamu borehole	A_4	12.8985768N	11.9281440E	18	Gumsa Road borehole	H_{10}	12.889326N	11.925246E
5	Gadala borehole	A_5	12.9055100N	11.9242450E		**KOLORI WARD**	K		
6	Kwari borehole	A_6	12.9008950N	11.9241283E	19	Kolri borehole	K_1	12.89619N	11.919140E
7	Ya'an Sule borehole	A_7	12.9081650N	11.9266850E	20	Cikin Kasuwa borehole	K_2	12.89857N	11.923340E
8	Lokojamari borehole	A_8	12.8972917N	11.9256617E	21	Anguwar Kanti borehole	K_3	12.889820N	11.927442E
	HAUSARI WARD	H			22	Karaukawu borehole	K_4	12.50056N	11.507610E

9	Kankare borehole	H_1	12.8898330N	11.9274930E	23	Tora-bora borehole	K_5	12.47625 N	11.504850E
10	Bakin Asibiti borehole	H_2	12.8848690N	11.9203730E	24	Makabarta borehole	K_6	12.33770 N	11.479050E
11	Kusurmari borehole	H_3			25	Technical borehole	K_7	12.34017 N	11.565670E
12	Low cost borehole	H_4	12.8820620N	11.9205580E	26	Kawuri primary school borehole	K_8	12.33500 N	11.551100E
13	Yan Tare borehole	H_5	12.8890240N	11.9301140E					

RESULTS AND DISCUSSIONS

RESULTS

SAMPLE ANALYSIS RESULTS

Table 1: The amount of DO (mg/L) present in the sample water from various locations in Geidam

		DO (mg/L)				
S/No.	Sample ID	#1	#2	#3	Mean	SD
1	Sample A1	13.15	13.16	13.17	13.16	0.01
2	Sample A2	15.45	15.44	15.40	15.43	0.03
3	Sample A3	13.52	13.38	13.43	13.44	0.07
4	Sample A4	19.52	19.53	19.54	19.53	0.01
5	Sample A5	14.96	14.96	14.98	14.97	0.01
6	Sample A6	10.20	10.09	10.13	10.14	0.05
7	Sample A7	19.81	19.79	19.74	19.78	0.03
8	Sample A8	29.65	29.67	29.70	29.67	0.02
9	Sample H1	10.33	10.33	10.34	10.33	0.01
10	Sample H2	10.13	10.00	10.01	10.05	0.07
11	Sample H3	23.29	23.30	23.32	23.30	0.02
12	Sample H4	16.30	16.28	16.25	16.27	0.03
13	Sample H5	19.01	19.01	19.03	19.02	0.01
14	Sample H6	14.32	14.33	14.34	14.33	0.01
15	Sample H7	15.28	15.12	15.18	15.20	0.08
16	Sample H8	12.17	12.16	12.13	12.15	0.02
17	Sample H9	14.25	14.26	14.27	14.26	0.01
18	Sample H10	15.42	15.26	15.32	15.34	0.08
19	Sample K1	14.68	14.66	14.63	14.65	0.02
20	Sample K2	6.23	6.23	6.24	6.23	0.00
21	Sample K3	11.84	11.84	11.86	11.85	0.01
22	Sample K4	19.01	18.78	18.80	18.86	0.13
23	Sample K5	4.39	4.39	4.40	4.39	0.00
24	Sample K6	10.14	10.15	10.15	10.15	0.01
25	Sample K7	15.36	15.20	15.26	15.27	0.08
26	Sample K8	10.19	10.18	10.16	10.18	0.02

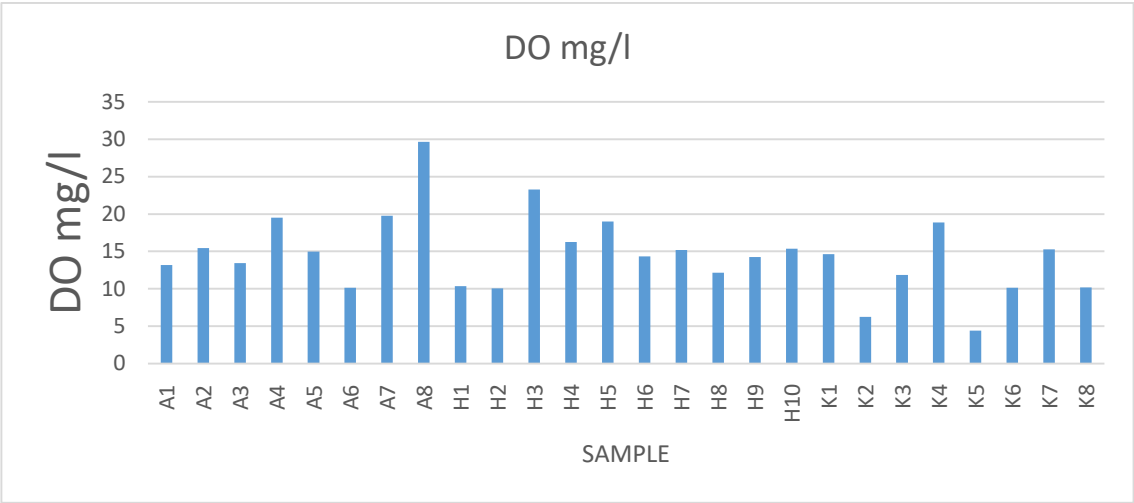

Figure 1: DO mg/l

Table 2: Amount of lead present in the sample water from various locations in Geidam.

		Lead (mg /L)				
S/No.	Sample ID	#1	#2	#3	Mean	SD
1	Sample A1	0.028	0.028	0.028	0.028	0.000
2	Sample A2	0.031	0.031	0.031	0.031	0.000
3	Sample A3	0.048	0.048	0.048	0.048	0.000
4	Sample A4	0.041	0.041	0.041	0.041	0.000
5	Sample A5	0.043	0.043	0.043	0.043	0.000
6	Sample A6	0.047	0.047	0.047	0.047	0.000
7	Sample A7	0.033	0.033	0.033	0.033	0.000
8	Sample A8	0.035	0.035	0.035	0.035	0.000
9	Sample H1	0.000	0.000	0.000	0.000	0.000
10	Sample H2	0.049	0.049	0.049	0.049	0.000
11	Sample H3	0.036	0.035	0.035	0.035	0.000
12	Sample H4	0.000	0.000	0.000	0.000	0.000
13	Sample H5	0.039	0.039	0.039	0.039	0.000
14	Sample H6	0.025	0.025	0.025	0.025	0.000
15	Sample H7	0.011	0.011	0.011	0.011	0.000
16	Sample H8	0.028	0.028	0.028	0.028	0.000
17	Sample H9	0.045	0.045	0.045	0.045	0.000
18	Sample H10	0.000	0.000	0.000	0.000	0.000
19	Sample K1	0.039	0.039	0.039	0.039	0.000
20	Sample K2	0.022	0.022	0.022	0.022	0.000
21	Sample K3	0.017	0.016	0.017	0.017	0.000
22	Sample K4	0.026	0.026	0.026	0.026	0.000
23	Sample K5	0.021	0.021	0.021	0.021	0.000
24	Sample K6	0.012	0.012	0.012	0.012	0.000
25	Sample K7	0.010	0.010	0.010	0.010	0.000
26	Sample K8	0.004	0.004	0.004	0.004	0.000

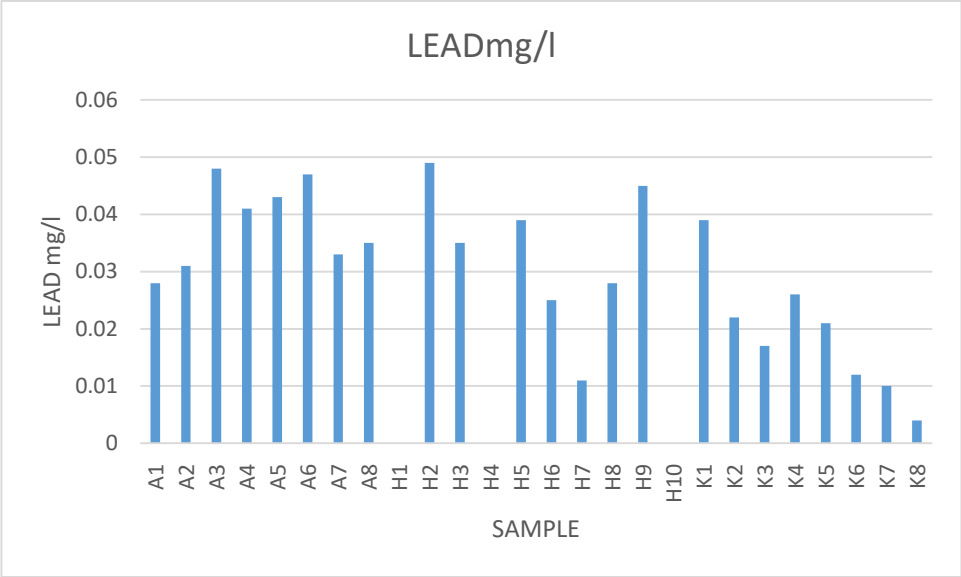

Figure 2: Lead mg/l

Table 3: Amount of Turbidity present in the sample water from various locations in Geidam.

		Turbidity (NTU)				
S/No.	Sample ID	#1	#2	#3	Mean	SD
1	Sample A1	9.68	9.49	9.58	9.58	0.10
2	Sample A2	0.86	0.90	0.88	0.88	0.02
3	Sample A3	23.35	22.88	22.02	22.75	0.68
4	Sample A4	4.31	4.22	4.27	4.27	0.04
5	Sample A5	11.01	10.79	10.90	10.90	0.11
6	Sample A6	17.62	17.26	16.61	17.16	0.51
7	Sample A7	13.96	14.66	14.31	14.31	0.35
8	Sample A8	1.72	1.69	1.71	1.71	0.02
9	Sample H1	17.54	17.19	17.37	17.37	0.18
10	Sample H2	16.74	17.58	16.34	16.89	0.63
11	Sample H3	17.14	16.80	16.97	16.97	0.17
12	Sample H4	1.72	1.81	1.77	1.77	0.04
13	Sample H5	7.00	6.86	6.93	6.93	0.07
14	Sample H6	5.27	5.16	5.22	5.22	0.05
15	Sample H7	0.90	0.88	0.85	0.88	0.03
16	Sample H8	0.68	0.71	0.69	0.69	0.02
17	Sample H9	10.49	10.28	10.39	10.39	0.10
18	Sample H10	11.54	11.31	10.88	11.24	0.33
19	Sample K1	10.35	10.86	10.60	10.60	0.26
20	Sample K2	4.58	4.49	4.54	4.54	0.05
21	Sample K3	0.69	0.67	0.68	0.68	0.01
22	Sample K4	2.04	2.15	1.99	2.06	0.08
23	Sample K5	3.23	3.17	3.20	3.20	0.03
24	Sample K6	1.12	1.10	1.11	1.11	0.01
25	Sample K7	1.08	1.06	1.02	1.05	0.03
26	Sample K8	0.54	0.57	0.55	0.55	0.01

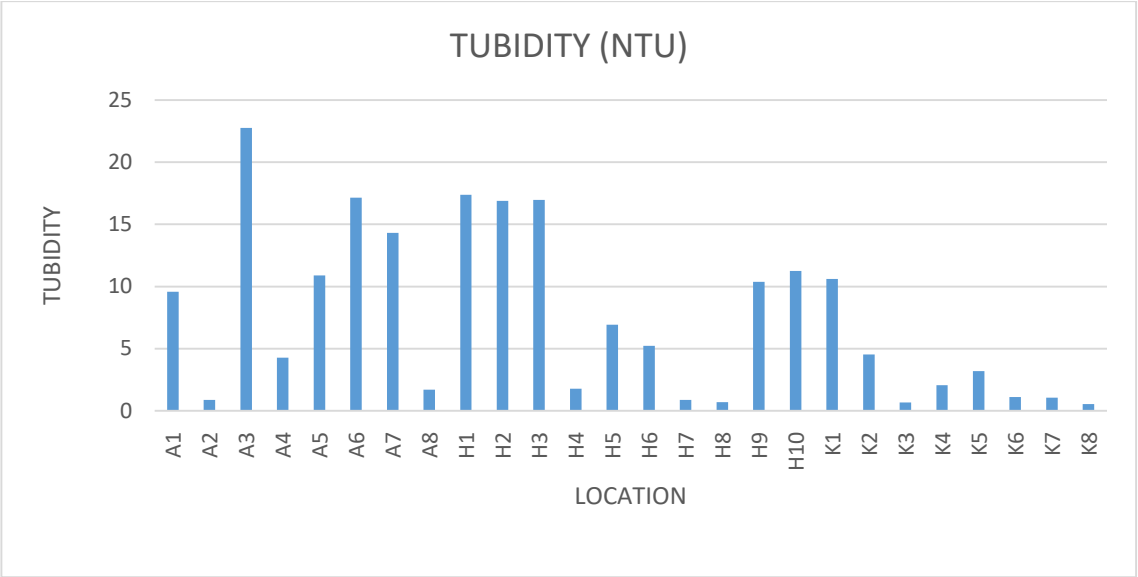

Figure 3: Turbidity

Table 4: Amount of Hardness present in the sample water from various locations in Geidam.

		Hardness (mg /L)				
S/No.	Sample ID	#1	#2	#3	Mean	SD
1	Sample A1	20.28	20.18	20.28	20.24	0.06
2	Sample A2	1.87	1.89	1.87	1.87	0.01
3	Sample A3	48.91	47.50	47.36	47.93	0.86
4	Sample A4	9.03	8.98	9.03	9.01	0.03
5	Sample A5	23.06	22.95	23.06	23.03	0.07
6	Sample A6	36.90	35.84	35.73	36.16	0.65
7	Sample A7	30.29	30.66	30.29	30.41	0.21
8	Sample A8	3.61	3.59	3.61	3.60	0.01
9	Sample H1	36.75	36.57	36.75	36.69	0.11
10	Sample H2	36.31	35.89	35.16	35.79	0.58
11	Sample H3	35.91	35.73	35.91	35.85	0.10
12	Sample H4	3.74	3.78	3.74	3.75	0.03
13	Sample H5	14.65	14.58	14.65	14.63	0.04
14	Sample H6	11.04	10.98	11.04	11.02	0.03
15	Sample H7	1.89	1.84	1.83	1.85	0.03
16	Sample H8	1.47	1.49	1.47	1.47	0.01
17	Sample H9	21.98	21.87	21.98	21.94	0.06
18	Sample H10	24.18	23.48	23.41	23.69	0.42
19	Sample K1	22.44	22.71	22.44	22.53	0.16
20	Sample K2	9.60	9.56	9.60	9.59	0.03
21	Sample K3	1.44	1.43	1.44	1.44	0.00
22	Sample K4	4.43	4.38	4.29	4.37	0.07
23	Sample K5	6.77	6.74	6.77	6.76	0.02
24	Sample K6	2.35	2.33	2.35	2.34	0.01
25	Sample K7	2.26	2.19	2.19	2.21	0.04

26	Sample K8	1.17	1.18	1.17	1.17	0.01

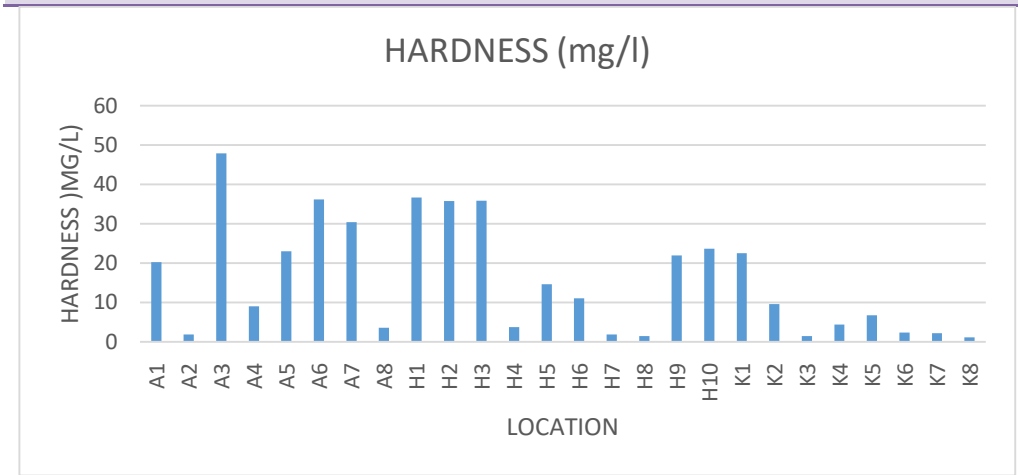

Figure 4: Hardness (mg/l)

Table 5: Amount of TDS present in the sample water from various locations in Geidam.

		TDS (mg/L)				
S/No.	Sample ID	#1	#2	#3	Mean	SD
1	Sample A1	89.43	89.28	89.53	89.42	0.12
2	Sample A2	8.27	8.31	8.25	8.28	0.03
3	Sample A3	213.98	209.64	210.08	211.23	2.38
4	Sample A4	39.82	39.75	39.86	39.81	0.06
5	Sample A5	101.72	101.55	101.83	101.70	0.14
6	Sample A6	161.43	158.16	158.49	159.36	1.80
7	Sample A7	134.35	134.88	133.98	134.40	0.45
8	Sample A8	15.92	15.90	15.94	15.92	0.02
9	Sample H1	162.09	161.82	162.27	162.06	0.23
10	Sample H2	159.79	157.47	156.28	157.85	1.79
11	Sample H3	158.38	158.13	158.57	158.36	0.22
12	Sample H4	16.58	16.65	16.54	16.59	0.06
13	Sample H5	64.62	64.52	64.70	64.61	0.09
14	Sample H6	48.69	48.61	48.74	48.68	0.07
15	Sample H7	8.27	8.11	8.12	8.17	0.09
16	Sample H8	6.52	6.54	6.50	6.52	0.02
17	Sample H9	96.94	96.78	97.05	96.92	0.13
18	Sample H10	105.77	103.63	103.84	104.41	1.18
19	Sample K1	99.53	99.92	99.26	99.57	0.33
20	Sample K2	42.35	42.29	42.40	42.35	0.06
21	Sample K3	6.36	6.35	6.36	6.36	0.01
22	Sample K4	19.50	19.22	19.07	19.26	0.22
23	Sample K5	29.86	29.82	29.90	29.86	0.04
24	Sample K6	10.34	10.33	10.36	10.34	0.01
25	Sample K7	9.87	9.67	9.69	9.75	0.11
26	Sample K8	5.18	5.20	5.17	5.19	0.02

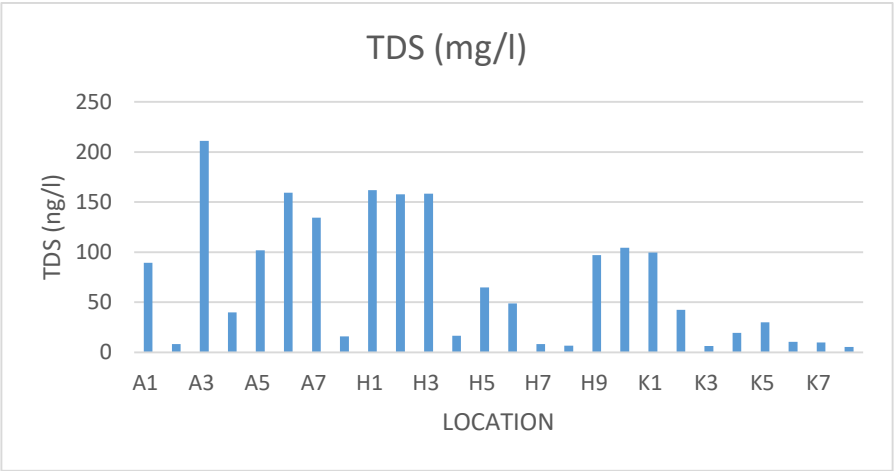

Figure 5: TDS (mg/l)

Table 6: Amount of Conductivity present in the sample water from various locations in Geidam.

		Conductivity (mS/cm)				
S/No.	Sample ID	#1	#2	#3	Mean	SD
1	Sample A1	426.58	425.89	427.07	426.51	0.59
2	Sample A2	39.47	39.62	39.36	39.48	0.13
3	Sample A3	1020.66	1000.01	1002.08	1007.58	11.37
4	Sample A4	189.93	189.63	190.15	189.90	0.26
5	Sample A5	485.19	484.40	485.75	485.12	0.68
6	Sample A6	770.02	754.44	756.00	760.15	8.58
7	Sample A7	640.86	643.36	639.10	641.10	2.14
8	Sample A8	75.94	75.82	76.03	75.93	0.11
9	Sample H1	773.15	771.90	774.04	773.03	1.08
10	Sample H2	762.22	751.12	745.44	752.92	8.54
11	Sample H3	755.50	754.27	756.36	755.38	1.05
12	Sample H4	79.09	79.40	78.87	79.12	0.26
13	Sample H5	308.26	307.76	308.61	308.21	0.43
14	Sample H6	232.24	231.86	232.51	232.20	0.32
15	Sample H7	39.47	38.67	38.75	38.97	0.44
16	Sample H8	31.08	31.20	31.00	31.09	0.10
17	Sample H9	462.39	461.64	462.92	462.31	0.64
18	Sample H10	504.51	494.30	495.32	498.04	5.62
19	Sample K1	474.77	476.62	473.47	474.95	1.59
20	Sample K2	202.03	201.70	202.26	202.00	0.28
21	Sample K3	30.32	30.27	30.35	30.31	0.04
22	Sample K4	93.02	91.67	90.97	91.89	1.04
23	Sample K5	142.45	142.22	142.61	142.43	0.20
24	Sample K6	49.34	49.26	49.40	49.34	0.07
25	Sample K7	47.10	46.15	46.24	46.50	0.52
26	Sample K8	24.73	24.82	24.66	24.73	0.08

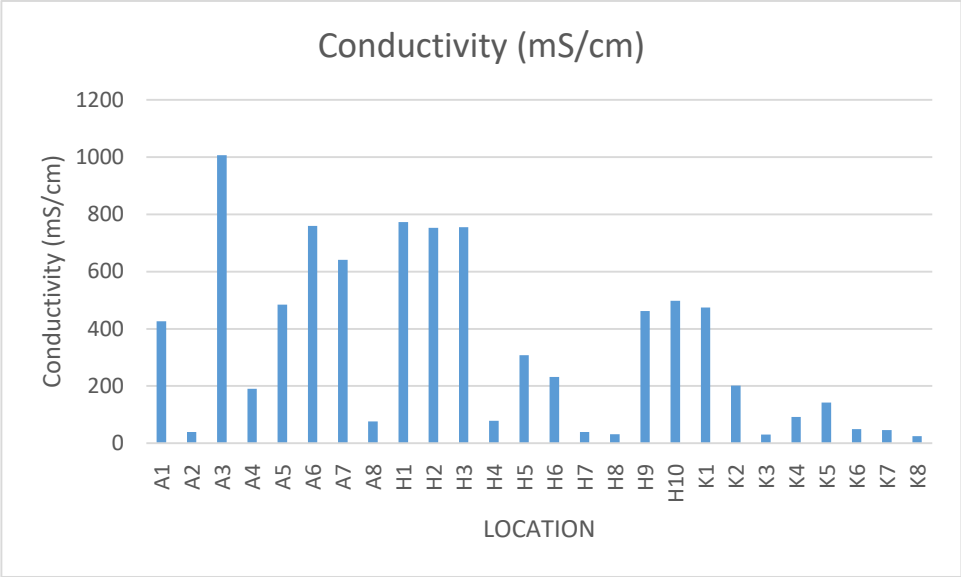

Figure 6: Conductivity

Table 7: Amount of pH present in the sample water from various locations in Geidam.

		pH				
S/No.	Sample ID	#1	#2	#3	Mean	SD
1	Sample A1	6.58	6.58	6.58	6.58	0.00
2	Sample A2	7.32	7.31	7.30	7.31	0.01
3	Sample A3	8.00	7.92	7.95	7.96	0.04
4	Sample A4	2.93	2.93	2.93	2.93	0.00
5	Sample A5	7.48	7.48	7.49	7.48	0.01
6	Sample A6	7.75	7.65	7.69	7.70	0.05
7	Sample A7	9.91	9.89	9.87	9.89	0.02
8	Sample A8	6.90	6.16	6.70	6.59	0.38
9	Sample H1	7.94	7.95	7.96	7.95	0.01
10	Sample H2	7.79	7.70	7.70	7.73	0.05
11	Sample H3	7.76	7.77	7.77	7.77	0.01
12	Sample H4	6.22	6.22	6.20	6.21	0.01
13	Sample H5	6.75	6.75	6.76	6.75	0.01
14	Sample H6	6.58	6.58	6.58	6.58	0.00
15	Sample H7	7.24	7.16	7.19	7.20	0.04
16	Sample H8	6.79	6.76	6.75	6.77	0.02
17	Sample H9	7.13	7.13	7.14	7.13	0.00
18	Sample H10	7.71	7.63	7.66	7.67	0.04
19	Sample K1	7.34	7.33	7.31	7.33	0.01
20	Sample K2	7.11	7.12	7.12	7.12	0.01
21	Sample K3	6.61	6.61	6.61	6.61	0.00
22	Sample K4	7.04	7.14	7.14	7.11	0.06
23	Sample K5	7.20	6.80	7.02	7.01	0.20
24	Sample K6	9.13	9.13	9.14	9.13	0.01
25	Sample K7	8.64	8.55	8.58	8.59	0.05
26	Sample K8	6.59	7.03	6.57	6.73	0.26

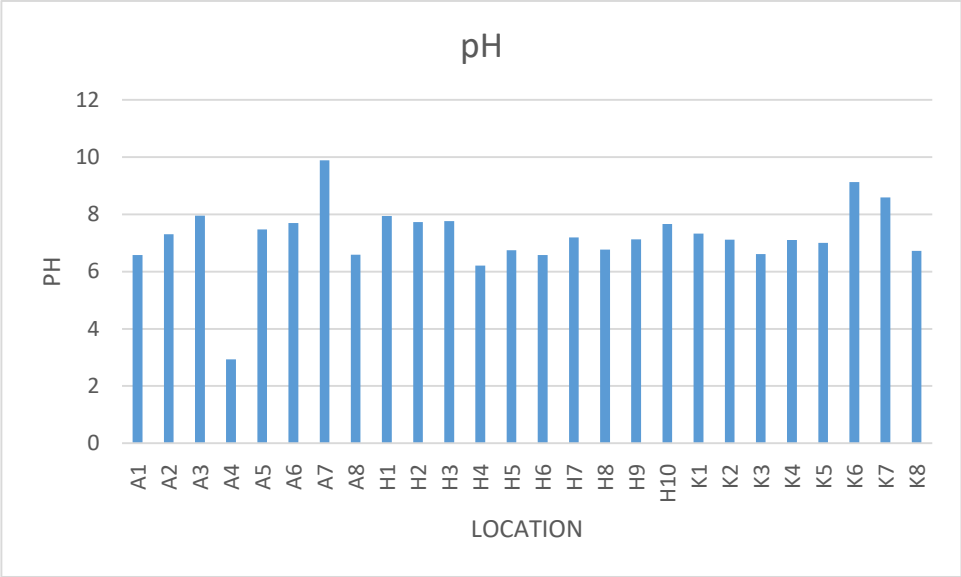

Figure 7: PH

Table 8: Amount of Chromium present in the sample water from various locations in Geidam.

		Chromium (mg/L)				
S/No.	Sample ID	#1	#2	#3	Mean	SD
1	Sample A1	0.025	0.025	0.025	0.025	0.000
2	Sample A2	0.015	0.015	0.015	0.015	0.000
3	Sample A3	0.034	0.034	0.034	0.034	0.000
4	Sample A4	0.029	0.029	0.029	0.029	0.000
5	Sample A5	0.028	0.028	0.028	0.028	0.000
6	Sample A6	0.033	0.033	0.033	0.033	0.000
7	Sample A7	0.027	0.027	0.027	0.027	0.000
8	Sample A8	0.019	0.019	0.019	0.019	0.000
9	Sample H1	0.017	0.017	0.017	0.017	0.000
10	Sample H2	0.018	0.020	0.021	0.020	0.002
11	Sample H3	0.029	0.029	0.029	0.029	0.000
12	Sample H4	0.008	0.008	0.008	0.008	0.000
13	Sample H5	0.007	0.007	0.007	0.007	0.000
14	Sample H6	0.021	0.021	0.021	0.021	0.000
15	Sample H7	0.008	0.008	0.008	0.008	0.000
16	Sample H8	0.013	0.013	0.013	0.013	0.000
17	Sample H9	0.031	0.030	0.031	0.031	0.000
18	Sample H10	0.016	0.016	0.016	0.016	0.000
19	Sample K1	0.029	0.029	0.029	0.029	0.000
20	Sample K2	0.019	0.019	0.019	0.019	0.000
21	Sample K3	0.009	0.009	0.009	0.009	0.000
22	Sample K4	0.017	0.016	0.016	0.016	0.000
23	Sample K5	0.017	0.017	0.017	0.017	0.000
24	Sample K6	0.000	0.000	0.000	0.000	0.000
25	Sample K7	0.008	0.008	0.008	0.008	0.000
26	Sample K8	0.004	0.005	0.005	0.005	0.000

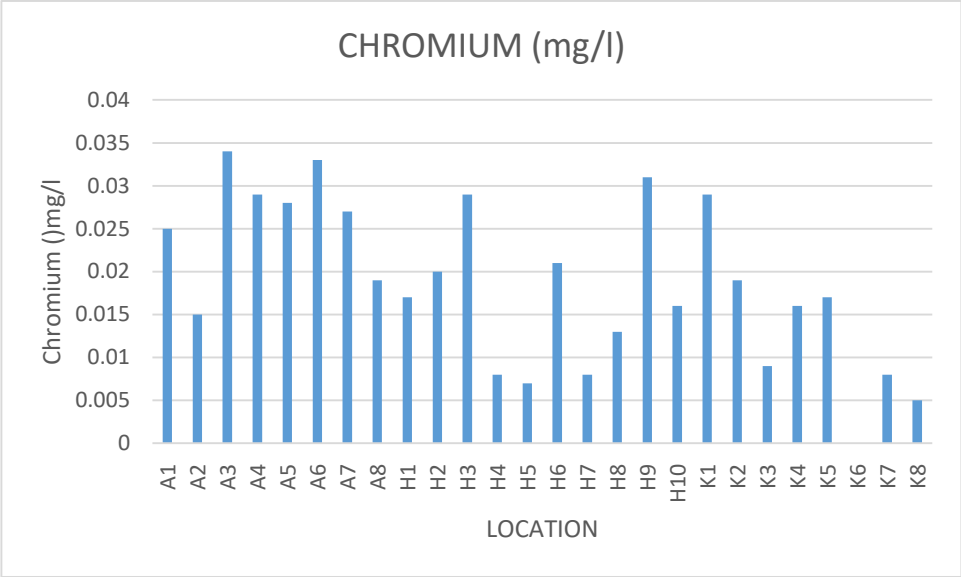

Figure 8: Chromium

Table 9: Amount of Cadmium present in the sample water from various locations in Geidam

		Cadmium (mg/L)				
S/No.	Sample ID	#1	#2	#3	Mean	SD
1	Sample A1	0.002	0.002	0.002	0.002	0.000
2	Sample A2	0.000	0.000	0.000	0.000	0.000
3	Sample A3	0.003	0.003	0.003	0.003	0.000
4	Sample A4	0.000	0.000	0.000	0.000	0.000
5	Sample A5	0.000	0.000	0.000	0.000	0.000
6	Sample A6	0.000	0.000	0.000	0.000	0.000
7	Sample A7	0.000	0.000	0.000	0.000	0.000
8	Sample A8	0.002	0.002	0.002	0.002	0.000
9	Sample H1	0.000	0.000	0.000	0.000	0.000
10	Sample H2	0.000	0.000	0.000	0.000	0.000
11	Sample H3	0.000	0.000	0.000	0.000	0.000
12	Sample H4	0.000	0.000	0.000	0.000	0.000
13	Sample H5	0.000	0.000	0.000	0.000	0.000
14	Sample H6	0.000	0.000	0.000	0.000	0.000
15	Sample H7	0.000	0.000	0.000	0.000	0.000
16	Sample H8	0.000	0.000	0.000	0.000	0.000
17	Sample H9	0.000	0.000	0.000	0.000	0.000
18	Sample H10	0.001	0.001	0.001	0.001	0.000
19	Sample K1	0.002	0.002	0.002	0.002	0.000
20	Sample K2	0.000	0.000	0.000	0.000	0.000
21	Sample K3	0.000	0.000	0.000	0.000	0.000
22	Sample K4	0.001	0.001	0.001	0.001	0.000
23	Sample K5	0.001	0.001	0.001	0.001	0.000
24	Sample K6	0.000	0.000	0.000	0.000	0.000
25	Sample K7	0.008	0.008	0.008	0.008	0.000
26	Sample K8	0.000	0.000	0.000	0.000	0.000

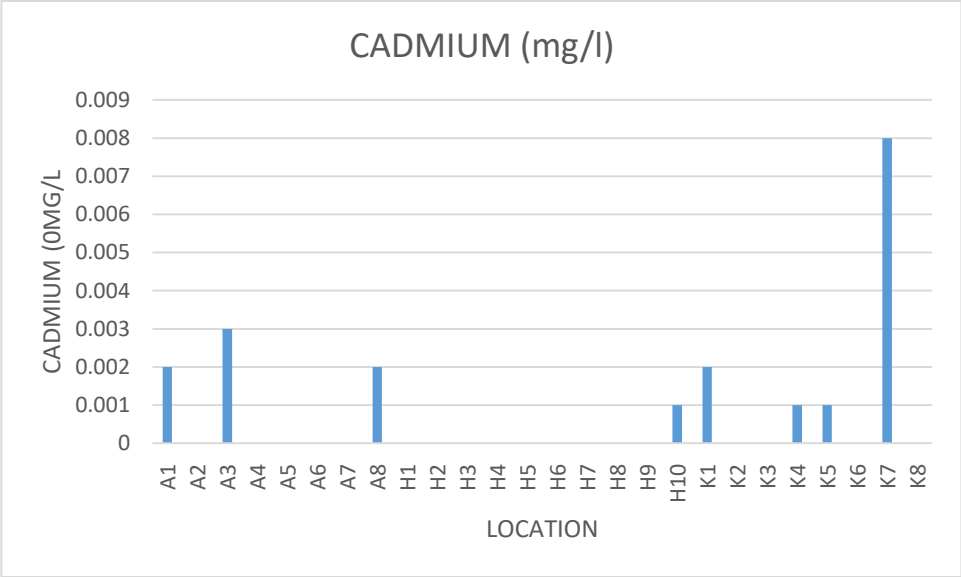

Figure 9: Cadmium

Table 10: Amount of iron present in the sample water from various locations in Geidam

		Iron (mg/L)				
S/No.	Sample ID	#1	#2	#3	Mean	SD
1	Sample A1	0.148	0.148	0.148	0.148	0.000
2	Sample A2	0.009	0.009	0.009	0.009	0.000
3	Sample A3	0.180	0.180	0.179	0.180	0.001
4	Sample A4	0.153	0.153	0.153	0.153	0.000
5	Sample A5	0.136	0.136	0.136	0.136	0.000
6	Sample A6	0.169	0.168	0.167	0.168	0.001
7	Sample A7	0.147	0.147	0.147	0.147	0.000
8	Sample A8	0.014	0.014	0.014	0.014	0.000
9	Sample H1	0.136	0.136	0.136	0.136	0.000
10	Sample H2	0.139	0.143	0.144	0.142	0.003
11	Sample H3	0.160	0.160	0.160	0.160	0.000
12	Sample H4	0.010	0.010	0.010	0.010	0.000
13	Sample H5	0.099	0.099	0.099	0.099	0.000
14	Sample H6	0.120	0.120	0.120	0.120	0.000
15	Sample H7	0.007	0.007	0.007	0.007	0.000
16	Sample H8	0.008	0.008	0.008	0.008	0.000
17	Sample H9	0.155	0.155	0.155	0.155	0.000
18	Sample H10	0.129	0.128	0.127	0.128	0.001
19	Sample K1	0.026	0.026	0.026	0.026	0.000
20	Sample K2	0.018	0.018	0.018	0.018	0.000
21	Sample K3	0.007	0.007	0.007	0.007	0.000
22	Sample K4	0.014	0.014	0.014	0.014	0.000
23	Sample K5	0.016	0.016	0.016	0.016	0.000
24	Sample K6	0.004	0.004	0.004	0.004	0.000
25	Sample K7	0.010	0.009	0.009	0.009	0.000
26	Sample K8	0.005	0.005	0.005	0.005	0.000

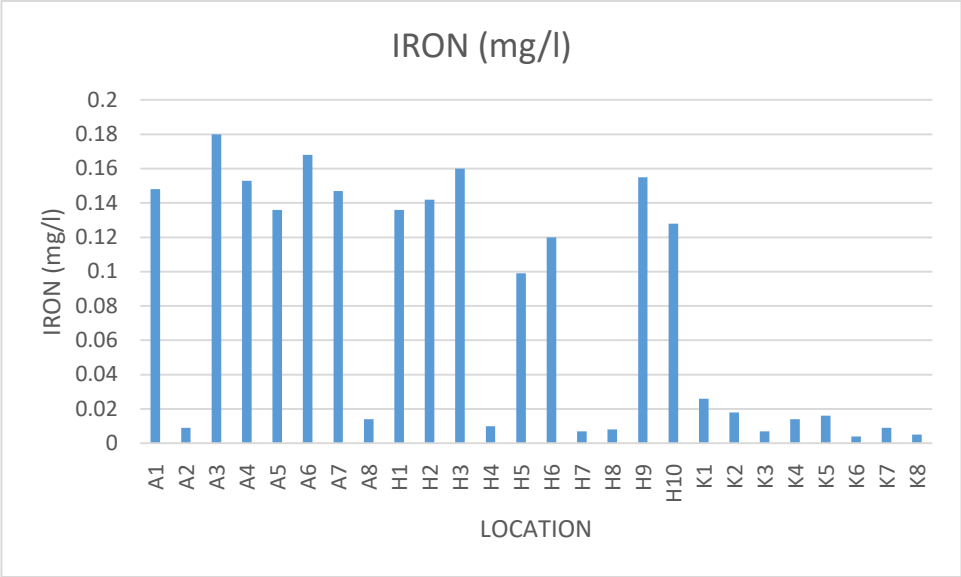

Figure 10: Iron

Table 11: Amount of Nickel present in the sample water from various locations in Geidam.

		Nickel (mg/L)				
S/No.	Sample ID	#1	#2	#3	Mean	SD
1	Sample A1	0.351	0.350	0.351	0.351	0.000
2	Sample A2	0.008	0.008	0.008	0.008	0.000
3	Sample A3	0.434	0.432	0.431	0.432	0.002
4	Sample A4	0.365	0.364	0.364	0.364	0.000
5	Sample A5	0.327	0.327	0.327	0.327	0.000
6	Sample A6	0.403	0.401	0.400	0.401	0.002
7	Sample A7	0.347	0.348	0.347	0.347	0.001
8	Sample A8	0.012	0.012	0.012	0.012	0.000
9	Sample H1	0.307	0.306	0.307	0.307	0.000
10	Sample H2	0.313	0.325	0.330	0.323	0.009
11	Sample H3	0.378	0.377	0.378	0.378	0.000
12	Sample H4	0.006	0.006	0.006	0.006	0.000
13	Sample H5	0.212	0.212	0.212	0.212	0.000
14	Sample H6	0.283	0.282	0.283	0.283	0.000
15	Sample H7	0.005	0.005	0.005	0.005	0.000
16	Sample H8	0.007	0.007	0.007	0.007	0.000
17	Sample H9	0.371	0.370	0.371	0.371	0.000
18	Sample H10	0.291	0.289	0.289	0.290	0.001
19	Sample K1	0.019	0.019	0.019	0.019	0.000
20	Sample K2	0.013	0.013	0.013	0.013	0.000
21	Sample K3	0.005	0.005	0.005	0.005	0.000
22	Sample K4	0.011	0.011	0.010	0.011	0.000
23	Sample K5	0.012	0.012	0.012	0.012	0.000
24	Sample K6	0.001	0.001	0.001	0.001	0.000
25	Sample K7	0.008	0.008	0.008	0.008	0.000
26	Sample K8	0.003	0.003	0.003	0.003	0.000

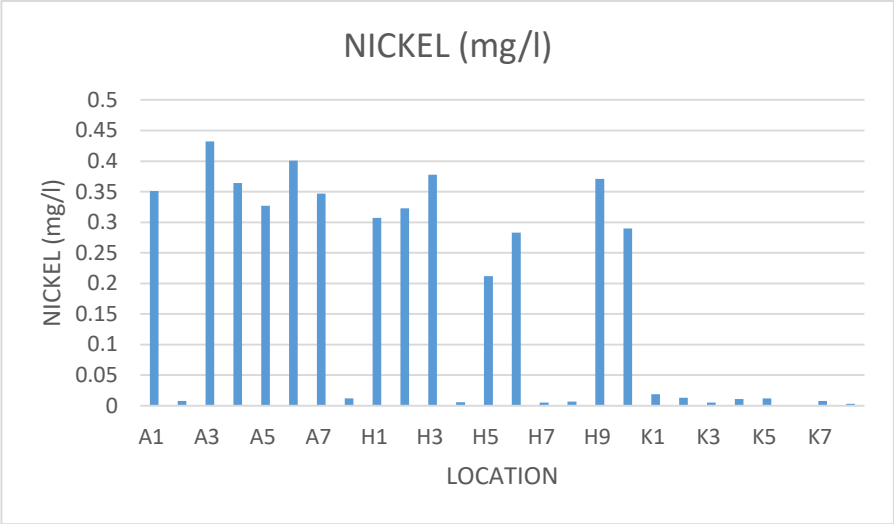

Figure 11: Nickel

DISCUSSION

Though some heavy metals are necessary in little quantities for the normal development of the genetic cycle, most of them become toxic at high concentration (Duruibe et al, 2007). The physicochemical parameters and heavy metals obtained from analysis of water samples were presented in table 1 to table 11 and their respective graph for easier appearance, below are discussion of the results;

DO (mg/L) content at higher rate is 29.67mg/l in sample A8 and lowest content rate is 4.39mg/L at sample K5 that are all conformity with the W.H.O standard.

The result in table 1 shows the amount of DO present in the sample water in from various locations in Geidam.it was high content in A8 sample water is about 29.67mg/L and follow by H3 with 23.32mg/l while K5 sample with 4.39mg/l all are below the WHO (2008) standard limit,

The amount of lead content in the sample is presented in table 2, lead is one of the most common heavy metal in drinking water, if occurred more than its permissible limit shows general metabolic poison and enzyme inhibitor cardiovascular effects, increased blood pressure and incidence of hypertension, Decreased kidney function and reproductive problems (in both men and women) (Gebrekidan etal.,2011). All the samples in this research showed detectable levels of lead and with all the samples having concentrations above the maximum acceptable concentration for drinking water of WHO (0.01 mg/L), accept for samples H1, H4, and H10 had zero mean value while K8 has 0.004 mg/L respectively

Turbidity is the cloudiness of water caused by a variety of particles and is another key parameter in drinking water analysis. It is also related to the content of diseases causing organisms in water, which may come from soil runoff (Adeyemi etal, (2007)). The standard recommended maximum turbidity limit, set by WHO for drinking water is 5 nephelometric turbidity units (NTU) while in the result water samples of turbidity concentration is 22.75m/L at higher A3 rate follow by H1 borehole of 17.37mg/L and lowest rate from sample K8, with 0.55ml/g indeed sample A3 and the almost about 9 samples has higher values of turbidity that are above the standard which can cause health impact to humans.

The hardness of the water was found in table 4, with 47.93mg/L at A3 sample is above the limit of W.H.O specification of drinking water and follow by H1, H2, H3, A6 and A7 respectively while 1.17mg/L hardness is from K8 sample which lowest and acceptable limit of W.H.O.

TDS content in drinking water from A3 is 221.23mg/l, has lower limit W.H.O level, K8 has lowest value of 5.19mg/L.(WHO 2008).

Conductivity content is high with mean value of 1007.58 ms/cm from A3 location with is not acceptable for drinking water additionally electrical conductivity is the ability of any medium, water in this case, to carry an electric current. The presence of dissolved solids such as calcium, chloride, and magnesium in water samples carries the electric current through water. The measured conductivity values of all the drinking water samples are plotted in Figure 6. According to WHO 2008, the maximum allowable level of conductivity is 1000ms/cm, while K8 sample has lowest value of 24.73 ms/cm.

The pH content range in table 6 above. According to WHO 2008 the acceptable pH range for drinking water is 6.5-8.5, therefore all the samples analysis are fit for drinking accepts sample A7 has a pH value of 9.89mg/L and K6 with mean value of 9.13 as the highest while A4 borehole water has the lowest range of 2.93mg/L The pH has classified as one of the most important water quality parameters. Measurement of pH relate to the acidity or alkalinity of the water, a water to be considered has acidic if the pH is below7.0, while it is to

be considered as alkaline if the pH is above 7.0, acidic lead to corrosion in pipes and pumping system while alkaline shows disinfection in water, the normal drinking water pH range according to WHO is between 6.5 and 8.5.

The amount of chromium content in the samples used is presented in table 8. A3 has the highest rate of 0.034 mg/L while sample K3 has the lowest mean of 0.00mg/L which are below the limit permissible, there are all within the limit guideline, hence there is no need for proper assessment the amount of chromium content in the samples. Chromium compound are toxic known carcinogens whereas chromium is an essential nutrient. Breathing high level can cause irritation to the lining of the noses ulcer runny nose and breathing problems such as asthma cough shortness of breath or wheezy. Skin contact can cause skin ulcers allergic reaction consisting of severe madness and swelling of the skin have been noted long term exposure can cause damage to the liver, kidney, circulatory and nerve tissues as well as skin irritation. (Greenberg 2005).

Table 9 shows cadmium content in drinking water with sample K7 has 0.008mg/L is greater than the standard the samples showed detectable levels of Cadmium and with all the samples having concentrations above the maximum acceptable concentration for drinking water (0.003 mg/L) Thus the water sample is not Suitable for drinking purposes and samples H10, K4 and K5 has 0.001mg/l while the rest borehole has 0.000mg/L equally which is below the limits When it higher than the standard it may cause toxic to kidney. Cadmium compound are known human pollutants, smokers get expose to significantly higher cadmium level than non-smoker. Severe damage to lungs may occur through breathing high level of cadmium. Ingesting very high level severely irritated the stomach leading to vomit and diarrhea long term exposure to lower lead to a build- up in the kidneys and possible kidneys disease, lungs damage and fragile bones. Significant damage to environment and human health they also cause irregularly in blood com-position, badly effect vital organs such as kidney and liver [Khan et al. (2011)]

The iron concentration table 10 of 0.168 mg/L at higher rate from sample A6 borehole water and 0.004m/L at lowest rate from Sample K6, almost all the samples has higher value than the W.H.O specification of drinking water. The study examined the status of heavy metal in boreholes in the north local government area of Osun state, Nigeria. Forty-one (41) functional hands dug well and nine boreholes in the area were sampled. Results showed that the concentration of zinc (Zn), lead (Pb) and manganese (Mn) where within world health organization standard (WHO1996). Maximum permissible limits with mean values of 0.02mg/l, 0.4mg/l, 0.03mg/l respectively (John et al, 2007).

NATIONAL AGENCY FOR FOOD AND DRUGS ADMINISTRATION AND CONTROL, (NAFDAC), WORLD HEALTH ORGANISATION (WHO) AND STANDARD ORGANISATIO (SON)

All water sources indeed for human consumption shall comply with Nigerian Standards for drinking water quality and shall receive authorization from ministry of health before being supplied to the population.

Chemical parameters inorganic constituents

S/N	Parameter	Unit	Maximum permitted Levels	Health Impact
1	Cadmium (Cd)	mg/L	0.003	Toxic to the kidney
2	Chloride (Cl)	mg/L	250	None
3	Chromium (Cr^{6+})	mg/L	0.05	Cancer
4	Fluoride (F)	mg/L	1.5	Fluorosis skeletal tissue (bones and teeth) morbidity
5	PH	mg/L	0.5-8.5	None
6	Iron (Fe^{2+})	mg/L	0.3	None
7	Lead (Pb)	mg/L	0.01	Cancer, metabolism, effect mental development, in instant toxic to the central and peripheral nervous system.
8	Zinc (Zn)	mg/L	3	None
9	Copper (Cu^{2+})	mg/L	1	Gastrointestinal disorder
10	Total dissolve solid	mg/L	500	None

11	Nitrate (NO_2)	mg/L	0.2	Cyanosis and asphyxia (blue baby syndrome) in infant under 3 months
12	Turbidity	NTU	5	
13	Conductivity	Ms/cm	1000	

CONCLUSION

The total drinking borehole water sample were collected from twenty six (26) different location, was analyzed total six 6 physicochemical parameters as, dissolved oxygen, conductivity, total dissolved solids (TDS), pH and turbidity, hardness and five heavy metals Cd, Cr, Fe, Ni, Pb using standard Procedures. The results were compared with other national and international standards among the analyzed samples, regarding parameters 99.01% for electrical conductivity, 98.17% for TDS and 53.10% for turbidity and 84.00% for pH shows concentration lower or within the limit accepts for turbidity which slightly lower than 93.4% admissible within the United States Environmental Protection Agency (USEPA). Meanwhile for the metals 99,00% for iron, 92.09% for cadmium, 99.00% for chromium are safe for drinking water accepts for lead 30.54% which is lower than the Safe Drinking Water Act requires EPA. Accesses of lead in the blood of children can result in: Lower IQ and hyperactivity, slowed growth, Hearing problems and Anemia. In rare cases, ingestion of lead can cause seizures, coma and even death, the results obtained from the present research shall be useful in future management of the Geidam water, the study indicated that some water is safe for human consumptions. However, concentration of lead and pH in boreholes are slightly above the allowed levels and the presence of some heavy metals shown in some of the water samples may be due to contamination from the source or along the line. However further research study and regular monitoring of the water quality is advised.

RECOMMENDATION

i. Regular monitoring to ensure conformity to World Health Organization standard and to ensure the portability water for public consumption.
ii. The federal Government should strictly regulate the way drinking water is produced.

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