Global Journal of Science Frontier Research
Chemistry
Volume 12 Issue 6 Version 1.0 Year 2012
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Analytical Assessment of Cadmium, Lead and Iron in Hand Dug Wells of Ilaro, South-Western Nigeria

By Eruola, A.O. & Adedokun, N.A
University of Agriculture, Abeokuta, Nigeria

Abstract - The levels of selected heavy metals; Cadmium, Lead and Iron in the hand dug wells of Ilaro town was critically assessed at strategic points of the area to determine the level of pollution caused by anthropogenic activity within the town using different physical and chemical processes. The Mean ± S.D of the results obtained are; Cadmium 0.017±0.016 mg/l; Lead 0.229±0.061 mg/l; Iron 1.076±2.393 mg/l. All the parameters were higher than the standards that were specified for drinking water by WHO. Consequently, the well water in the study location is not suit for drinking.

Keywords : Ilaro, Heavy metals, Pollution, Metal, Water quality, Contaminants.

GJSFR-B Classification: FOR Code: 030199

Strictly as per the compliance and regulations of :

Analytical Assessment of Cadmium, Lead and Iron in Hand Dug Wells of Ilaro, South-Western Nigeria

Eruola, A.O. [α] & Adedokun, N.A [σ]

Abstract - The levels of selected heavy metals; Cadmium, Lead and Iron in the hand dug wells of Ilaro town was critically assessed at strategic points of the area to determine the level of pollution caused by anthropogenic activity within the town using different physical and chemical processes. The Mean ± S.D of the results obtained are; Cadmium 0.017±0.016 mg/l; Lead 0.229±0.061 mg/l; Iron 1.076±2.393 mg/l. All the parameters were higher than the standards that were specified for drinking water by WHO. Consequently, the well water in the study location is not suit for drinking.

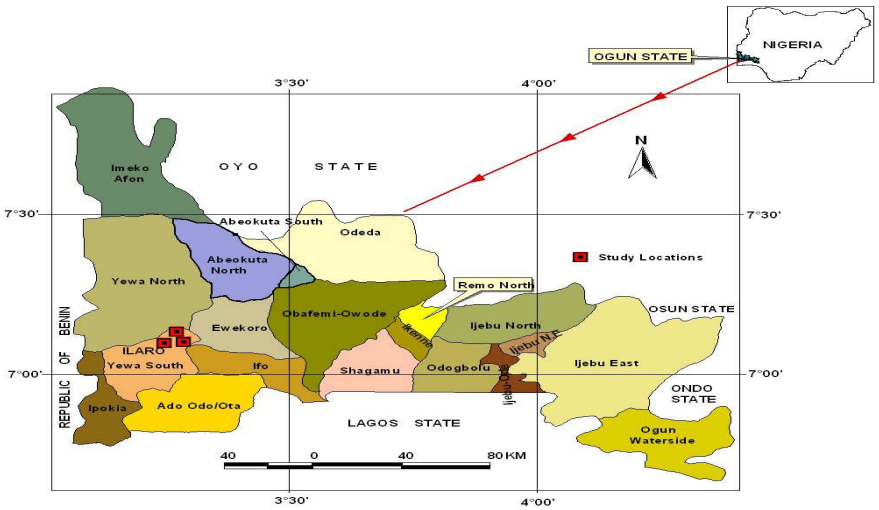
Keywords : Ilaro, Heavy metals, Pollution, Metal, Water quality, Contaminants.

I. Introduction

A primary concern of people living in developing countries is that of obtaining clean drinking water. The quality of groundwater is a function of natural processes as well as anthropogenic activities [9]. Quality drinking water is essential for life. Unfortunately, in many developing countries of the world, including Nigeria, good, portable and hygienic water has become a scarce commodity [6].Several human activities have constituted great havoc to the quality of water which we are not taking cognizance of and the health implication of any water that is polluted either lightly or heavily with heavy metal is highly significant. Due to the frequent and sometimes lengthy periods of interruption in the supply of treated piped water, many households rely on other sources of water such as wells, boreholes, springs and surface waters. The use of groundwater as the only source of portable water supply is increasing worldwide. In the United States, 90 - 95% [5] of rural and suburban water comes from this source and in Ghana, it is 62 - 71% [3]. Water has unique chemical properties due to its polarity and hydrogen bonds which means it is able to dissolve, absorb, adsorb or suspend many different compounds [10], thus, in nature, water is not pure as it acquires contaminants from its surrounding and those arising from humans and animals as well as other biological activities [7].

II. Study Area

Ilaro is found in South-western part of Nigeria as shown in figure 1.The land is flat and sloppy where mainly we have streams. Some areas are swampy and low lying. Generally, the soil is firmed and rich for agricultural farming. Ilaro town is about 50 km from Abeokuta, the Ogun State capital, and about 100 km from Ikeja, the capital city of Lagos State. The landform is that of eroded pediment plain with well-incised valleys forming a trellis pattern. The soils are developed over a deeply weathered layer of sedimentary rocks consisting of false bedded sandstones which underlies the area. The sediments are of lower cretaceous rocks or Abeokuta form.



Author σ : University of Agriculture, Abeokuta, Nigeria. E-mail : noaadedokun@yahoo.com
Author α : Yaba College of Technology, Lagos State, Nigeria.

III. Material and Method

Water samples were collected from hand dug wells which are used for drinking and domestic purposes in Ilaro. The well water samples were collected using 500ml screw-capped plastic containers that have been washed with detergents, dried and rinsed with 10%HNO_3 to avoid contamination by any physical or chemical means. The choice of the sampling locations was carefully selected with some factors in view. Before collection of the water samples, small volume of the water was allowed to run without collection for 3-4 minutes so that sample collected would actually be a true representative of the water, to get fresh water and also to have homogenous mixture. Water sample were obtained to rinse the container before collection. On collection, the samples collected were preserved immediately with HNO_3 to keep the metals in solution. The samples were tested for four physico-chemical parameters; Total Dissolved Solid, pH, Electrical Conductivity and Temperature. Samples without preservative was tested for the previously listed physical parameters by taking about 50mls volume into a beaker that have been previously rinsed with distilled water and later with the water sample to be tested

The collected water sample in 500ml container were return to the laboratory for further analysis and kept in the refrigerator at low temperature to minimize physical and chemical reactions. Digested water samples were sent to be analyzed using Atomic Absorption Spectrophotometer (AAS) to test for the interested heavy metals (Cd, Pb and Fe)

IV. Result and Discussion

The summary of the physical and chemical results of the water samples analyses from the 10 points are given below in Tables 1 and 2. pH in Ilaro ranges from 3.90-7.03.The water is generally acidic except for F.P.I, Ilaro which is neutral. The effects of acidic water on human health and the environment have been widely reported. For example, acidic water has been known to be aggressive and enhance the dissolution of iron and manganese, causes unpleasant taste in water [4]. The water samples has actually shows the relationship between the physical parameters .The higher the temperature, the more the dissolved solids in the water and the higher the electrical conductivity Temperature of the points is from 27-28.8^{0}C. TDS ranges from 12mg/l-286mg/l. TDS values generally are not up to the MCL of 500ppm, but it implication is that it impair the water quality and affect the clarity of water.High concentration of TDS could result to salty and unpalatable taste in water. High concentration of TDS could result to gastrointestinal irritation. Electrical Conductivity of the sampled points is from 25-560μs/cm. It was observed from result that most of these wells were not suitable for domestic purposes for which they are presently used for. 70% of tested samples contain detectable amount of cadmium with concentration above the maximum contaminant level (0.003mg/l) suggested by WHO (fig.2). This is of concern because cadmium has carcinogenic properties as well as long biological half-life [8] leading to chronic effect as a result of accumulation in the liver and renal cortex [4]. It can also cause kidney damage as well as produce acute health effects resulting from over exposure to high concentrations [8].

Table 1 : Physical Parameters.

Parameters	S01	S02	S03	S04	S05	S06	S07	S08	S09	S10
P^H	6.52	5.71	5.89	5.16	5.25	4.77	3.90	5.12	6.22	7.03
TDS **(mg/l)**	86	12	50	58	32	108	202	286	216	20
Temperature (^{0}C)	27	27.4	27.6	28.8	27.6	28.1	27.4	27.5	28.4	28.2
E.C **(μS/cm)**	169	25	99	113	63	213	398	560	426	40

Table 2 : Heavy Metals Concentrations in Water Samples.

Parameters Sample	Locations	Coordinate	Cadmium (mg/l)	Iron (mg/l)	Lead (mg/l)
S01	Oke- ola, Ilaro	N06.89821, E003.00829	0.011	ND	0.249
S02	Express,Ilaro	N06.89228, E003.99855	0.014	0.024	0.221
S03	Orita, Ilaro	N06.88520, E003.00235	0.012	0.134	0.303
S04	Musa Str, Ilaro	N06.89123, E003.01600	0.003	ND	0.262
S05	Otegbeye,Ilaro	N06.89525, E003.01499	ND	ND	0.317
S06	Lesli,Ilaro	N06.88650, E003.01347	0.003	0.049	0.236
S07	Aderogu,Ilaro	N06.88329, E003.01118	0.018	0.041	0.196
S08	Akiniku,Ilaro	N06.88723, E003.02233	0.004	0.039	0.284
S09	Gbogodi, Ilaro	N06.87657, E003.00357	0.066	8.406	0.261
S10	F.P.I. Ilaro	N06.88972, E003.98886	0.008	ND	0.291

Table 3 : Statistical summary of the investigated Physico-Chemical Variables.

Variables	Mean ± S.D (Range)	MCL	No above MCL	% above MCL
pH	5.33 ± 0.73 (3.9-7.03)	6.5-8.5	8	80%
Temperature (^{0}C)	27.52 ± 0.76 (26.1-28.9)	-	-	
E.C (μS/cm)	197.2 ± 150(25-560)	1000	-	
TDS (mg/l)	100.25 ± 76.6 (12-286)	500	-	
Cadmium (mg/l)	0.017 ± 0.016 (0.003-0.066)	0.003 mg/l	7	70%
Lead (mg/l)	0.229 ± 0.061(0.102-0.317)	0.01mg/l	10	100%
Iron (mg/l)	1.076 ± 2.393 (0.009-8.406)	0.3 mg/l	1	16.67%

NOTE: MCL is Maximum Contaminant Level set by [7] for drinking water

70% of tested samples contain detectable amount of cadmium with concentration above the maximum contaminant level (0.003mg/l) suggested by WHO (fig.1). This is of concern because cadmium has carcinogenic properties as well as long biological half-life [8] leading to chronic effect as a result of accumulation in the liver and renal cortex [4]. It can also cause kidney damage as well as produce acute health effects resulting from over exposure to high concentrations [8].

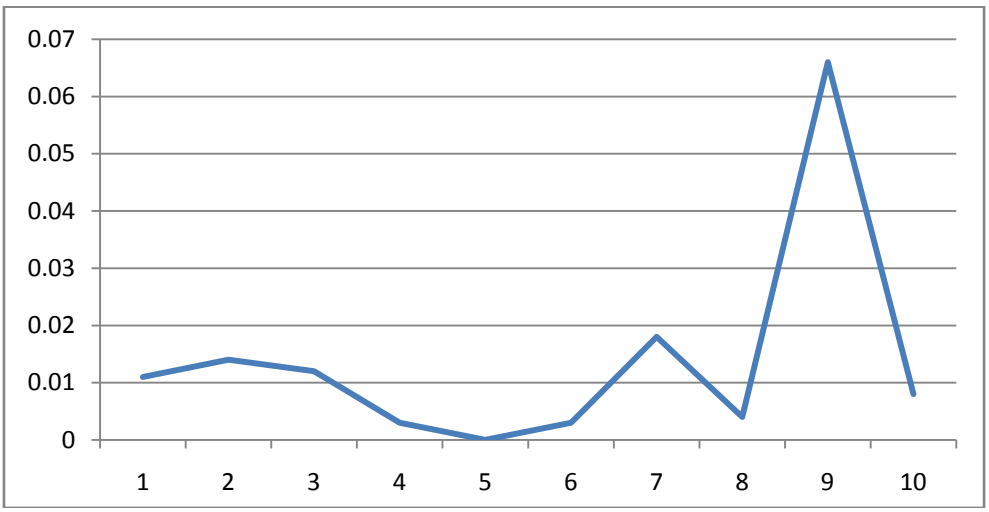


Figure 2 : Cadmiumlevels in water samples.

Table 3 showed the comparison of the heavy metal contamination in the sampled wells in the two study locations. Although the metals concentrations in water samples were generally above the maximum Contaminants Level; Cadmium concentration is higher in Ilaro wells (0.019 mg/l) than in Aiyetoro wells (0.015mg/l). Also, the Lead concentration in Aiyetoro wells (0.262 mg/l) is higher than that of Ilaro wells (0.195 mg/l). Finally, the Iron Level in Aiyetoro wells (1.280 mg/l) is higher than in Ilaro wells (0.704 mg/l)

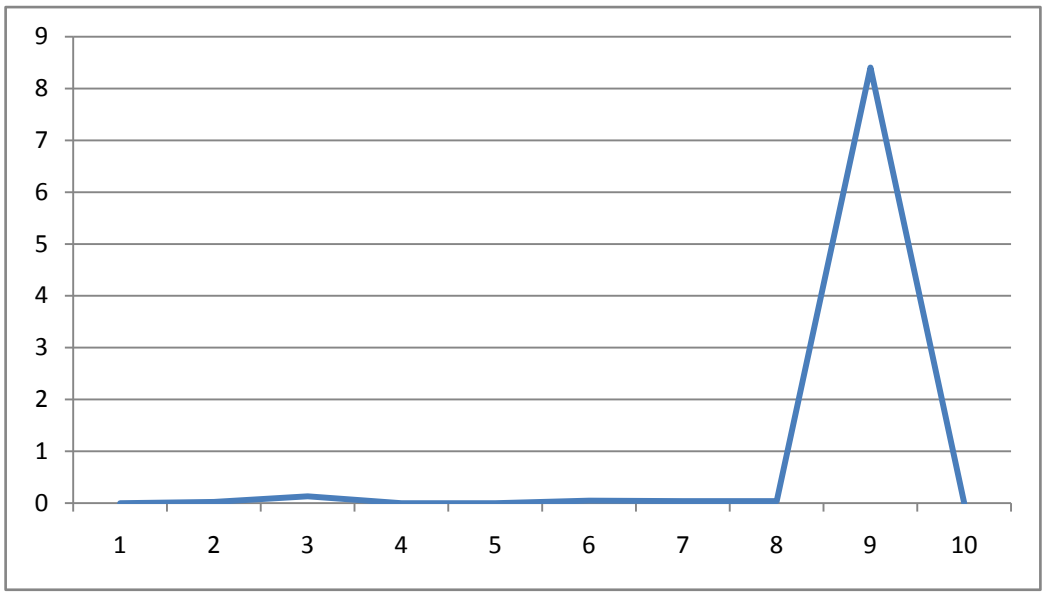


Figure 3 : Iron level in water samples.

Furthermore, the result showed that all water sample contained lead concentration that does not conform with the maximum contaminant level 0.01mg/l. The lead concentration in well samples in the study area fell in the range of 0.102mg/l - 0.317mg/l concentration (fig. 2). This result is of great concern as lead has been recognized for centuries as a cumulative general metabolic poison [1]. It is a neurotoxin and it is responsible for the most common type of human metal toxicosis. Also studies have linked lead exposures even at low concentration and increases in blood pressure (Zietz et. al., 2007) as well as with reduced intelligence quotient in children (Needleman, 1993) and with attention disorders (Yule and Rutter, 1985). Thus the danger of lead poisoning becomes very critical and real for the users.

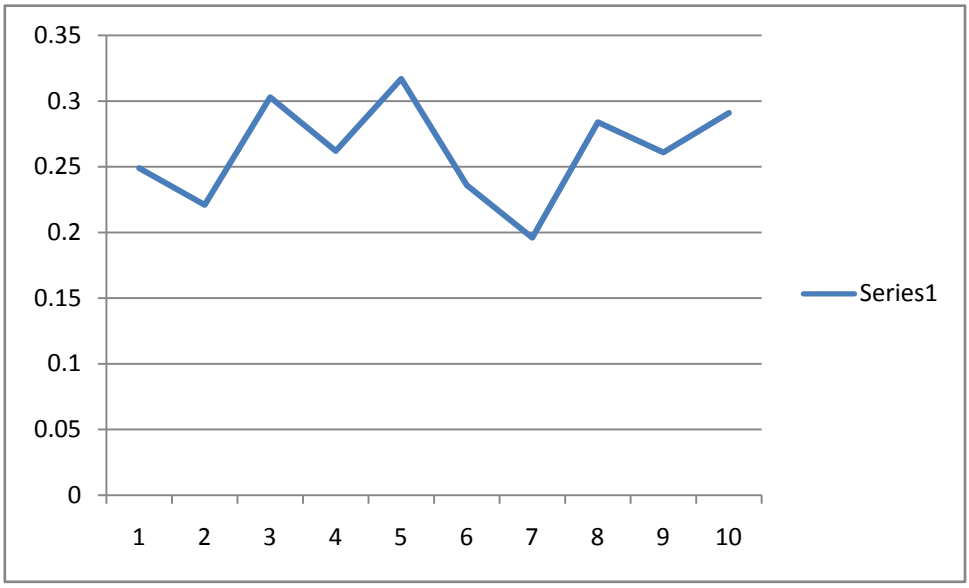


Figure 4 : Lead Level in water samples.

V. Conclusion

The result of this study showed that the groundwater of the study areas contain all the analyzed heavy metals; 70% of water samples contain Cadmium above the maximum Contaminants Level, all the water samples contain Lead higher than the Maximum Contaminants Level while 10% of the water samples contain Iron higher than the Maximum Contaminants Level. The results for Conductivity and Total Dissolve Solids were generally low to the Maximum Contaminants Level while 90% of the water samples were generally acidic. These suggest a significant risk of this population to heavy metal toxicity and acidic water thereby making the water unsuitable for drinking.

References Références Referencias

1. Adepoju-Bello, A.A. and O.M. Alabi, 2005. Heavy metals: A review. The Nig. J. Pharm., 37: 41-45.
2. Edward K.A., Classen G.A. Schroten EHJ (1983). The water resource in tropical Africa, and exploitation, ILCA-Inter. livestock centre for Africa Res., Rep., Addis Ababa p. 28
3. GEMS/Water Project (1997). Water Quality Data for selected stations 1991-1995. Ghana National Committee for International Hydrology and Water Resources Programmes. Water Research Institute (WRICSIR) Accra, Ghana.
4. Hammer, M.J., and M.J. Hammer, Jr., 2004. Water quality in: Water and Waste water Technology. 5th Edn. New Jersey: Prentice-Hall, pp:139-159
5. Howell J. M, Coyne M.S, Cornelius P.L (1995). Faecal bacteria in agricultural waters of the bluegrass region of Kentucky. J. Environ. Qual. 24: 411-419.
6. IDLO. Water Tenure Reform and Pubic Access to Water as a Basic Need, International Development Law Organization Voice of Development Jurists Series. 2006
7. Mendie, U., 2005. The Nature of Water. In: The Theory and Practice of Clean Water Production for Domestic and Industrial Use. Lagos: Lacto-Medals Publishers, pp: 1-21.
8. Orisakwe, O.E., I.O. Igwilo, O.J. Afonne, J.U. Maduabuchi, E. Obi and J.C, Nduka, 2006.Heavy metal hazard of sachet water in Nigeria. Arch. Environ. Occupation Health, 61 (5):209-213
9. Sajjad M.M, Rahim S, Tahir S.S. Chemical quality of groundwater of Rawalpindi/Islamabad Pakistan 24th WEDC Conference, Islamabad, Pakistan, 1998.
10. WHO, 2007. Water for Pharmaceutical Use. In: Quality Assurance of Pharmaceuticals: A Compendium of Guidelines and Related Materials. 2nd Updated Edn. World Health Organisation, Geneva, 2: 170-187.
11. Yule, W. and M. Rutter, 1985. Effect on children behavior and cognitive performance:a critical review. In Dietary and Environmental lead (Pb): Human health effect. R. Mahaffey, (Ed.). New York : Elesvier, PP:211-251.
12. Zietz, B.P., J, Lap and R Suchenwirth, 2007. Assessment and Management of tap water contamination in lower saxon, German. Int. J. Environment Health Resources 17(6): 407-418