ISSN 2350-1030

International Journal of Recent Research in Physics and Chemical Sciences (IJRRPCS)
Vol. 2, Issue 2, pp: (19-22), Month: October 2015 – March 2016, Available at: www.paperpublications.org

Trace Metals Concentration in Shallow Well Water in Enugu Metropolis

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Abstract: **This work assesses the concentration of heavy metals in Enugu Municipal well-water considering the fact that some Enugu inhabitants depend on well-water as their major source of water supply. Water from twenty four (24) different hand dug wells from six locations were investigated for Zn, Cu, Pb, Mn, Cd, and Fe using Atomic Absorption Spectroscopy (AAS). The result of the study expressed as the means and standard deviations were compared to WHO and EU standards for drinking water, and it was found that well waters from Iva-Valley and Uwani areas suffer from Cd and Mn pollution. The remaining four locations (Emene, Asata, Abakpa Nike and Achara Layout) were all free from Cd and Mn pollution. Cu, Zn, Fe and Pb concentrations were either completely absent or below world threshold limits at all the locations.**

Keywords: **Heavy metals, well-water, contamination, atomic absorption.**

1. INTRODUCTION

Millions of people in developing world rely heavily on ground water mostly through shallow dug wells. These can easily become polluted, primarily because of human activities. Ground water contamination can occur whenever there is a source releasing contaminants to the environment. The sources of ground water pollution are many and varied, and include: -Natural and Anthropogenic origins. (Marcovecchio et al., 2007; Sililo et al., 2001). The vulnerability of an aquifer to such pollution is directly linked to (a) Accessibility of the saturated zone, in a hydraulic sense to the penetration of mobile contaminants. (b) Attenuation capacity as a result of physio-chemical retention or reaction of pollutants, (c) The manner of pollutant disposition. (d) The physiochemical mobility and persistence of the pollutant (Silito et al., 2001)

The degree/extent of interaction between the soil/aquifer characteristics and the pollutant (factors (a) – (d) will determine the vulnerability of an aquifer to pollution (Foster, 1987). The most common contaminants are heavy metals. Heavy metals are elements having atomic weights between 63.546 and 200.590 and a specific gravity greater than 4.0, i.e. at least 5 times that of water. They exist in water in colloidal, particulate and dissolved phases (Adepoju Bello et al., 2009). Some of the metals are essential to sustain life at a very low concentration. However, most, if not all elements are toxic at sufficient high concentration. (Dudkas and Miller, 1999, Goyer, 1995). Calcium, Magnesium, potassium and sodium must be present for normal body functions. Also, cobalt, copper, iron, manganese, molybdium and zince are needed at low levels as catalyst for enzyme activities (Adepoju-Bello et al., 2009) and can cause serious health effects with varied symptoms depending on the nature and quantity of the metal ingested. This research project was initiated as a limited scale study of the quality of well waters within Enugu municipal and interpretation of the findings, in term of the danger the pollutants pose to inhabitants of Enugu that depend on the wells for their water use. It is a preliminary communication towards a more detailed research into the sources and ultimate fates of heavy metal pollution of Enugu water bodies.

2. MATERIAL AND METHOD

Sampling:

A total of 24 different hand-dug wells were chosen from six locations in Enugu municipality – Abakpa Nike; Achara Layout, Asata, Emene, Iva- Valley and Uwani. A chemically cleaned plastic can was used to collect water from the wells. Samples were collected in quadruplicate from the various locations and transported to the laboratory and analyzed within 48hrs.

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Sample Analysis:

Heavy metals were determined in the water samples using a Perkins Elmer Model PE 2502 Atomic Absorption Spectrophotometer.

Statistical Analysis:

All data generated were analysed statistically by the method described by Cyrpian Oyeka (Oyeka, 1990).

3. RESULTS AND DISCUSSION

The results of this study are shown in table 1. In this table, the concentrations in mg/L of the individual heavy metals Iron (Fe), Zinc (Zn), Cadmium (Cd), Copper (Cu), Lead (Pb) and Manganese (Mn) in well water from Abakpa Nike, Achara Layout, Asata, Emene, Iva-Valley, and Uwani as analyzed using atomic absorption spectrophotometer are presented.

Table 1: The means and standard deviations of the concentrations of heavy metals in well waters in the six locations (mg/L)

Element	Abakpa Nike	Achara Layout	Asata	Emene	Iva Valley	Uwani	WHO 1993	EU 1999
Cd	ND	ND	ND	ND	0.01±0.05	0.006±0.004	0.01	0.01
Mn	0.05±0.3	0.01±0.01	0.08±0.02	0.15±0.04	0.7±0.07	0.6±0.41	0.5	0.05
Pb	ND	ND	ND	ND	ND	ND	0.01	0.01
Zn	0.02±0.01	0.89±0.74	ND	0.81±0.48	0.22±0.16	0.01±0.38	3.0	NM
Fe	0.03±0.16	0.03±0.02	0.08±005	0.11±0.39	1.10±0.61	0.01±0.04	NG	0.0
Cu	ND	ND	ND	ND	ND	ND	2.0	2.0

Key: ND – Note detected; NM – Not mentioned; NG – no guideline.

It is found from the results that Cd was not detected in Abakpa Nike, Achara Layout, Asata and Emene but were detected in Iva-Valley and Uwani at the levels of 0.01± 0.05mg/L, and 0.006± 0.004mg/L respectively. These concentrations were found to be higher than WHO and EU standards. This shows that the well water from Iva-Valley and Uwani are contaminated with Cd. Manganese was found to be present in all the well water analyzed. However, Abakpa Nike, Achara-Layout and Asata well water not polluted with manganese. Emene, Iva-Valley and Uwani well water are contaminated with Mn in comparison with EU and WHO standards. From the analysis it was observed that Pb and Cu were not detected in any of the wells in Enugu municipal. This probably is due to the high retention of Pb in the top layer of the soil. This corroborates the findings of Davies (1995) which stated that lead is especially prone to accumulation in surface horizons of soil because of its low water solubility which results in very low transportation. Zinc (Zn) was found to be present in all the well water in Enugu municipal with exception of Asata where it was not detected. All the wells under study showed that Enugu municipal well water are not contaminated with Zinc (Zn) going by WHO standard. It was observed from the analysis that iron (Fe) was above EU standard in Iva-Valley well water (1.10 ±0.604). In addition, iron was found in all the well water samples in all the locations. This could be associated with the report that iron occurs at high concentration in Nigerian soils (Asaolu et al., 1997; Asaolu and Olaofe, 2004; Nwajei and Gagophien, 2000). The major source of Fe is most probably the pyrite gangue found in the Enugu coal seams as well as the associated shales in the area mined.

4. CONCLUSION

In conclusion, the level of heavy metals in all the well water examined show that there are serious reasons to believe that Cd, Mn, Zn and Fe are contaminating Iva-Valley and Uwani well waters at varying degrees. This suggests a significant risk to the inhabitants of these areas given the toxicity of these metals and the fact that many depend on hand dug wells as their only sources of water supply. It is important that bacteriological assessment of water from these different wells is investigated to verify the severity of the pollution, and be able to initiate a remediation plan and educate people on how safe their well waters are for drinking and other domestic applications.

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