LEAD CONCENTRATIONS IN LAGOS GROUNDWATER

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ABSTRACT

Heavy metal contamination of ground water is becoming a great environmental issue. This paper presents an assessment of the level of lead in 100 samples of groundwater from the residential and industrial zones of Lagos. The determination was done by Atomic Absorption Spectrophotometry (AAS). Most of the samples analyzed contained lead at concentrations above WHO recommended maximum concentration level. Samples from the industrial zone are several times more contaminated than those from the residential zone thereby implicating industrial effluent as a possible source of this contamination. The maximum concentration level found in samples from the residential zone is 0.019 mg/L while the maximum concentration level found in those from the industrial zone is 0.24mg/L. This study focused on lead due rampant cases of lead related morbidity and mortality in some part of Nigeria.

INTRODUCTION

In the recent years Ground water contamination has attracted a lot of attention and has become an important environmental issue (Vodela et al, 1997) and between the wide diversity of contaminants affecting water resources, heavy metals receive particular concern considering their strong toxicity even at low concentrations (Marcovecchio et al, 2007). Among the heavy metals lead stands out. For several years now, lead has been the intense focus of environmental health research globally and this is understandable, considering the perennial effect of lead toxicity.

Lead is a cumulative general metabolic poison (Adepoju-Bello and Alabi, 2005), a neurotoxin and is responsible for the most common type of human metal toxicosis (Berman, 1980). Lead is recognized as a cause of secondary porphyria resulting, from heme biosynthesis inhibition, and is characterized by elevated levels of blood δ-aminolevulinic acid (ALA), zinc protoporphyrin (ZPP), urinary ALA and coproporphyrin (CPU) (Daniell et al, 1997).

Lead is also known to cause injury to the central and peripheral nervous systems, which results in headache, dizziness, memory deficits and decreased nerve conduction velocity. The absorption of this heavy metal is known to be greater in children than in adults, which makes them particularly vulnerable to lead toxicity (Goyer, R.A., 1997). Their bones and developing teeth take up about eighty-five percent of the lead absorbed, while the blood accumulates only about ten percent. (Goyer, R.A., 1997).

The source of lead in water is mostly from the drainage and surface runoffs, (Sridhar, 2000) in addition to effluent discharges from industries, which contribute to the lead levels in the final recipients such as rivers, streams or wells (Ayodele,1996). Once lead is introduced into the environment, it persists.

In Nigeria today, the use of ground water has become an agent of development because the government is unable to meet the ever increasing water demand. Thus, inhabitants have had to look for alternative ground water sources such as shallow wells and boreholes. The quality of these ground water sources are affected by the characteristics of the media through which the water passes on its way to the ground water zone of saturation (Adeyemi et al, 2007), thus, the heavy metals discharged by industries, exhaust from transportation vehicles, municipal wastes, hazardous waste sites as well as from fertilizers for agricultural purposes and accidental oil spillages from tankers can result in a steady rise in contamination of ground water (Vodela et al, 1997; Igwilo et al, 2006).

There is a need to assess the quality of ground water sources to enable us to fully appreciate the health implication of continuing consumption of water from such sources. World Health Organisation has specified Maximum Contaminant Level for the presence of heavy metals in water. With the aid of Atomic Absorption Spectrophotometer the levels of lead in 100 ground water samples from different locations in Lagos city were assessed in this study.

METHOD

Instrumentation

Buck Scientific 210VGP Atomic Absorption Spectrophotometer. Buck Scientific 210VGP Atomic Absorption Spectrophotometer was employed in the determination of the metal content. All the operational conditions in the instrumentation manual e.g. slit width, current of lamps, beam balancing, and the wavelength of maximum absorption were followed.

Chemical and Reagents

All chemicals and reagents were of the analytical grade and were obtained from BDH Chemicals Ltd, UK. 5% trioxonitrate (V) acid was used for the digestion of the samples. Lead Nitrate was used to prepare the standard.

Sample collection and location

Ground water samples were randomly collected from 100 sampling sites which were a mixture of shallow wells and boreholes. The sampling sites were of two categories: a residential area and an industrial area. Distilled water served as control.

Sample digestion

To ensure the removal of organic impurities from the samples and thus prevent interference in analysis, the samples were digested with concentrated nitric acid. 10ml of nitric acid was added to 50ml of water in a 250ml conical flask. The mixture was evaporated to half its volume on a hot plate after which it was allowed to cool and then filtered.

Standard preparation

1000ppm stock solution of Lead was prepared by dissolving in a 1 litre volumetric flask 1.60g of Lead nitrate with 5% nitric acid. The mixture was shaken and the flask made up to the 1 litre mark with the 5% nitric acid for each metal. Calibration solutions of the target metal ions were prepared from the standard stock by serial dilution.

Sample Analysis

The digested water samples were analysed for the presence of lead using the Buck Scientific 210VGP Atomic Absorption Spectrophotometer. Air-acetylene was the flame used and hollow cathode lamp of the corresponding elements was the resonance line source, the wavelength for the determination of the metal was 283.31nm. The digested samples were analysed in duplicates with the average concentration of the metal present being displayed in mg/L by the instrument after extrapolation from the standard curve.

RESULTS AND DISCUSSION

The calibration curve was obtained using a series of varying concentrations of lead standard. The calibration curve was linear with a correlation coefficient of 0.959. The concentration level ranged from zero to 0.26 mg/L. There was no detectable lead ion in the distilled water which served as the control. Figure 1 and Figure 2 show the levels of lead in residential and industrial areas of Lagos respectively. The maximum concentration detected for the residential area is 0.019 mg/L while the maximum for the industrial area is 0.26 mg/L. In the residential area, 62% of the samples analyzed were found to be above WHO maximum concentration level. Generally the concentration levels in the industrial area and several times greater than those of the residential area. This can easily be attributed to nearness to source of contamination. Most of these companies have very a high level of heavy metals in the effluent which are discharged untreated.

For the protection of human health, guideline for the presence of lead in water has been set by different International Organisations such as USEPA, WHO, EPA, European Union Commission (Marcovecchio, 2007). According to the WHO the maximum contaminant level for lead is 0.01mg/L(WHO, 2000; Hammer and Hammer Jr., 2004). This figure is far below the levels obtained in the samples of water in this study and this constitutes a serious health hazard.

Lead poisoning could cause a variety of diseases. Severe Kidney and brain damage have been reported on long term exposure. Lead can also substitute for calcium in bone causing skeletal anomalies especially in children. This result is very worrisome as it represents lead contamination in most urban cities in Nigeria with similar activities. Close to 80% of 140 million estimated population of Nigerians live or migrate to the urban cities either for a short or long stay. Out of this population, over 15 million people reside in Lagos state. Previous work reported high level of lead [up to 9.8mg/kg] in some common foodstuff in the Lagos metropolis especially vegetables (Afolami et al., 2010). This means that the actually daily intake of lead may be several times the level coming from drinking water source.

CONCLUSION

This study has been able to demonstrate the big gap between lead contamination of ground water in an industrial zone and that in a less industrialized zone. In both cases the levels of lead are elevated but the result obtained from ground water in the industrial zone is alarming. Since the ground water is consumed both in the industrial zone and residential zone, this may lead to some adverse consequences to health. Since many disease conditions arise as a result of the lead contamination, there is an urgent need to enforce effluent treatment to reduce environmental and health risk that lead can pose. Other toxic heavy metals will be the focus of future study on the sampling locations.

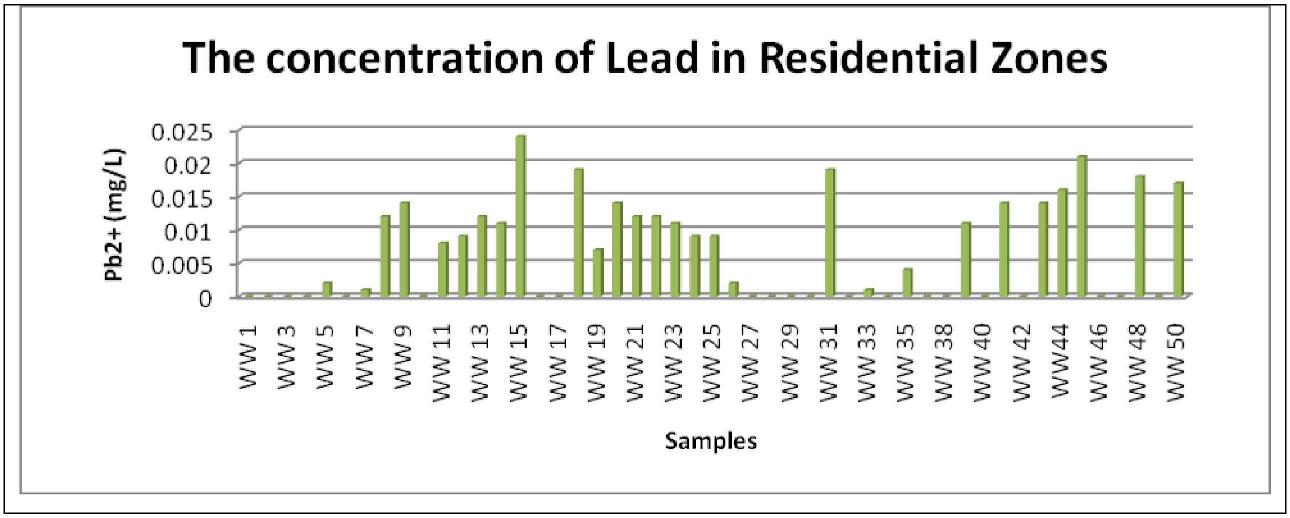

Figure 1: The concentration of Lead in Residential Zone

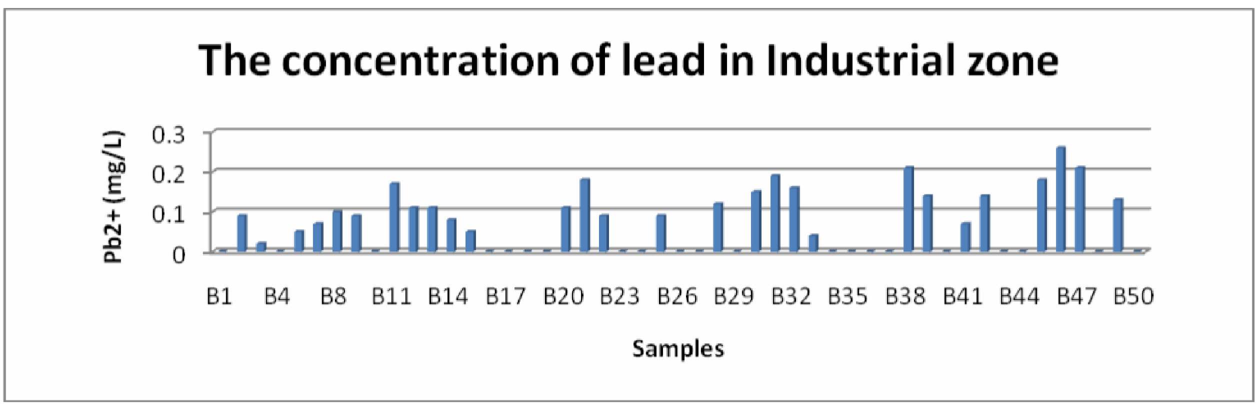

Figure 2: The concentration of Lead in Industrial Zone

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