Scholarly Journals of Biotechnology Vol. 2(1), pp. 1-6, January 2013
Available online at http:// www.scholarly-journals.com/SJB
ISSN 2315-6171 © 2013 Scholarly-Journals

Full Length Research Paper

Investigation of heavy metals in drinking water (sachet and bottled) in ago-Iwoye and nvirons, Ijebu North lga, Ogun state, Nigeria.

David T. W., Awoh D. K. AND Essa G. A.

Accepted 13 August, 2012

This study assessed and monitored the concentrations of Mg, Ca, Mn, Fe, Zn, Cu, Pb, Cr, Cd and Ni, in three (3) Bottled and five (5) Sachet water in Ijebu-North LGA of Ogun state, Nigeria. Analysis was run on the water samples using the Atomic Absorption Spectrophotometer (AAS). The results revealed that the concentrations of the following metals Mg, Ca, Mn, Fe, and Cd in the samples were low compared with World Health Organisation (WHO) standard 2005 and the following, Zn, Cu, Pb, Zn and Cr, were not detected. However, close monitoring of metals pollution and the drinking of sampled water of Ijebu-North LGA of Ogun state is recommended with a view to minimizing the risks to the health of the population that depends on the water supply.

Key words: Concentration, samples, heavy metals, pollution

INTRODUCTION

Water is one of man's most important natural resources and there are many conflicting demands on it. Therefore, there is need for skilled management of our water resources for domestic, industrial, supply, crop irrigation, transport, recreation, sport, power generation and waste disposal. Water is sometimes known as a universal solvent and can dissolve most compounds except for a few.

There are different sources through which we can get our water. These sources include;

a. Groundwater, which are subsurface water in the zone of saturation including water below the water table, the water emerging from some deep groundwater many have fallen as rain some decades, hundreds or even millions of years ago. Water from these wells are typically rich in dissolved solids especially carbonates and sulphates of Calcium and magnesium.
b. Rainwater, this water is collected from the atmosphere whenever it rains.
c. Rivers, Canals and low land reservoirs, the low land surface waters will have a significant bacterial load as a result of sewage disposal into the rivers or generally due to pollution. It may also contain algae, suspended solids and a variety of dissolved constituents.

Heavy metal is an exact term used to describe more than dozen elements that are metals or metalloids (elements that have both metal and non-metal characteristics). They are natural components of the earth's crust. They are high relative density minerals (relative density of about 4.5 times that of water). They are usually found in sediments, specific gravity of some metals includes; Cadmium, 8.65; Iron, 7.9; Lead, 11.34; Mercury, 13.456 (Lide 1992).

Generally, water pollution is described as the presence in water of enough harmful or objectionable material to damage the waters quality. Water pollution has many source and characteristics. Although, human activities have always had impact on coastal areas, most of these impacts have led to environmental pollution, i.e., the introduction of substance by man into the environment, which may put water resources and human health at risk (*His et al.,* 1999). Major heavy metals associated with water pollution include the following: Zn, Cu, Pb, Cd, Hg, Ni and Cr. The presence of metals in aquatic environment is partially due to natural processes such as volcanic activities, erosions and weathering, but mostly results from industrial processes particularly those concerned with mining and processing of metal ores, the finishing and plating of metals and the manufacturing of metal objects (Hernandez-Hernandez *et al.,* 1990).

Heavy metals though have effect on human health; they are needed in trace in human body system and also for industrial processes. In right concentration, heavy

*Corresponding Author Email: wemidavid@yahoo.com

metals are essential to life. In excess, these same chemicals can be poisonous; similarly, chronic low exposures to heavy metals can have serious health effects in the long run. Heavy metals are toxic when they are not metabolized in the body and are accumulated in the soft tissues. Heavy metals are already in the environment, all that needs to be done is to modify their concentration and the way in which they spread. Heavy metal can enter water supply by industrial and consumer waste or even from acidic rain breaking down soil and releasing heavy metal into the stream, lake, rivers and ground water. This heavy metal therefore enters human body through food and water intake. Also, the use of heavy metal components as additives to agricultural soil from various sources, the intake by food and folder crops, serve as other sources of heavy metal intake. The ambient air also serves as source of heavy metal intake. Some common sources of Heavy metals in our environment are;

- Lead: Leaded gasoline, tyre wear, lubricating oil, grease.
- Zinc: Tyre wear, motor oil, grease, brake emission, corrosion of galvanized parts.
- Iron: Auto body rust, engine parts.
- Copper: Bearing wear, engine part, brake emission
- Cadmium: Tyre wear, fuel burning and batteries.
- Nickel: Diesel fuel and gasoline, lubricating oil and brake emission.
- Chromium: Air conditioning coolants, engine parts, break emission.

Many people seeking purity opt for bottled water rather than the kind from the tap. But new research shows contaminants lurk there too. Brands of bottled water turned up a variety of contaminants, including cancer-linked chemicals according to a study by environmental advocacy group (www.msnbcnews.com).

Takahisa (1971) worked in the Zintsu river basin Japan; he discovered the prevalence of the disease associated with loss in bone tissue. When the assessment of the environment was undertaken, it was discovered that there is high concentration of lead, zinc and cadmium in water, soil as well as plant. This was linked to the destruction of Japanese industrial complex during World War II; hence, good industrial waste disposal practices were largely ignored.

Environmental exposure of the inhabitants on the vicinity of industry, particularly for the workers in battery or paint factories have played a significant role in the increase in the blood level of lead and other dangerous heavy metals (Fergusson *et al.,* 1981; Adeniji and Anetor, 1999). Helmut (2000) stated that the possible sources of nitrate contamination includes manure applied to land, agricultural fertilizer, industrial effluent, domestics waste water, septic systems, human waste, lagoons, animal feed lots and native soil organic matter as well as geologic sources. Tochobanglous *et al.* (1977) studied environmental hazard of solid waste and traced twenty-two diseases to the problems of solid waste with heavy metals. Heavy metals are chemical elements with specific gravity that is at least five times the specific gravity of water. The specific gravity of water is 1 at 4^o c. simply stated specific gravity is a measure of density of a given amount of solid substance when it is compared to equal amount of water. Some well-known toxic metallic elements with specific gravity that is 5 or more times that of water are cadmium, 8.65; iron, 7.9; lead, 11.34 and mercury 13.546 (Lide, 1992).

Elueze *et al.* (2001) used geochemical principles to evaluate the concentration of heavy metals and indicated that the evaluated amount of heavy metals in the area studied was largely due to factory and industrial discharge. In some quantities, certain heavy metals are nutritionally essential for a healthy life. Some of these are referred to as trace elements (e.g. Iron, copper, manganese, zinc). International Occupational Safety and Health Information Centre (IOSHIC) believe these elements, or some form of them, are commonly found naturally in foodstuffs, in fruits and vegetables, and in commercially available multivitamin products (IOSHIC, 1999). In the right concentrations, many metals are essential to life. In excess, these same chemicals can be poisonous. Similarly, chronic low exposures to heavy metals can have serious health effects in the long run. The main threats to human well-being are associated with lead, arsenic, cadmium and mercury; it is these substances that are targeted by International legislative bodies. In 1996, the OECD agreed to phase out many uses of lead (OECD, 1996). A rapid assessment of drinking water quality, conducted in Nigeria in 2002-2004 and supported by UNICEF and WHO, noted the lack of an acceptable Drinking Water Quality Standard in Nigeria, which would guarantee the quality of water supplied to people (www.unicef.org).

MATRIALS AND METHOD

All the data and information are obtained from analysis of Sachet and bottled water samples from different manufacturers consumed in the study area, which covers Ago-Iwoye, Ijebu-Igbo, Oru, and Ijebu-ode on November 03, 2008. Five (5) sachets and three (3) bottled packaged water were collected from different manufactures. All manufacturers refused access to their factories for understanding of their water treatment processes and source of water, but it is believed that the sources of their water are from boreholes. All the sachets and bottled water has NAFDAC registration number. NAFDAC is Nigeria's health and safety regulatory body which ensures among others things, the quality of water intake by Nigerians the study area inclusive.

Ten (10) Heavy Metals were analysed (Fe, Cu, Cd, Pb,

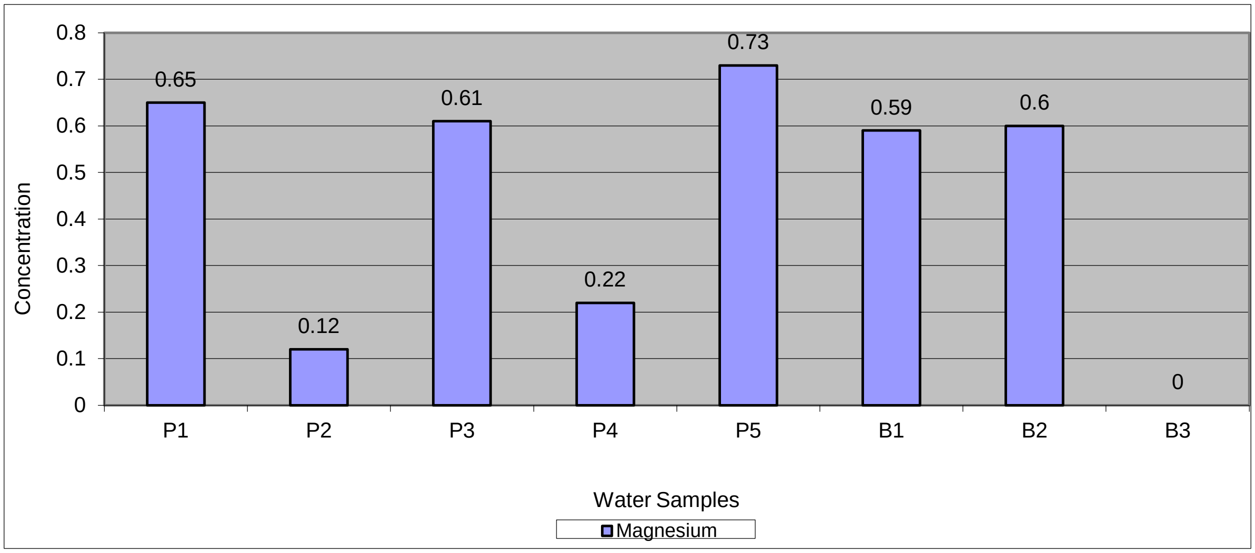

Figure.1: Bar charts showing the concentration of magnesium in different water samples

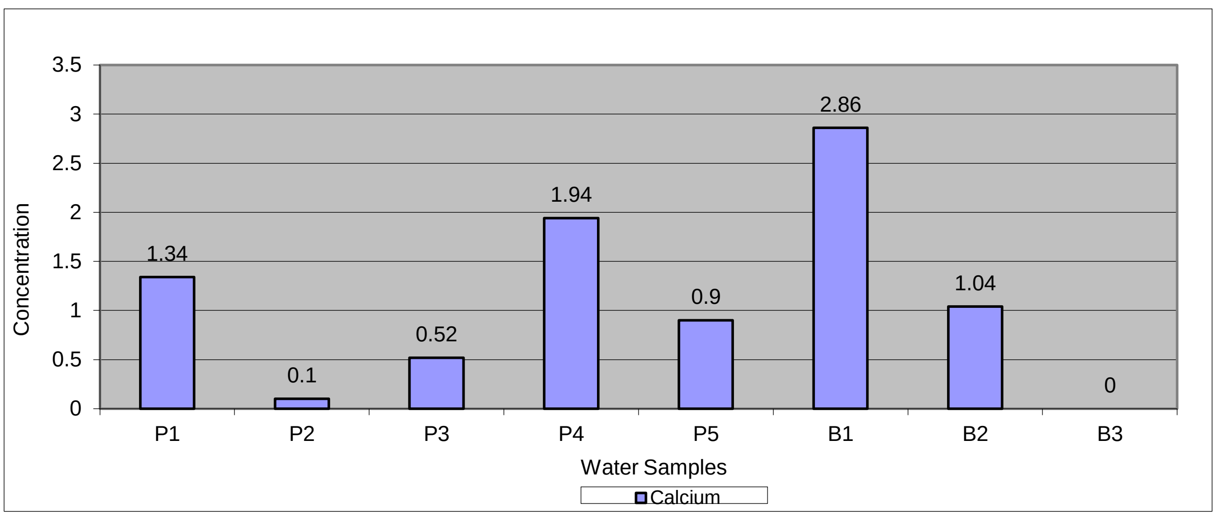

Figure.2: Bar charts showing the concentration of calcium in different water samples

Cr, Zn, Mn, Ni, Mg and Ca) using model 210VGP of the Basic Scientific Atomic Absorption Spectrophotometer series with Air Acetylene gas mixture as Oxidant. Water samples were aspirated directly after setting the wavelength of the element to be determined and the equipment calibrated for each element. The results were recorded in mg/L of solution and were calculated to mg/Kg of sample using the weight of water sample as a denominator of extract volume (50 ml).

Each metal to be determined has a particular wavelength and there is always a standard sample prepared as a control in line with the above mentioned procedures with every set of samples, to ensure accuracy of data through comparison. Below are the particular wavelengths for particular metals that were analysed:

METAL ANALYSIS ON THE ATOMIC ABSORPTION SPECTROPHOTOMETER (AAS)

Materials used in the laboratory include the oven, beaker, volumetric flask, digestion tube, Nitric acid, Perchloric acid, weighing balance and the Atomic Absorption Spectrophotometer (AAS). AS analysis involves the absorption by free atoms of an element of light at a wave length specific to the element. It is useful for quantitative determination of many elements present in sample solution.

Light Source

A light source (commonly a hollow cathode l amp) which

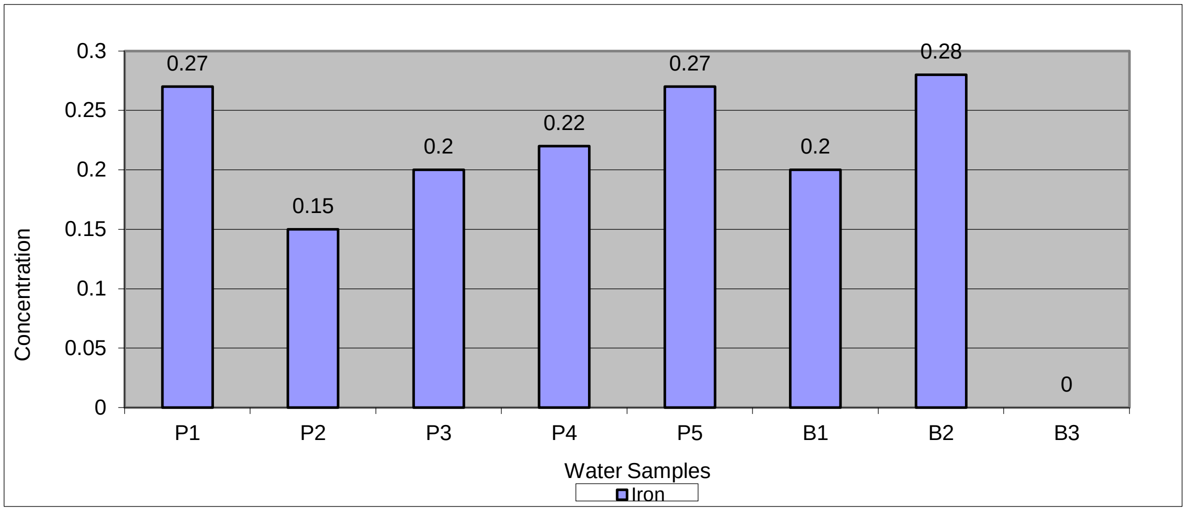

Figure.3: Bar charts showing the concentration of iron in different water samples

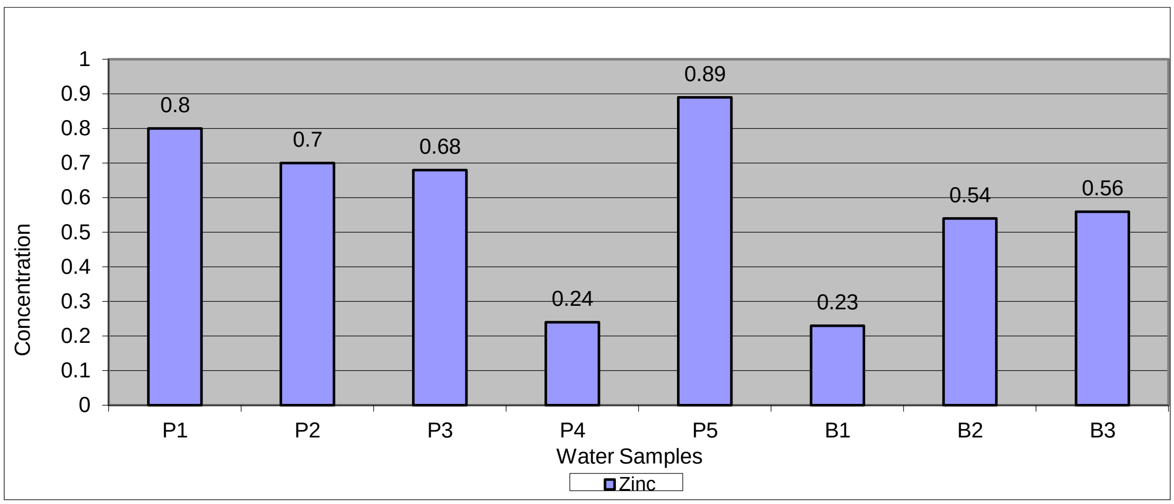

Figure.4: Bar charts showing the concentration of zinc in different water samples

emits sharp atomic lines of the element to be determined is used. These metal atoms are excited to emit through impact with the filled gas ions, when an electric current is applied to the lamp with anode and cathode sealed glass cylinder filled with an inert gas like Neon or Argon.

The Sample Cell

This consists essentially of the premix burner system. This is supported to produce ground state atoms in the optical path of the instrument. The water sample is aspirated through the nebulizer and sprayed into the flame via the mixing chamber where it is mixed with oxidant. The process is called atomic absorption, it is the light energy absorbed in the excitation process that is measured.

Detection and Measurement Unit:
This unit consists of the monochromatic, the detector, some electronic components and the read-out. The monochromatic disperses the various wavelengths of the light which are emitted from the source so as to isolate the spectra line of interest. It deflects different wavelengths of light at different angles.

RESULT AND DISCUSSION

Statistical analysis was performed using SPSS (Statistical Package for Social Scientist). Table 1 below shows the concentration of metals in samples as against WHO 2005 standard (limit) in the study area. Below are Bar charts showing the concentration of metals of the

Table 1: Concentration of metals in Sachet and Bottled water sample and WHO[1] (2005) Limit.

Metals (Mg/L)	WHO (2005)[1]	P1	P2	P3	P4	P5	B1	B2	B3
Mg	50.00	0.65	0.12	0.61	0.22	0.73	0.59	0.06	nd
Cu	2.00	Nd	nd	nd	nd	nd	nd	nd	nd
Ca	200.00	1.34	0.10	0.52	1.94	0.9	2.86	1.04	nd
Fe	0.30	0.27	0.15	0.20	0.22	0.27	0.20	0.28	nd
Cd	0.01	Nd	nd	nd	nd	nd	nd	nd	nd
Pb	0.01	Nd	nd	nd	nd	nd	nd	nd	nd
Mn	0.05	0.04	0.03	0.01	0.03	0.04	0.02	0.01	0.03
Cr	0.05	Nd	nd	nd	nd	nd	nd	nd	nd
Zn	3.00	0.80	0.70	0.68	0.24	0.89	0.23	0.54	0.56
Ni	0.02	Nd	nd	nd	nd	nd	nd	nd	nd

nd : not detected
WHO1:World Health Organization
P1, P2, P3, P4 and P5 →Sachet Water 1, 2, 3, 4, and 5
B1, B2 and B3 →Bottle Water 1, 2 and 3
Date: 13th November 2008

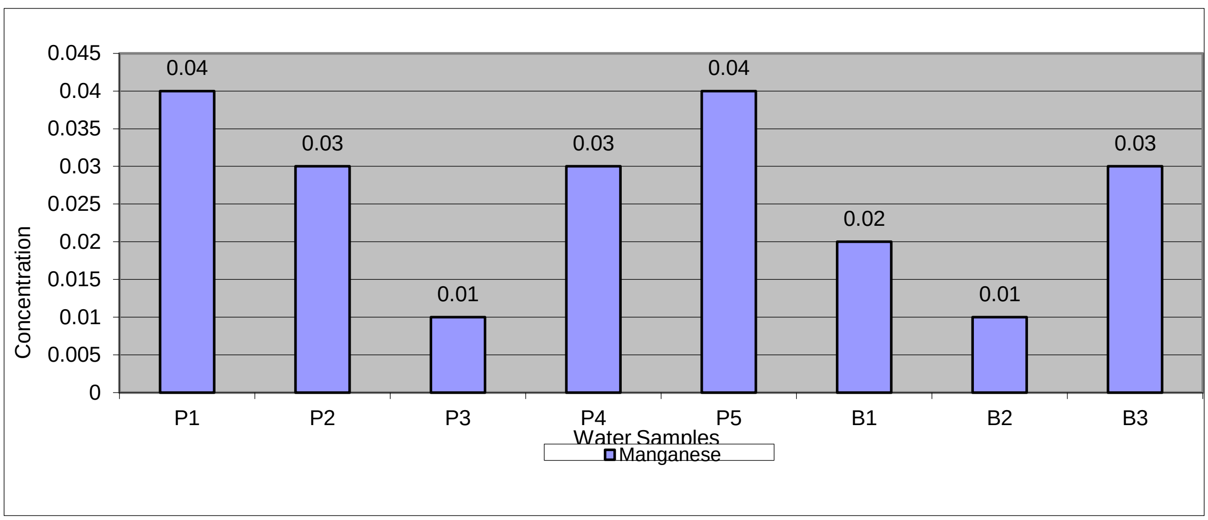

Figure.5: Bar charts showing the concentration of manganese in different water samples

above samples from the study area shown in figure (1-5).

The following Heavy metals were tested for Magnesium (Mg), Calcium (Ca), Manganese (Mn), Iron (Fe), Zinc (Zn), Copper (Cu), Lead (Pb), Chromium (Cr), Cadmium (Cd) and Nickel (Ni), and from the result and analysis, only Mg, Ca, Fe, Mn and Zn, where observed. Figure. 1 shows the concentration of Mg in water sample from the study area. From the table 1, the concentration of Mg is between 0.06 mg/L and 0.73mg/L. when compared with WHO (2005) standand of 50mg/L, the concentration is low and not toxic. The concentration of Calcium (Ca) from table 1 and figure 2 indicate a relatively low concentration in the study area. Ca falls within the range of 0.1mg/L and 2.86mg/L as against toxicity limit of WHO (2005) of 200mg/L. Iron (Fe) concentration in water sample is between 0.15mg/L and 0.28mg/L. Though not above the WHO (2005) limit, the concentration of Fe in B2 at 0.28 and P1, P2 at 0.28 appears high, while that of B2, B3, B4 and B1 are relatively low, the concentration is still below toxicity limit.

Zinc (Zn) levels vary from a minimum of 0.23mg/L to maximum of 0.89mg/L. The concentration is still within the WHO (2005) limit, and is not toxic for both sachets and bottle waters. The concentrations of Manganese (Mn) in the samples varied from a minimum of 0.01mg/L to a maximum of 0.04mg/L. Concentration of Mn is low in Bottled water between 0.01mg/L and 0.03mg/L, while sachet water P1, P5 has the highest of 0.04 mg/L, the concentration of Mn still falls within the WHO (2005) limit. From the study, it is observed that the following heavy metals were not detected. They include; Copper (Cu), Cadmium (Cd), Lead (Pb), Chromium (Cr), and Nickel (Ni). This absence does not pose any health implication to the resident of the study area.

CONCLUSION

This investigation of the concentration of heavy metals in the samples gave a good indication of the present state of metal contamination of both bottled and sachets water in Ijebu North LGA, comprising Ago-Iwoye, Oru and Ijebu-Ode which is at a very low level. Presently, consumption of this sampled water in Ijebu North LGA, Ogun State Nigeria is high and may obviously not lead to immediate poisoning. However, long term effect if there is not enough check maybe of major concern. Consequently, close monitoring of heavy metals must be carried out by the regulatory agency (e.g. NAFDAC) in Ijebu-North LGA., in view of the possible risks to the health of consumers, particularly in the processing and packing stages of the water.

REFERENCES

Adeniji, FAA, Anetor, JI (1999). Lead poisoning in two distant states of Nigeria: An indication of the real size of the problem. Afri. J. Med. Sci. 28: 107-112.

Elueze, AA, Anyanwu, AJ, Bolarinwa, AT (2001). Geoenvironmental evaluation of battery factory site in Ibadan Southern Nigeria. J. Mining and Geol. 37(1): 91-100.

Fergusson, J.E, Hobbard, KA, Ting, RLH (1981). Lead in human hair: general survey-battery factory employees and their families, Environmental Pollution (Sec. B) 1: 71-78.

Helmut, DK (2000). Soil and Groundwater contamination and remediation technology in Europe in- Sato K (Ed) Groundwater updates Springer, Best set typesetter ltd, Hong Kong, pp. 3-8.

Hernandez-Hernandez, F, Medina, J, Ansuategi, J, Conea, M (1990). Heavy Metal Concentrations in some Marine Organisms from the Mediterranean Sea (Castellon Spain): Metal Accumulation in different Tissues. Sci. Marine J. 54(2): 113-129.

His, E, Beiras, R, Seaman, MNL (1999). The Assessment of Marine-Pollution Bioassays with Bivalve Embryos and Larvae. Advanced Marine Biol. J. 37:1-178.

IOSHIC (1999). International Occupational Safety and Health Information Centre.

Lide, DR (1992). CRC Handbook of Chemistry and Physics, A ready-reference book of chemical and physical data. 73rd edition. (CRC Press, Boca Raton, 1992)

OECD (1996). Declaration on risk reduction for Lead. Adopted at the meeting of Environment Minister. 20 February 1996.

Takahisa, DK (1971). Effect of river basin on Human health (ed.) Rex Charles publication. pp. 12-14.

Tochobanoglous, GH, Haisen, HL, Vigils, UW (1977). Integrated solid waste management, Tijani, M.N., Onibolusi. p. 213.

WHO (World Health Organisation) (2005). Guidelines for drinking water quality in the World. Geneva Recommendation.