ASSESSMENT OF HEAVY METAL CONCENTRATIONS IN SEDIMENT AND WATER FROM OBA DAM, SOUTHWEST NIGERIA

***OLADEJO, O. P.; & **AYANKOSO, A. S.**
**Department of Physics, Emmanuel Alayande College of Education, P.M.B. 1010, Oyo, Oyo State **Department of Chemistry, Emmanuel Alayande College of Education, P.M.B. 1010, Oyo, Oyo State*

ABSTRACT
Water is one of the most essentials of life; it constitutes more than seventy percent of the human body. The need to drink quality water cannot be over emphasized because it determines the quality of life, no wonder water is life. The study estimated the concentration of heavy metals in the sediment and water from Oba Dam in Ogbomoso, Oyo state. The sediment, sediment water and treated water were investigated for heavy metal presence using atomic absortion spectrometer (AAS). The results shown that Mn, Fe, Zn,Pb, Ni,Cr and Co, Mn, Fe, Pb, Ni and Cr, and Mn and Fe were more than recommended level in sediment, sediment water and treated water respectively. Also, selenium and Phosphorous were revealed in the treated water but were not part of the trend in the sediment and sediment water. Therefore, continuous evaluation and monitoring are essential in view of constant flow of both human and industrial wastes in the dam.

Key words: sediment, treated water, metal, concentration and dam

INTRODUCTION
Sediments are materials formed due to transportation and deposition of organic and mineral matter found at the bottom of oceans, lakes, ponds and rivers and dams. Heavy metals accumulate in sediments through complex physical and chemical adsorption mechanisms depending on the nature of the sediment matrix and the properties of the adsorbed compounds. Soil is a basic natural non

renewable resource, playing a major role in the development, property and even in the existence a nation (Schroeder, 1984).

Pollution of the natural environment by heavy metals is a universal problem because these metals are indestructible and most of them have toxic effects on living organisms, when permissible concentration levels are exceeded (Mmolawa, Likuku & Gaboutloeloe, 2011). Contaminants such as hydrocarbons, heavy metals and pesticides have been known to have direct toxic effects when released into the aquatic environment and the sediments constitutes the sink for theses pollutants (Forstner et al., 1998; Fleeger et al., 2003). Heavy metals are either naturally occurring in the environment or through anthropogenic; discharged from industrial, domestic and agricultural waste water system (Ho et al; 2001 Uwaechia et al; 2014). The heavy metal gets into rivers and dams by erosion, mainly or from sources such as rock weathering, soil erosion and the dissolution of water soluble salts move through aquatic environments independent of human activities and usually without any detrimental effects (Garbrino et al 1995; Uwaechia et al; 2014, & Opuene et al; 2008).

The elements in the soil are dissolved by water to form a solution that supports plant life and from which plants obtain their required essential nutrients which man depends on for survival. Though heavy metals play important roles in our society as most of them are vital raw materials in most industries, (Cu, Se, Zn, etc.) and as essential materials in the maintenance of some metabolic activities in human bodies, others at certain concentrations have been implicated in health complications in the liver, lung, intestine, blood etc.

The rate of terminal diseases is on the increase these days especially in Africa, where access to qualitative medication is poor. Some of these diseases are caused by the injection of heavy metal that are non-biodegradable causing metabolic disorder in humans or the food which human beings depend. This study investigates the concentration of some of these heavy metals and find out whether or not the identified ones are within the permissible level. Sediment and water from Oba water dam in Ogbomoso north of Oyo state, Nigeria is selected as the site to be investigated. Oba dam is the main source of pipe borne water supply to Ogbomoso township.

Materials and method

Samples treatment

A known volume (5 cm^3) of concentrated hydrochloric acid was added to 250 cm^3 of water sample and evaporated to 25 cm^3. The concentrate was transferred to 50 cm^3 standard flask and diluted to the mark with distilled deionized water (Aremu, Olonisakin, & Ahmed, 2006). The sediment sample was air-dried, and then sieved using 200 mm mesh. 5 grams of the sediment sample was weighed into 150 cm^3 conical flask, digested using 150 cm^3 Nitric acid, 2 cm^3 perchloric acid and placed on a hot plate for 3 h (Adeyeye, 1993). On cooling, the digest was filtered into 100 cm^3 volumetric flask and make up to mark with distilled water.

Mineral analysis

The elemental analysis was done in the water samples using Perkins Elmer and Oak Brown atomic absorption spectrophotometer. The instrument settings and operational conditions were done in accordance with the manufacturer's specifications. All the chemicals used were of analytical grade and carried out at IITA, Ibadan, Nigeria.

Atomic Absorption Spectrophotometer (AAS)

RESULTS AND DISCUSSION

The heavy metal contents of the sampled sediments from the reservoir are presented in Table 1.0 and graphs and Figures 1a and 1b. The concentration of

the heavy metals were presented in **Fe>Mn>Zn>Cr>Ni>Pb>Co>Cd>Cu** which means: 1056.60ppm>28.93ppm>12.34ppm>9.08ppm>8.01ppm>7.28ppm>5.74ppm>4.26ppm>1.77ppm.

Table 1.0: Elemental concentrations in the samples

S/N	Element	Sediment (ppm)	Sediment water (ppm)	Treated water (ppm)
1.	Mn	28.93	0.44	0.08
2.	Fe	1056.60	0.32	0.25
3.	Cu	1.77	0.11	0.08
4.	Zn	12.34	0.09	0.03
5.	Pb	7.28	0.12	0.00
6.	Ni	8.01	0.06	0.01
7.	Cr	9.08	0.07	0.02
8.	Co	5.74	0.03	0.00
9.	Cd	4.26	0.02	0.00
10.	Se	-	0.00	0.02
11.	Po4-P	-	0.02	0.06

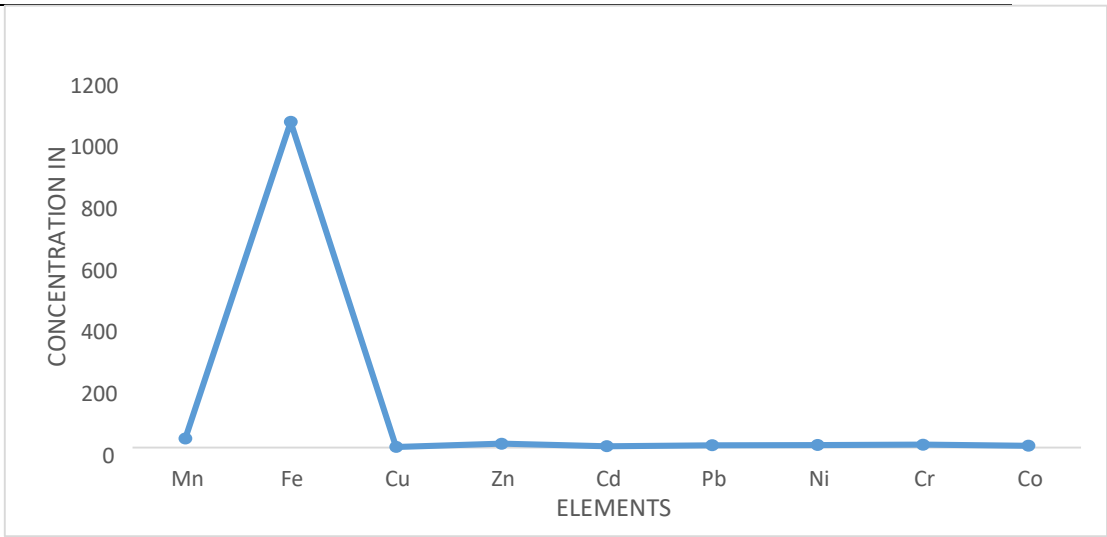

Figure 1.0a: Concentrations of identified heavy metals in the sediment.

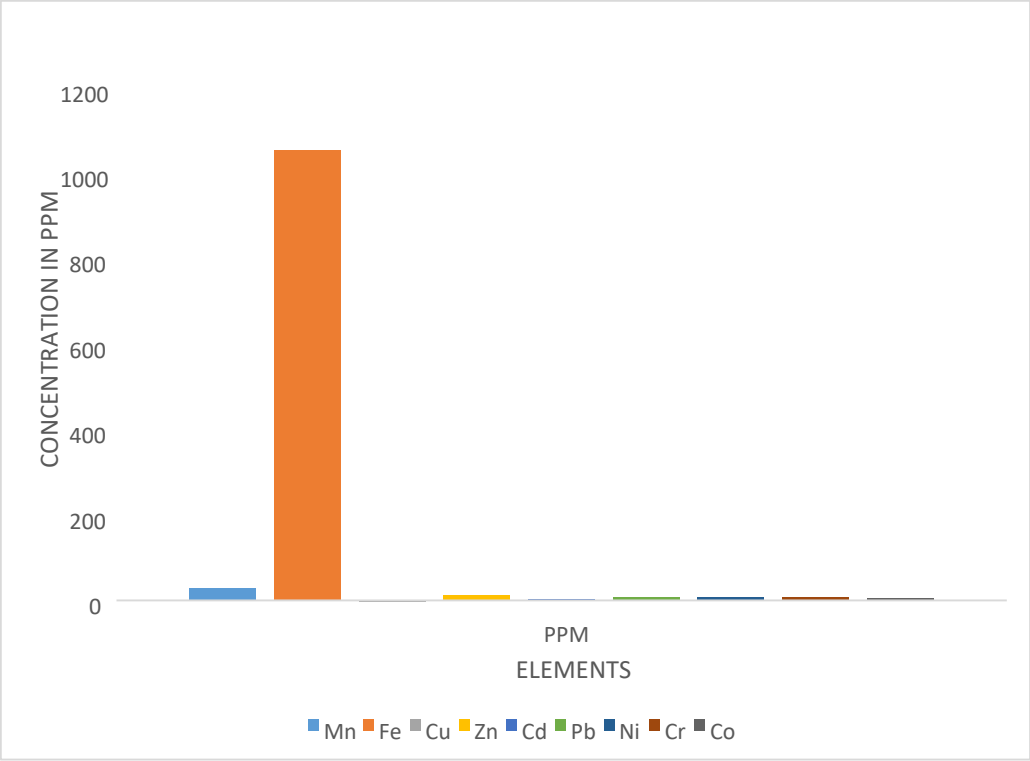

Figure 1.0b: Bar chart showing concentrations of identified heavy metals in the sediment

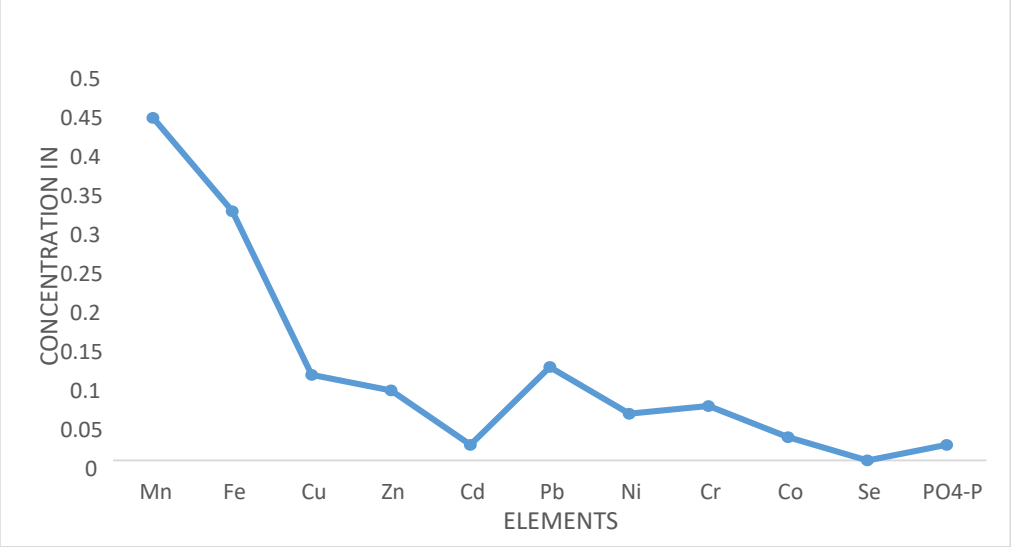

Figure 2.0a: Concentrations of identified heavy metals in the sediment.

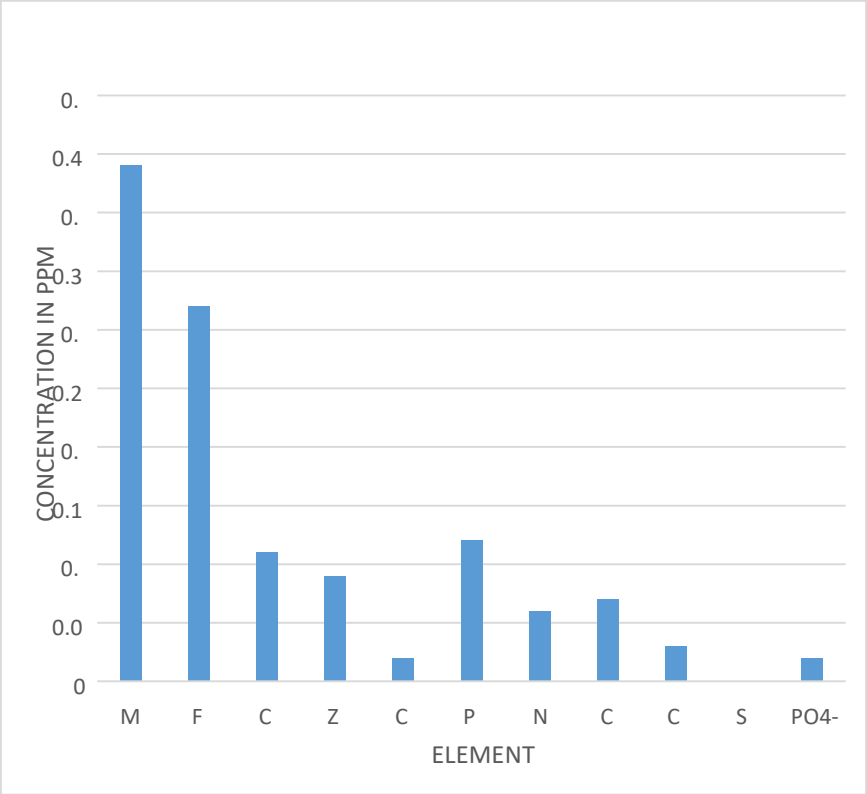

Figure 2.0b: Bar chart showing concentrations of identified heavy metals in the sediment water.

The heavy metals present in the water sample from the sediment tank were presented in Table 1.0 and graph Figures 2.0a and 2.0b. The concentrations of the heavy metals were presented in this order:

Mn>Fe>Pb>Cu>Zn>Cr>Ni>Co>>Cd>Po4-P>Se

0.44ppm>0.32ppm>0.12ppm>0.11ppm>0.09ppm>0.07ppm>0.06ppm>0.03ppm>0.02ppm>0.00ppm.

The heavy metals from the treated water were also determined. The concentrations were found to be in order:

Fe>Mn>Cu>PO_4-P > Zn > Cr > Se> Ni> Pb>Co>Cd

Which means 0.25ppm>0.08ppm>0.06ppm>0.03ppm>0.002ppm>0.01ppm>0.00ppm.

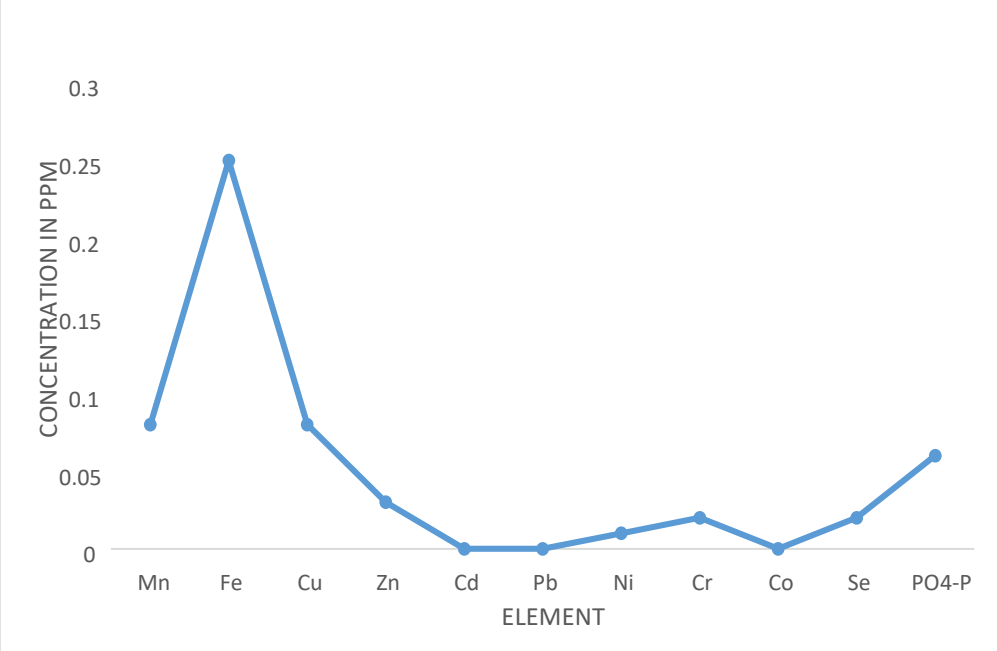

Figure 3.0a: Concentrations of identified heavy metals in the treated water.

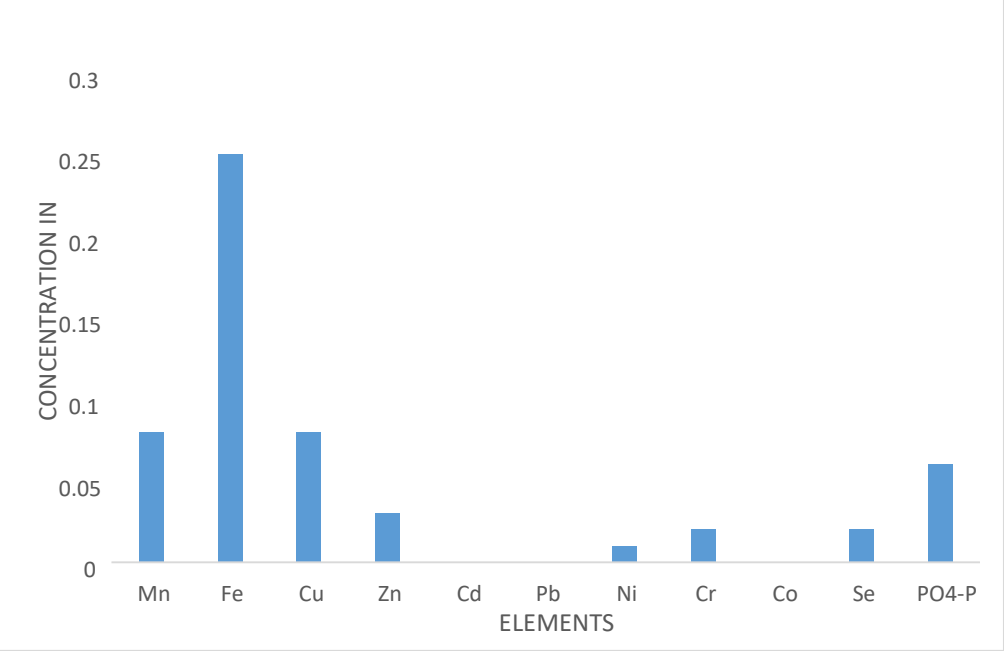

Figure 3.0b: Bar chart showing concentrations of identified heavy metals in the treated water.

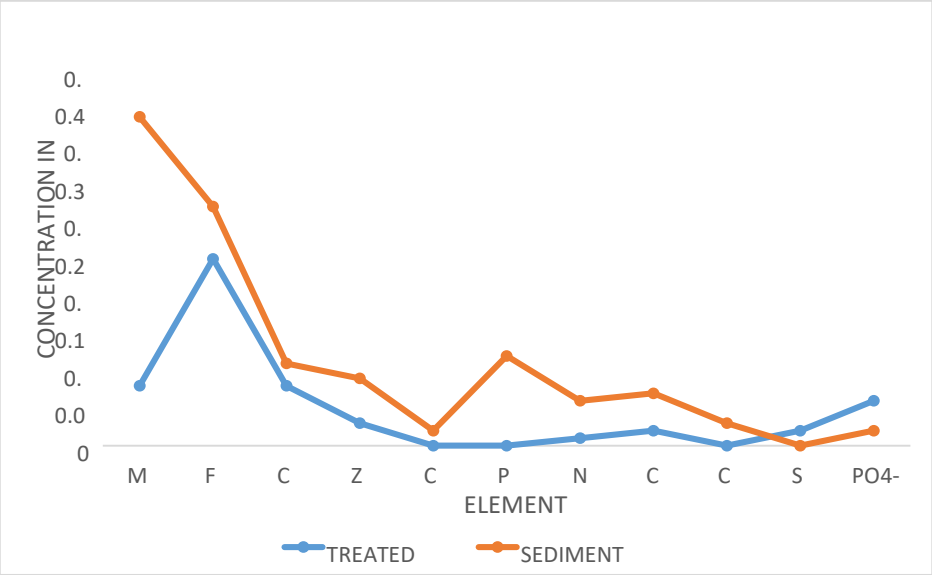

Figure 4.0a: Concentrations of identified heavy metals in the treated water and sediment water.

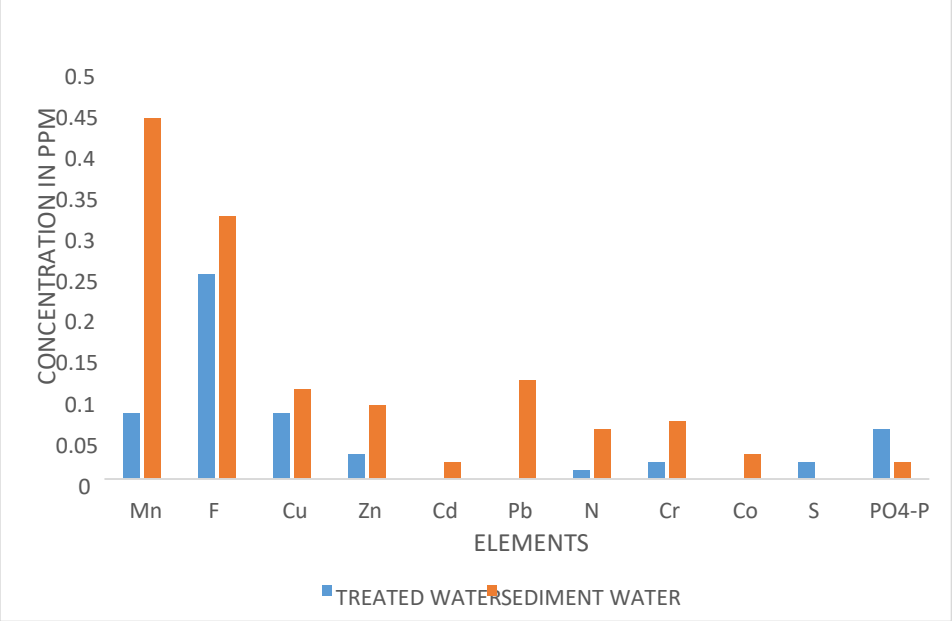

Figure 4.0b: Bar chart showing concentrations of identified heavy metals in the treated water and sediment water.

The result of the treated and sediment water were plotted in figure 4.0a and 4.0b. It was found that there is correlation between the trends of the graph except for

Mn was lower in the treated water, Pb higher in the sediment water. Throughout the trend, the concentrations of elements were higher in the sediment water except for **Se** and **Po4-P** which are higher in treated water.

From Figures 5.0a and 5.0b. the trend of the concentration of elements in treated water, sediments water and sediment were compared. The trends of the element concentration are the same but for the presence of **Fe** which is very high.

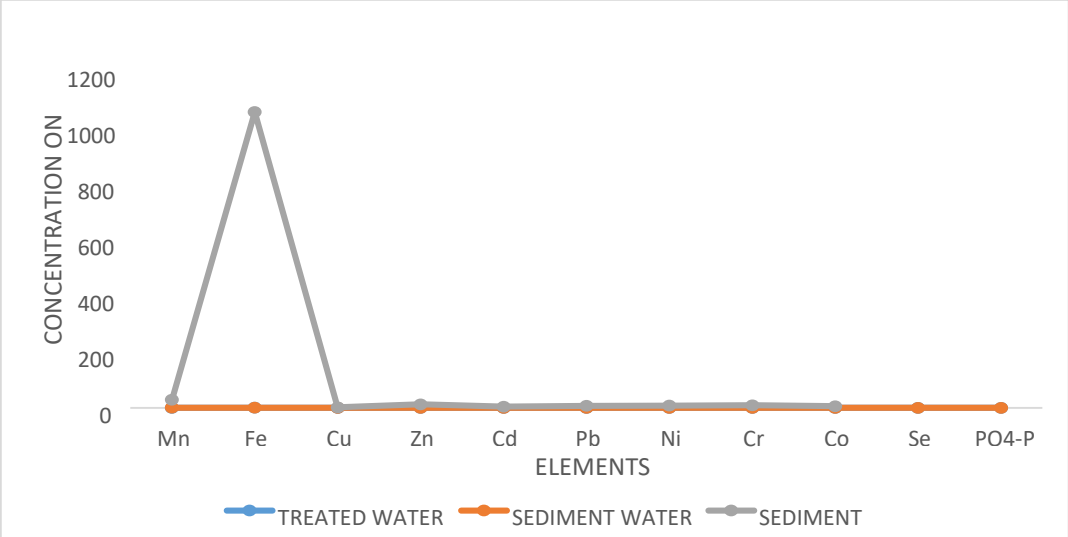

Figure 5.0a: Concentrations of identified heavy metals in the sediment, sediment water and treated water.

Figure 5.0b: Bar chart showing concentrations of identified heavy metals in the sediment, sediment water and treated water.

The research has presented heavy metal concentrations (Mn, Fe, Cu, Zn, Pb, Ni, Cr, Co, Cd, Se, P04-P) in sediment, sediment water and treated water obtained from ogbomoso dam in oyo state of Nigeria. The results revealed that there are some heavy metals that are present in the sediment (Mn, Fe, Cu, Zn, Pb, Ni, Cr, Co, Cd) that are above recommended level by either WHO, European union, United States of America, China, Canada or India. Such metals include Mn, Fe, Zn, Pb, Ni, Cr and Co.

There are some metals present in sediment water (Mn, Fe, Cu, Zn, Pb, Ni, Cr, Co, Cd, Se, P04-P) that are above recommended values by the standard organization as mentioned above. Such metal includes Mn, Fe, Pb, Ni and Cr.

Also it was revealed that in the treated water some heavy metals were present water (Mn, Fe, Cu, Zn, Pb, Ni, Cr, Co, Cd, Se, P04-P) some of them, selenium and phosphorus was revealed but were not part of the trend in the sediment and sediment water.

The concentrations of the heavy metals analyzed were compared with some drinking water quality standards:

Manganese (Mn): the concentration of manganese (Mn) is more than the recommended value set by European union and Canada standard in sediment water, treated water and sediment but less than India standard in treated water.

Iron (Fe): The concentration of iron (Fe) is greater than European union and Canada standard in sediment water, treated water and sediment.

Copper (Cu): The concentration of copper (Cu) is less than European Union and Canada standard in sediment water, treated and sediment. However, the concentration is more than Canada standard in sediment

Zinc (Zn): The concentration of Zinc (Zn) is less than Canada and India recommended values in sediment water, treated water but far more than Canada and India standard in sediment.

Lead (Pb): It was found out that the concentration of lead (Pb) is more than European Union, United States of America, China, Canada in sediment water and sediment but less in India standard for sediment water. The presence of Pb is not found in treated water.

Nickel (Ni) metal concentration is more than recommended value by European Union, United States of America, China and WHO in sediment water and sediment but less than recommended value by European Union, United state of America. However, it is more than China standard for treated water.

Chromium (Cr) is among the heavy metals found, the concentration is more than recommended value by WHO, European union, China, Canada and India but less than United States of America standard in sediment water. The concentration is also more in sediment according to WHO, European union, United state of America, China, Canada and India. However, it is less than WHO, European union, United state of America, China, Canada and India standard in treated water.

Cobalt (Co): The concentration of cobalt metal is more than Canada standard is sediment water and more than Canada standard in sediment but no trace of the metal was found in the treated water.

Cadmium (Cd): Cadmium is among the heavy metals found in the sediment; the concentration is less than recommended value by WHO, European union, China, Canada and United States of America but more than India standard in sediment water. The concentration is also more in sediment according to WHO, European union, United state of America, China, Canada and India. However, there is no trace in treated water.

Selenium (Se) was found to be less in recommended concentration by WHO and United States of America but more than European union, China and India for treated water. However, no trace of element was found in sediment water and sediment.

PO_4-P: this compound was found in both sediment water and treated water but no limit was listed.

Most of these metals were far more than recommended values.Mn, Fe, Zn, Pb, Ni, Cr and Co were all most in concentration in the sediment compare to the sediment water and treated water which could have been as a result of sedimentation. Pb, Cd and Co was not found in the treated water, this could be adduced to purification process.

No trace of Se was found in both sediment water and sediment but found in treated water, this could have been deposited in water during the treatment procedure.

P04-P was found in both sediment water and treated water but not in the sediment. This could be as a result of reaction process.

Conclusion

The concentration of the toxic heavy metal found at each level of water production or purification as ascertained by the research could be adjudged to pose some health threat when compared to the permissible standard by World Health Organization (WHO), European union, United States of America, China, Canada and India Standards (https://en.wikipedia.org/wiki/Drinking_water_quality_standards).

Recommendation

This research has revealed the presence of some poisonous heavy metal beyond the permissible limits in the Oba dam, concentration of heavy metals in the sediment and water from Oba Dam in Ogbomoso, Oyo state therefore continuous evaluation and monitoring and essential in view of constant flow of both human and industrial waste into the dam.

References

Aremu M.O., Atolaiye, B. O., Gav, B. L.,Opaluwa, O. D., Sangari, D. U. and Madu, P. C. (2011). Metal concentration in sediment and water from river Doma, Farinruwa and Mada in Nasarawa state, Nigeria. http://www.academicjournals.org/jece

Aremu M.O., Olonisakin, A. and Ahmes, S. A.(2006). Assessment of heavy metal content in some selected agricultural products planted along some roads in Nasarawa State, Nigeria. Journal of Engineering and Applied Science, 1(3): 199-204

Fleeger, J.W., Carman, K.R., and Nisbet, R.M., (2003). Indirect effects of contaminants in aquatic ecosystems. Science Total Environ., 317 (1-3), 207–233.

Forstner, U., Calmano, W., Hong, J., & Kersten, M. (1998). Effects of redox variations on metal speciation. Waste Management and Research, 4, 95–104

Mmolawa K. B., Likuku A. S & Gaboutloeloe G. K. (2011). Assessment of heavy metal pollution in soils along major roadside areas in Botswana. African Journal of Environmental Science and Technology, 5(3), 186-196