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Monitoring the Effect of Water Pollution in Twelve Selected Water Dams in Osun State of SouthWestern Nigeria

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Abstract
The level of water pollution by heavy metals (Cu, Zn, Co, Ni, As, Mn, Cd, Cr. Pb) in twelve selected water Dams in Osun state were determined in order to know their distribution and possible source into the dams. Their bottom sediment and water were collected for analysis. The result in sediment showed that the concentration of manganese is high in all the dams with values ranging from 21.27-775.99mg/kg and it spreads across all the locations. Cobalt was detected only at one location with concentration of 3.01mg/kg. The result in water analysis showed that the concentration of zinc is more than that of manganese, almost in all the dams. The values detected were between 0.0618mg/kg and 0.5068mg/kg while that of manganese was between 0.0112mg/kg and 0.1887 mg/kg. Cobalt and cadmium were not detected in all the dams. The variation in the concentration of these metals in sediment and water may be due to chemical factors such as solubility, ion exchange ratio and electrochemical deposition. The concentrations of all metals detected were below the standard limit for the heavy metals in surface water according to Regulatory authority Specification. Meanwhile, bioaccumulation of these metals in tissue of the body may be toxic to human health.

Keywords: Pollution, heavy metals, water Dams, electrochemical, contamination.
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Introduction
Water is fundamental to life sustenance. It is vital for drinking, agriculture and industries. However, availability of water is not the major problem but its high quality for the human use. Water pollution and contamination are increasing everyday due to the increase in the number of industries, agricultural practices and indiscriminate disposal of domestic wastes. Water pollution is the introduction into water, substance that alters its composition either directly or indirectly. Contamination on its own is when the level of pollutants is below the hazard level (Holdgate, 1979). Water can be contaminated by heavy metals such as cadmium (Cd), Chromium (Cr), Mercury (Hg), Arsenic (As), Manganese (Mn), Zinc (Zn), Copper (Cu), Lead (Pb), etc. due to their existence in the earth crust and through anthropogenic sources. Heavy metals weathered from natural rock formation spread widely into the environment occurring in particulate or dissolved form in soil, lakes, rivers, seawater and seafloor sediment. Executive accumulation of heavy metals can have deleterious effects on soil fertility, water quality, affect ecosystem functions and constitute a risk to animals and human health (Sun *et al.*, 2001).

In the light of these, it is necessary to know the levels of pollution and contamination of the water the public consume (if any) and to develop technologies for improving the level of water purification, remediation of contaminated sites (Milligan *et al.*, 2001) and finding techniques to reduce and manage the effluents produced by industries. The presence of a metal

does not necessary indicate an environmental problem; however, it is a matter of concern when the amount detected approaches or exceeds the concentration that can harm organisms, including humans (Sawyer *et al.*, 1994).

Heavy metals are chemical elements with specific gravity that which are five times the specific gravity of water. Specific gravity is the measure of the density of a given amount of solid substance when compared to an equal amount of water. Heavy metals are widely distributed in the earth's crust. Volcanoes and the weathering from the natural rock formation release heavy metals into the atmosphere. The activities of mining industry depends o the ability to find and extract the scattered natural concentration of commercially valuable heavy metals such as iron, nickel, or lead. Major anthropogenic sources of heavy metals are wastes from industries and agriculture; household wastes; urban drainage and deposition of airborne pollutants. The way many products made from these metals are used may also release toxic metals into the environment. For example, lead was once added to gasoline to enhance the performance of automobile engine and this volatile, highly toxic metal was widely dispersed with the exhaust gases. The waste from agricultural pesticides, use of fertilizer and domestic wastes when deposited on soil close to the rivers, lakes and coastal water, after decomposition and subsequent leaching would eventually find their ways into the surface water. For example, in Southwestern Nova Scotia, acid rain has made lakes and rivers much more acidic, enabling dissolution of heavy metals more readily from rock, soil and sediment (Loving, 1997). This preliminary work is focused on determining the presence and the spread of heavy metals in the surface water dams in locations considered and to also compare the results with standard of toxicity that are already established so as to ascertain human and animal safety.

Materials and Methods

Both sediments and water samples were collected in twelve different surface water dams in Osun State, Southwestern Nigeria. The area on map as shown below were selected due to the intense agricultural practices, nearness to the industrial zones and dumping sites.

Water samples were collected at reasonable distances from the bank of the dam and kept inside labelled tagged plastic container for analysis. Also, sediment samples were collected at the floor of the dam using a grab collector in polythene bags and plastic container with tagging minerals. Complete sampling technique was strictly followed. The samples were air-dried for days, grounded and sieved with 1mm mesh, and kept inside the plastic container for onward digestion.

The acid-acid digestion method was employed for this work. 1.2g of sample weighed with analytical balance was put into Teflon beaker and 3ml of HF were added followed by 5ml of squaregia (150ml of diluted HCL + 50ml of HNO_3) the mixture was properly shaken together. 30ml of boric acid was also added and heated for 45 to 60 minutes. Distilled water was added to the required 100ml and stored for analysis.

Fig. 1: Map of Osun State showing the location of the Dams.

Analysis of heavy metals (copper, cobalt, chromium, cadmium, arsenic, manganese, nickel, lead and zinc) was performed using a Bulk Scientific Model 200-A, atomic absorption/emission spectrophotometer equipped with flame lamp. The method employed was one-point calibration for quick and direct concentration analysis. The standard required is 10ppm and AAS gives the signals in ppm (Miroslau and Vladimir, 1999, Benhard, 1985).

Results and Discussion

The concentration of these metals in sediment and water are shown in Tables 1 and 2. Figures 2 and 3 both showed the presentation of the sediment and water analysis using bar charts. Manganese was the metal detected with highest concentration in the sediment followed by Zinc in the locations; while in water, the concentration of Zinc was the highest, and followed by Manganese. The reason for the above exchange in Zinc and Manganese concentrations in sediment and water may be due to the chemical factor like the normal cation-anion exchange.

Table 1: Concentration of heavy metals in sediment (mg/kg)

Metals/ Location	Cu	Zn	Cr	Pb	As	Ni	Mn	Cd	Cu
AJAGUNLASE	0.493	21.631	1.126	ND	1.773	1.866	135.96	ND	ND
EDE	0.493	11.331	1.126	0.868	2.66	4.666	775.99	1.359	ND
EKO-ENDE	0.493	20.602	2.252	0.868	1.773	2.8	68.818	1.359	ND
EJIGBO	0.493	3.09	2.252	ND	0.887	ND	44.395	ND	ND
IBA	0.493	4.12	3.378	ND	ND	ND	52.719	ND	ND
IFE-ODAN	0.985	11.331	3.378	ND	3.546	2.8	144.28	1.359	ND
IREE	ND	33.993	1.126	ND	2.66	3.733	188.67	ND	ND
IWO	0.493	19.577	1.126	ND	ND	0.933	58.269	ND	ND
OKE-OSUN	ND	2.06	1.126	ND	1.773	0.933	58.269	ND	2.013
OKUKU	0.985	14.421	1.126	ND	2.66	1.866	54.569	ND	ND
OLUPONA	ND	7.211	2.252	ND	0.887	0.933	57.344	ND	ND
TOOTO	ND	5.15	ND	1.736	0.887	0.933	21.273	ND	ND

Table 2: Concentration of heavy metals in water (mg/kg)

Metals/ Location	Cu	Zn	Cr	Pb	As	Ni	Mn	Cd	Cu
AJAGUNLASE	ND	0.2101	ND	ND	ND	0.0112	0.0555	ND	ND
EDE	0.0059	0.309	0.0135	0.0208	ND	0.0208	0.1887	ND	ND
IFE-ODAN	0.0118	0.1364	ND	ND	ND	0.0224	0.0777	ND	ND
EKO-ENDE	ND	0.0618	ND	ND	ND	ND	0.0112	ND	ND
EJIGBO	0.0059	0.0989	ND	ND	ND	ND	0.0333	ND	ND
IBA	ND	0.1854	ND	ND	ND	ND	0.0333	ND	ND
IREE	0.0059	0.1607	0.0135	0.0208	0.0106	0.0336	0.1665	ND	ND
IWO	0.0118	0.3708	ND	0.0104	0.0106	0.0112	0.1221	ND	ND
OKE-OSUN	0.0059	0.2843	ND	0.0104	ND	ND	0.0666	ND	ND
OKUKU	ND	0.5068	ND	ND	ND	ND	0.0333	ND	ND
OLUPONA	ND	0.8821	0.0135	ND	ND	0.0112	0.0777	ND	ND
TOOTO	ND	0.173	ND	ND	ND	ND	0.0444	ND	ND

ND: Not detected.

The existence of the metals analyzed was prominent except lead, cadmium and cobalt which were detected in few locations as shown in figure 2.

The concentrations of arsenic found in sediment from the dam were generally low compared to the standard range of 20-60mg/kg. The range of arsenic in the samples is from 0.887mg/kg to 3.546mg/kg. It was not detected at Iba and Iwo dams, and the presence of shellfish and haddock may have contributed to its concentration. Cadmium was detected in the sediments three dam; Erinle dam in Ede, Eko-Ende and Ife-Odan dams with equal concentration of 1.359mg/kg. This may be due to the presence of shellfish in these dams and the use of insecticide, fungicide and commercial fertilizer that contain cadmium through agricultural operation around the dams. Chromium was detected in all the dams except at Tooto. The concentration is between 1.126mg/kg and 3.378mg/kg which are below the normal range of 75-100mg/kg according to Federal Water Pollutant control Association (FWPCA). Its presence may be due to natural existence in soil and vegetation. Cobalt was detected in sediment at Oke-Osun in Osogbo. It was not found in water samples in all the dams. It absence in water may be due to the effect of effluents release from Osogbo steel rolling and Machine Tools. Copper was found almost in the dams except at Iree/Eripa, Oke-Osun, Oluponna and Tooto with peak concentration at Okuku and Ife-Odan (0.985mg/kg). The values are below the normal value of 60-125mg/kg specified by FWPCA. A geogenic source is highly suspected.

Lead was found at three locations namely Erinle in Ede, Eko-Ende (0.868mg/kg) and Tooto dams (1.736mg/kg) at quantities below the threshold limit. It is naturally found in soil with high concentration of galena and geologically, galena is found in the middle belt zone of the country. It was not detected in other dams. Manganese has the highest concentration of 775.99mg/kg at Erinle dam in Ede. The value in all the locations is between 21.273mg/kg at Tooto in Osun state mini scheme and 775.99mg/kg at Ede. It is an essential element in plant and human; and at same time toxic depending on the concentration accumulated. The concentration detected is within the normal range of 20mg/kg to 3000mg/kg. High concentration may be due to its use in houses and burning of fossil fuels. It causes manganese psychosis in human being. Zinc is the second metal with high concentration and was found in all the locations with peak concentration at Iree/Eripa and the least at Oke-Osun. The concentration is between 2,060 and 33.993mg/kg. It is found naturally in the earth crust. The peak value of zinc is below the threshold limit specified for Environmental quality criteria in Canada 1994.

In all the locations, the concentration of the metals detected were below the standard limit in bottom sediment and surface water dam as stipulated by Federal Water Pollutant control Association (Adriano, 2001).

In general, the concentrations of these metals were small when compared to the concentration in the sediments. The distribution is very scanty while cadmium and cobalt were not detected in all the dams as shown in Figure 3. The concentrations of zinc which were very high in all the dams ranged from 0.0618mg/kg at Eko-Ende to 0.5068mg/kg at Okuku dam while that of manganese which followed ranged from 0.0112mg/kg at Eko-Ende to 0.1887mg/kg at Erinle dam at Ede. Other metals detected were very low in concentration as shown in

the chart. The concentrations of all the metals were below the standard link for heavy metals in surface water according to Federal water pollutant control association (Adriano, 2001).

Conclusion

The result showed different pattern of heavy metals in the twelve dams. The geological formation, the location of industries and agricultural practices may have influenced the heavy metals concentrations and distributions.

Manganese was the metal detected with high concentration in sediments in all the dams with the peak concentration of 775.99mg/kg at Erinle dam in Ede. The values of manganese in all the dams is between 21.273mg/kg at Tooto dam in Osun state mini scheme and 775.99mg/kg at Ede dam. Zinc is the second metal with high concentration spread across all the dams with values between 2.060mg/kg at Oluponna and 33.993mg/kg at Iree.

In all the dams, results showed that there is little or no concentration of cobalt except at Oke-Osun in Osogbo with concentration of 2.013mg/kg. Deposition of wastes from the steel rolling and Osogbo machine tool in the past might have contributed to the existence of cobalt around the place. All the metals in all the locations have concentration below the probable effects level (PEL) according to the Environmental quality criteria in Canada. Nevertheless, there could be bioaccumulation in living tissues which may eventually be at toxic level with time.

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