DETERMINATION OF HEAVY METALS IN SEWAGE WATER, SOIL AND PLANTS GROWING ALONG DISCHARGE CHANNEL OF SHARADA INDUSTRIAL EFFLUENT, KANO STATE, NIGERIA.

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***ABSTRACT*: The determination of heavy metal in sewage water, soil and plant growing along the discharge channel of Sharada industrial effluent. Pollution is the release of contaminant natural environment and should be evaluated for the safety level weather it is free from contamination of heavy metals. Most of the study that have conducted in soil, plant and water samples showed that heavy metals exit in soil, water and plant samples. This study focuses on sewage water, soil and plant along the discharged channel of Sharada industrial effluent because it is widely used and it became the basic need for farming and irrigation around the area. The evaluation of the safety level of sewage water, soil and plant is very important. Hence, this study is done to achieve a few objectives. That are to determine the concentration of heavy metals in sewage water, soil and plant samples weather they are safe or not according to the standard of water quality, soil and plant for heavy metals by WHO and EPA. So as to determine the concentration of each element in order to identify which is the most concentrated and vice versa. This study compares the level of heavy metals concentration according to the types of site sampling from industrial agricultural and housing areas. By using AAS, the result of this study showed that the levels of most heavy metals concentration exceed the limit for the level of the soil, plant and water quality. Therefore, some of the sample analyzed in this study is not safe for consumption because the lead, zinc, chromium and cadmium content were higher than the permitted level.**

Index Terms: Heavy metals, sewage water, soil, plant, industrial effluent, pollution, channels, concentration, farming, irrigation, consumption

Introduction

Pollution

Is the release of contaminant into a natural environment that cause instability, disorders, harm or discomfort to the ecosystem. I.e. physical system or living organisms, (Gari 2002). Pollution can take form of chemical substances or energy, such as noise heat or light pollutants, the element of pollution, can be foreign substances or energies or naturally occurring, they are considered contaminants when they exceed natural levels. Pollution is often classified as point source or non-point source pollution.

Pollution may be due to release of chemicals and particulates into the atmosphere, light tress pass, industrial noise, chemical spill or underground leakage and release of waste products and contaminant into surface run off into water body (Gari 2002).

Types of pollution

Pollution is divided into two types, point source and non-point source pollution.

- **Point source pollution(PSP)**

Refers to contaminants that enter a water way through a discrete conveyance, such as a pipe or ditch, examples of sources in this category include discharges from a sewage treatment plant, or a city storm drain.

- **Non-point source (NPS) Pollution**

Refers to diffuse contaminant that does not originate from a single discrete source, NPS Pollution is often the cumulative effects of small amounts of contaminants gathered from a large area.

Environmental pollution

Land pollution is the degradation of earths land surfaces often causes by human activities and their misuse of land resources it occurs when waste is not disposed properly.

Healthy hard disposal of urban and industrial wastes, exploitation of minerals and improper use of soil by inadequate agricultural practices are a few factors.

Urbanization and industrialization are major causes of land pollution.

The industrial revolution set a series of event into motion which destroyed natural habitats and polluted the environment, causing disease in both human and other species of animals, (L. Gari, 2002).

Bio magnification described situations where toxins (such as heavy metals) may pass through tropics levels, becoming exponentially more concentrated in the process. Invasive species can completely out native species and reduce biodiversity. Invasive plants can contribute debris and biomolecules (alletopathy) that can alter soil and chemical composition of an environment often reduce native species competitiveness also soil can become infertile and unsuitable for plants.

Types of environmental pollution

There are three major types of environmental pollution

- Air pollution
- Water pollution
- Soil pollution

Most of air pollutants are sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, volatile organic compounds, and air borne particles, with radioactive pollutants among the most destructive ones (especially when produced by nuclear explosions).

Water pollutants include insecticides and herbicides, food processing waste, pollutants from livestock operations, volatile organic compounds, heavy metals, chemical waste and others. Soil pollutants include hydrocarbons, solvents and heavy metals.

Heavy metals

The term heavy metal refers to any metallic chemical element that has a relatively high density and is toxic or poisonous at a low concentration, (Duffus, 2002).

Examples of heavy metals include cadmium (Cd), Chromium (Cr), Lead (pb), Iron (Fe), Zinc (Zn), Copper (Cu), and Manganese (Mn).

Heavy metals are natural components of earth's crust (Galloway, 1982) they cannot be degrade or destroyed.

To smaller extent they enter our bodies via food, drinking water and air. As trace elements, some heavy metals (e.g. copper, lead and zinc) are essential to maintain the metabolism of human body. However, at high concentration they can lead to poisoning. Heavy metal poisoning could results, for instance, from drinking water contamination (e.g. lead pipe), high ambient air concentration near emission sources or intake via the food chain.

Heavy metals are dangerous because they tend to bio-accumulation (Duffus, 202.).

Materials and method

Study area

The study was carried out at one of the Kano state, Nigeria Industrial Area located at Sharada of Kano metropolitan. The industrial Area covers 8500 hectares.

Sampling Sites

In this study seven sampling sites were taken (Centre of the drainage) at five, ten and fifteen feet from the both side of drainage top soil samples (0-15cm) and sub-soil (15-30cm) depth were taken from each site using digger, hoe and tape. Fourteen soil samples, six plant samples and a water sample were collected during the study.

Soil samples processing and pre-treatment

The soil samples collected were dried at room temperature, sieved and stored in a peak.

Plant samples pre-treatment

Each plant sample was dried at room temperature, grained sieved and stored in a pack.

Determination of heavy metals in soil

The double acid extraction method was used for this experiment as follows:

5g of soil was added into an acid- washed 50ml conical flask and 25ml of extraction reagent (0.005 HCL in 0.125m $H_2So_{4)}$ were also added. The resultant mixture was shaking for 15 minutes on a reciprocating shaker at a minimum of 180 oscillations/minutes. The suspension was filtered through what man, NO. 42 filter paper and the filtrates was analyzed for cadmium, copper, iron, manganese, chromium, and lead using atomic absorption spectrophotometer, Soil science society 1971.

Determination of heavy metals in plants

1g of dried plant tissue was added into a silica and ashes in a muffle furnace at 475-500^0 c for four hours (4hrs). The ash was cooled and dissolved in 5ml of 20% (2m) HCL warmed in order to effect complete solution of the residue. The solution was filtered through an acid wash filtered filter paper into a 50ml volumetric flask.

The filter paper was washed with hot water and dilute to volume after cooling with distilled water. Atomic absorption spectrophotometer was used to analyses cadmium, iron, zinc, and chromium, manganese, copper and lead, Soil science society 1971.

Determination of heavy metals in water

500ml of water sample was transferred into a large beaker (750ml) capacity and 15m of concentrated nitric acid ($HN0_{3)}$ was added. It is then evaporated on a stream bath to approximately 25ml and transferred to a 50ml acid-washed volumetric flask. Deionized water was used to make up the mark. Atomic absorption spectrophotometer was used to analyzed cadmium, cupper, iron, zinc, manganese, chromium and lead, Chemical society (1968).

Computation of heavy metals was done using the relation formula below

$$\text{Conc.} = \frac{\text{Absorbance of individual metal}}{\text{Slope from the standard graph}}$$

But, slope = $[DY/DX = Y_0 - Y_1/X_0\text{-}X_1]$

Presentation of Results

Heavy metals (Cd, Cr, Fe, Mn, Pb, Zn, and Cu) were present in plants, soil and water samples analyzed but the content differ, was presented in table 1-4 below:

Table 1: Concentration (ppm) of some heavy metals in plants growing along the effluent discharged channel of Sharada industrial Estate.

S/N	Heavy metals	Concentration A B C D E F
1	Cadmium (Cd)	7 2 3 7 5 2
2	Chromium (Cr)	4 2 3 6 3 1
3	Iron (Fe)	2.5 1.5 1.5 1 3 2
4	Manganese (Mn)	1.5 3 2 4 2 3
5	Lead (Pb)	4 5.5 5 5 8 10
6	Zinc (Zn)	9.5 14.5 12 8 6.5 4
7	Copper (Cu)	5 4.5 5 3 1 4

Table 2: Concentration (ppm) of some heavy metals in top soil (0-15cm) depth along the effluent discharge channel of Sharada industrial Estate

		Concentration						
S/N	**Heavy metals**	**A**	**B**	**C**	**D**	**E**	**F**	**UW**
1	Cadmium (Cd)	6	5	3	6	4	7	4
2	Chromium (Cr)	8	4	8	7	4	7	6
3	Iron (Fe)	1	2	1	1.5	0.5	2	1.5
4	Manganese (Mn)	2.5	1.5	2	2	3	4	2
5	Lead (Pb)	9.5	3	9	5	10.5	8.5	10
6	Zinc (Zn)	26.5	9	26	3.5	3	9	2
7	Copper (Cu)	3	3	5	1.5	4	1	3.5

Table 3: Concentration (ppm) of some heavy metals in sub-soil (15-30cm) depth along the effluent discharge channel of Sharada industrial Area:

		Concentration						
S/N	**Heavy metals**	**A**	**B**	**C**	**D**	**E**	**F**	**UW**
1	Cadmium (Cd)	7	3	4	4	3	3	6
2	Chromium (Cr)	5	4	6	2	7	1	4
3	Iron (Fe)	3.5	3	1.5	1	2	1	1
4	Manganese (Mn)	1.5	2.5	4	4	3.5	3.5	2.5
5	Lead (Pb)	4.5	7	6	4.5	5.5	12	6.6
6	Zinc (Zn)	27	13	12	11	9	6.5	2
7	Copper (Cu)	3	4	2	2.5	6.5	2.5	2

Table 4: Concentration of some heavy metals in the sewage water along the effluent discharge channel of Sharada industrial Area:

S/N	**Heavy metals**	**Concentration (ppm)**
1	Cadmium (Cd)	6
2	Chromium (Cr)	9
3	Iron (Fe)	2
4	Manganese (Mn)	2.5
5	Lead (Pb)	4
6	Zinc (Zn)	5
7	Copper (Cu)	2.5

Discussion

The heavy metals analyzed in the samples were Cd, Cr, Fe, Mn, Pb, Zn, and Cu, they were also found to be present in all the soil, plants and water samples except that there was a variation in concentration.

The result of plant sample at the right hand side of the channel (A, B and C equivalent to 5ft, 10ft, and 15ft respectively) shows an increase in the concentration of Lead and zinc and decrease in Cd, Fe, Mn, Pb, Zn and Cu.

In the left hand side D, E and f respectively equivalent to 5ft, 10ft and 15ft respectively) there was an increase in the concentration of Lead and zinc, while decrease in the concentration of Cr, Fe, Mn, Cu, and Cd remain unchanged.

However, the concentration of heavy metals analyzed in the plant samples at right hand side of the channel were found to be higher concentration, then the left hand side when compared to the regulatory environmental standard for the heavy metals according to the WHO 1984.

The result of the top soil (0-15cm depth) at the right hand side of the channel (A,B, and C equivalent to 5ft, 10ft and 15ft respectively) shows an increase in the concentration of Cr, Fe, Mn, Pb, and zinc remained unchanged in the subsoil (15-30cm) of the same side of the channel there was also decrease in the concentration of Cd, Fe, Zn, and Cu while increase in the concentration of Cr, Mn and Pb.

In the top soil of the left hand side of the channel (D, E and F equivalent to 5ft, 10ft and 15ft respectively) there was an increase in the concentration of cadmium, manganese and lead while decrease in concentration of Fe, Zn, and Cr remain unchanged.

The concentration of the heavy metals under the water (Uw) were found to be a little bit higher than that of two sides and there are in conformity with the environmental regulatory standards except for Cd.

The result of water samples analyzed but the concentration of Cr, Cd and Zn were higher and the concentration of Fe, Mn, Cu, and Lead decreases and their concentration were in line with WHO 1984 international water quality.

Meanwhile all of Cr, Cd, and Zn present in sewage water were highly found in (fig 29) the result indicated that most of Cd, Cr, and Zn in sewage water originated from discharge channel of Sharada industrial Effluents.

Conclusion

From the analysis of the result obtained it may be seen that certain industrial activities increases the concentration of heavy metals around the area.

The overall study indicated that the concentration of heavy metals in soil samples at the top soil at (0-15cm) depth is greater than sub soil at (15-30cm) depth. Also the concentration of Cr, Zn, and Pb was above the regulatory environmental guidelines by WHO 2003.

An increase in Cr, Zn and Pb concentration in the result suggests that heavy use of agrochemicals materials for planting and other industrial activities could cause increase in the content of heavy metals in some of the samples.

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