

Elemental Composition Study of leachate in some dumpsites in Bauchi Metropolis

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Abstract
Elemental composition study of leachates at four different dumpsites were conducted by analyzing samples of leachates for some heavy metal (cr, cd, pb, and cu) using complexometric method. The results of analyses showed that the leachate from the four dumpsites have the following ranges of mean concentrations 0.08 – 0.22 mg/dm^3 Cd; 0.01 – 0.10 mg/dm^3 Cr; 1.81 mg/dm^3 Pb; and 1.11 – 1.99 mg/dm^3 Cu. These heavy metals are present in the leachates in low amount. Their presence however suggested that solid waste dumpsite contributes to heavy metals contamination of the environment.
Keywords: Heavy metals, complexometric method, dumpsites, Contamination, leachate.

1.0 Introduction

The final disposition of solid waste is a practice that still brings serious impacts to the environment generating pollution by-products such as leachate, a dark-coloured, strong-smelling highly toxic liquid. Leachate originates from the decomposition of organic matter, the intensity of pluvial waters and other liquids derived from waste (Bertazzoli and Pelegrini, 2002).

The toxicity and impact provoked for the leachate on microflora and microfauna is very strong and they are influenced by various factors such as organic matter, heavy metals and nitrogen concentrations as well as mass flux of contaminations being transported, (Isidori et al., 2003).

Studies have shown that leachate at refuse dumpsites contain different kinds and concentrations of heavy metals, depending on the age, contents and location (Odukoya et al., 2009). In recent times, it has been reported that heavy metals from waste dumpsites can be accumulated and persist in leachate at an environmentally hazardous level (Amusan et al., 2005).

In Nigeria, leachate from refuse dumpsites constitutes a source of heavy metal pollution to aquatic environment (Ande et al., 2009).

Identifying compounds that cause the toxicity in the leachate is not easy because the physicochemical characteristics of leachate is highly variable and dependant on the following factors; local environmental conditions, time elapsed after waste disposal and landfill characteristics as well (Bertazzoli, Pelegrini 2002).

Leachate from a dumpsite varies widely in composition depending on the age of the landfill and the type of waste that it contains (Henry et al 1996)

Additional leachate volume is produced during the decomposition of carbonaceous materials, producing a range of other materials including methane, carbondioxide and a complex mixture of organic acids, aldelydes alcohols and simple sugars. Pollution of ground water by leachates from dumpsites have been organized (Hem, et al 1989). The practice of dumpsites system as method of waste disposal in many countries is usually far from standard recommendations (Adewale 2009)

A standardized dumpsites system involves carefully selected location and is usually constructed and maintained by means of engineering techniques, ensuring minimized pollution of air, water, soil and risk to man and animals.

Dumpsites practice involves placing waste in one area with the aim of controlling pollution (Alloway and Ayres, 1997). Dumpsites in developing countries context is usually an unlined shallow hollow (often) not deeper than (50cm) Zurbrugg et al, (2003) referred to it as "dumps" receives solid wastes in a more or less uncontrolled manner, making uneconomical use of the available space which allows free access to waste pickers, animals and flies and often produce unpleasant and hazardous smoke from slow-burning fire. Hence leachate of diverse composition are produced, depending on site construction and operational practice, age of the dumpsite, climatic and hydrological conditions and surface water ingress into the dumpsite (Cambell, 1993). Leachate therefore migrate vertically and laterally into the environment by direct discharge into streams and bodies of water around the dumpsite.

The realization of the polluting effect of dumpsite leachates on the environment has prompted a number of

studies. These include studies on domestic wastes (Sridhar et al, 1985). Leachate quality (Aluko et al, 2000).
At the study, leachates are discharged into the environmental media without treatment. This has resulted in low farm produce, release of obnoxious gases into the environment, contamination of the domestic water sources (Tairu, 1998).

2.0 Materials and Methods

2.1 Study Areas and Site Location

The study was conducted on four dumpsites in major residential areas of Bauchi metropolis viz:-RafinMakaranta (RM); Gwallaga ward (GW), Makama Housing Estate (MHE) and YelwaMakaranta (YM).

2.2 Sample Collection

Leachate samples were collected from vicinities of the municipal solid waste (MSW) dumpsites by digging a hole about 0- 30 cm deep, water was poured on the solid wastes and allowed to drain into the hole. The leachate was collected and filtered through a 250 mm Whatman filter paper and then stored in plastic bottle. Four samples were collected between November – December 2010. The leachate analyses were done in accordance with standard procedure and guidelines by WHO, (1996) for heavy metals.

2.3 Samples analysis

1. Determination of Lead using Xylenol Orange as Indicator

Leachate sample (25.0 cm^3) was pipetted into a 250 cm^3 volumetric flask, diluted with about 25 cm^3 of distilled water and 3 drops of the indicator solution were added. The solution turned red, hence dilute nitric acid (0.5 M) was added cautiously and with stirring, until the solution acquired a yellow colour. A pinch of hexamine (hexamethylentriamine) powder was added until the colour was intensely red. This was to ensure that the solution has attains a pH of 6. The solution was titrated with standard EDTA solution (0.05 M) until the colour changed to lemon-yellow and the concentration of the lead ion was calculated.

2. Determination of Cadmium using xylenol Orange as Indicator

Leachate sample (25.0 cm^3) was pipetted and diluted with distilled water (50 cm^3), and three drops of the indicator solution were added followed by a drop of dilute H_2SO_4 (0.05 M) and the solution turned yellow. A pinch of hexamine was then added and shaken vigorously, until the colour turned deep red. The solution was then titrated with EDTA solution (0.05 M) slowly near the end point to a colour change from red to yellow and the concentration of Cadmium was then calculated.

3. Determination of Chromium using Xylenol Orange as Indicator

Leachate sample (25.0 cm^3) was pipetted into 250 cm^3 conical flask and diluted with distilled water (25 cm^3) . Xylenol orange indicator (three drops) was added to obtain yellow solution. A pinch of powdered hexamine was added and the solution became red. The resulting solution was titrated with EDTA solution (0.05 M) and the solution turned purple which indicated the end point. The concentration of cadmium was then calculated.

4. Determination of copper using Xylenol Orange as Indicator

Leachate sample (25.0 cm^3) was pipetted into 250 cm^3 conical flask and diluted with distilled water (50 cm^3) followed by the addition of three drops of xylenol orange indicator to obtain a blue solution. A pinch of hexamine powder was added and the solution turned red. The solution was then titrated with EDTA solution (0.05 M) to purple colour end point and the concentration of copper was then calculated.

3.0 Results and discussion

3.1 Results

The results of heavy metal analysis of leachate from the four dumpsites in November – December, 2010 are presented in a Table as shown.

Table 1: Mean Concentration of Heavy Metals (mg/dm^3) in Leachate

Location	Cd	Cr	Pb	Cu
MHE	0.08 ± 0.00	0.01 ± 0.04	1.81 ± 0.61	1.33 ± 0.06
Gw	0.18 ± 0.04	0.02 ± 0.01	2.60 ± 0.82	1.99 ± 0.33
Rm	0.11 ± 0.02	0.10 ± 0.08	2.25 ± 0.12	1.19 ± 0.05
Ym	0.22 ± 0.08	0.06 ± 0.02	2.14 ± 1.10	1.11 ± 1.29

MHE = Makama Housing Estate, GW = Gwallaga, Rm = Rafin Makaranta, Ym = Yelwa Makaranta

The heavy metals considered for this study are Cadmium, Chromium, Lead and Copper, which are toxic to plants when present in leachate at concentrations above tolerance level.

3.2 Discussion

Cadmium is a toxic metal having functions neither in human body nor in animals or plants. It is present in fossil fuel such as coal and oil. This present study indicates the mean concentrations range of 0.08 – 0.22 mg/dm^3 for cadmium in the dumpsites leachates. This range of concentrations were quite lower than those reported by David et al.,(2009) as 1.28 – 21.31 mg/dm^3 and Okorokwo et al.,(2006) as 1.64 – 2.50 mg/dm^3 but within the range ascertained by Oviasogie et al., 2010 (0.14 – 0.90 mg/dm^3). Furthermore these concentrations are also lower than the allowable limit of 1.00 mg/dm^3 by FEPA, (1991) and WHO, (1997). The low level of contaminants in these dumpsites accounts for the low concentrations of these metals in the leachates.

Chromium is a toxic heavy metal. It occurs naturally in leachate at a normal range of 5 – 15000 mg/dm^3. In this study the mean concentrations of chromium in the dumpsites leachates were found to range from 0.01 – 0.10 mg/dm^3. These concentrations were lower than those reported by (Ande et al., 2010) i.e13.00 – 24.20 mg/dm^3 and by (Oviasogie et al., 2009) as 3.50 – 9.00 mg/dm^3. The allowable limit of Chromium in Dumpsite leachate is 1.00 mg/dm^3 as reported by FEPA, 1991 and WHO, 1997.

Increase lead concentration in leachates is usually attributed to industrial activities (Eddy et al., 2006). Lead is mostly found in automobile battery in sufficient amount. The result of this study showed a mean lead concentration of leachates at the dumpsites as 1.81 – 2.60 mg/L. These concentrations were below the permissible lead concentration of 15 – 25 mg/dm^3 as reported by Eddy et al., 2006. And below the concentrations reported by(Agyarko et al., 20100) as 8.59 – 9.20 mg/dm^3. The concentration of lead obtained in this study indicate that the leachate at these dumpsites exceed the allowable limit of 1.00 mg/dm^3 by FEPA, 1991 and WHO, 1997. This is due to auto mobile activities at the sites.

Copper is an essential micronutrient required by plants for their healthy growth. The normal range of copper falls within 7-8.0 mg/dm^3 (Eddy et al., 2006), the concentration of copper for the dumpsites studied for leachate range from 1.11 – 1.99 mg/dm^3. These concentrations were lower than those reported by David et al, 2009 (16.41-76.18 mg/dm^3). The lower concentrations of copper obtain in this study as compared with those of literatures suggested that the leachate at the dumpsites is not polluted with copper.

4.0 Conclusion

We may conclude that analyses of the dumpsites leachates samples showed low concentrations of Cd (0.08 – 0.22 mg/dm^3), Cr (0.01 – 0.10 mg/dm^3), Pb (1.81 mg/dm^3), and Cu (1.11 – 1.99 mg/dm^3). The dumpsites may not be classified as contaminated since these heavy metal concentrations were within FEPA (1.0 mg/dm^3) and WHO ((1.0 mg/dm^3)) permissible limits respectively.

5.0 Acknowledgement

The authors wish to acknowledge the Chemistry Programme of Abubakar Tafawa Balewa University, Bauchi, for providing an enabling environment for this work.

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