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Research Article

Evaluation and Environmental Impact Assessments of Leachates Composition from Waste Dumpsites within Minna and his Environs, Nigeria

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Abstract

The evaluation and environmental impact assessment of leachates composition from wastes dump sites were carried out to assess the level and impact of some pollutants around Minna Metropolis and its environs. Studies were carried out randomly from five different dump sites. The composition of leachates varied widely on each location of the dumpsites and also with the composition of the solid wastes. All parameters examined show low organic compositions of leachate and the pH tends towards alkaline phase. Various heavy metal concentrations which includes, Lead (Pb), Copper (Cu) and Chromium (Cr) were found to be relatively within the acceptable level in the environment.

Keywords: Impact; Composition; Copper; Chromium; Lead

Introduction

Wastes are substances which are discarded of or intended to be discarded by a community. Solid waste disposal is placed highly so as not to impact the society or environment negatively. This waste could be assimilated in such a way that they are not visible in the environment either by reusing, recycling or recovery of the wastes.

With the fast improvement of the state, some natural situations are arising which includes, air quality weakening, contamination of stream water, illicit dumping and non-clean landfill of modern and municipal solid wastes are increasing. Therefore, Niger State Environmental Protection Agency in charge of safety of the environment started to put into impact serious regulation to build an incorporated waste administration framework for insurance of environment. The reasonable advancement and monetary development represents a major trial to environment, for example, greenhouse gas discharges, asset utilization and enormous waste era. The outcome of human activities is municipal solid waste which may lead to environmental pollution and endanger mankind's health, if the proper management scheme isn't provided.

The main aim of this studies is to evaluate and assess the impact of leachate composition within the studied area. With the aim for proffer remediation in case of any negative impact to the environments.

Materials and Methods

Collection and sorting of samples

Waste samples was collected from each main dumpsite. The samples were collected from five most populated areas in Minna; Kpakungu, Barkinsaleh, Maitumbi, Tunga and Chanchanga. The waste was segregated into non- biodegradable and biodegradable.

Analyses and procedures

Characterization of solid waste

The characterization of solid waste was done by evaluating the elemental composition the leachate composition.

Leachate compositions

The leachate sample were analyzed for physio-chemical parameters that included: pH, organic carbon, organic nitrogen, organic

matter and heavy metals (Pb, Cr and Cu). To analyze the different chemical components of the sample, different instrumental and experimental approach was used. A detailed description of the techniques can be found in Standard Methods for the Examination of Water and Waste Water, 20th Edition [1]. Summaries of these techniques are presented in the following sections,

Determination of pH

A digital pH-meter was used in the laboratory to determine the pH of the samples. 10-g of the sample was weighed into a beaker with 10-ml of distilled water and allow to stand for 30 minutes. It was stirred occasionally with a glass rod and the electrode of the pH-meter was inserted into partially settled suspension.

Determination of organic nitrogen

0.5-g of the sample was dissolved in 10-ml of distilled water and swirled for some minutes and allowed to stand for 30 minutes residence time. 0.5-g of copper sulphate was added as catalyst and 20-ml of sulphuric acid (conc.H_2SO_4). The solution was heated cautiously at low heat on a digestion stand until the water has been removed and frothing has ceased, the heat was increased till the digest clears. The mixture was boiled for 5 hours and the heating was regulated so that the H_2SO_4 condenses about middle of the way up to neck of the flask. The solution was allowed to cool and 100-ml of water was added to the solution. The solution with 10-ml of Sodium hydroxide (NaOH)was poured inside a distillation flask. 10-ml of H_3BO_3- indicator placed under the condenser of a distillation apparatus. 50m-ml of the distillate was collected and titrated against 0.01N of Hydrogen chloride solution (Hl) until the color changes from green to pink at the end point, and the result was expressed in mg/100g

$$\% \text{ Total Nitrogen} = \frac{T.V \times 0.01N \times 0.014 \times 10}{Weight\ of\ sample} \times 1003.5$$

T.V =Titre value of hydrochloric value
N = Normality of solution

Determination of organic carbon

0.5-g of the sample was dissolved in 10-ml of potassium dichromate ($K_2Cr_2O_7$) and 10-ml of concentrated Hydrogen sulphate (conc. H_2SO_4). The solution was swirled vigorously for 1 minute and allow to stand on a sheet of asbestos for 30minutes residence time. 100-ml of distilled water was added after standing. 3 drops of ferroin indicator was added and the solution was titrated against 0.5N ammonium chloride (NH_4SO_4) until the color changes from dark green to maroon color in reflected light against a white balance background at the end point, and the result was expressed in mg/100g.

The dichromate has been standardized by preparing the blank titration with the same process without the sample.

$$\% \text{ Organic Carbon} = \frac{(\text{meg } K_2Cr_2O_7 - \text{meg } FeSO_4) \times 0.5N \times 0.03 \times 100(f)}{\text{Weight of sample}}$$

Meg= normality of solution × ml of solution
N = Normality of solution, f = 1.33

Determination of Organic Matter

The organic matter was calculated by multiplying the organic carbon calculated with a factor of 1.729.

% Organic matter = organic carbon * 1.729

Determination of copper

The amounts of copper present in the samples were determined by HACH DR2 spectrophotometer using copper powder pillows at wavelength of 560nm. The results were expressed in mg/100g.

Determination of iron

The amounts of iron (II) present in the samples were determined by HACH DR2 spectrophotometer using ferrous powder pillow at wavelength of 508nm. The results were expressed in mg/100g.

Determination of Chromium

The amounts of chromium present in the samples were determined by HACH DR2 spectrophotometer using chromium metal powder pillow at wavelength f 510nm. The results were expressed in mg/100g.

Data and results

The leachate composition consists of the pH, the organic matter, the organic carbon, the carbon and heavy metals in the MSW.

Leachate composition: Barkinsaleh

The pH values obtained in this location ranges from 6.82 - 8.54. The range of organic matter in the MSW is within 1.33 - 12.07%. Organic carbon in the waste is within the range of 0.77 - 6.98%. The amount of copper detected in the selected sample ranges between 1.04 - 3.30mg/100g. The amount of chromium found in the sample ranges within 0.90 - 1.70mg/100g. The amount of lead found in the MSW sample ranges within 0.13- 1.80mg/100g, which is above the acceptable concentration recommended by WHO.

S/No	Parameters	Units	Paper	Nylon	Plastics
1	pH	-	8.54	7.87	6.82
2	Organic carbon	%	6.98	0.92	0.77
3	Organic matter	%	12.07	1.59	1.33
4	Organic nitrogen	%	0.98	0.52	0.67
5	Cu	mg/100g	3.30	1.50	1.04
6	Pb	mg/100g	1.80	1.50	0.13
7	Cr	mg/100g	1.70	2.60	0.90

Table 1: Leachate composition in Samples: Barkin Saleh.

Leachate composition in samples: Chanchaga

The pH values obtained in this location ranges from 6.54 and 8.47. The range of organic matter in the MSW is within 5.91 - 10.35%. Organic carbon in the waste is within the range of 3.42 - 5.99%. The amount of copper detected in the selected MSW ranges between 0.42 - 3.70mg/100g. The amount of chromium found in the MSW ranges within 0.70 - 1.80mg/100g. The amount of lead found in the sample ranges within 0.56 - 1.20 mg/100.

Leachate composition: Kpakungu

The pH values obtained in this location ranges from 6.78 -7.85 shown in Table 4. The range of organic matter in the MSW is within 0.41 - 1.73%. Organic carbon in the waste is within the range of 0.24 - 1.52%. The amount of copper detected in the selected sample ranges between 2.60 - 4.40 mg/100g. The amount of chromium found in the sample ranges within 0.70 - 1.80mg/100g. The amount of lead found in the MSW sample ranges within 1.00 - 2.20 mg/100g.

S/No	Parameters	Units	Paper	Nylon	Plastics
1	pH	-	8.47	6.54	6.71
2	Organic Carbon	%	5.99	4.49	3.42
3	Organic Matter	%	10.35	7.76	5.91
4	Organic Nitrogen	%	0.34	0.27	0.41
5	Cu	mg/100g	3.70	2.30	0.42
6	Pb	mg/100g	0.56	1.00	1.20
7	Cr	mg/l00g	1.80	0.70	1.30

Table 2: Leachate composition in Samples: Chanchaga.

S/No	Parameters	Units	Papers	Nylon	Plastics
1	Ph	-	7.08	6.78	7.85
2	Organic carbon	%	1.52	0.24	0.67
3	Organic matter	%	1.73	0.41	1.16
4	Organic nitrogen	%	0.35	0.48	0.21
5	Cu	mg/100g	4.40	2.90	2.60
6	Pb	mg/100g	2.00	1.00	1.30
7	Cr	mg/100g	3.40	1.60	2.50

Table 3: Leachate composition in Samples: Kpakungu.

Leachate composition in Samples: Tunga

The pH values obtained in this location ranges from 6.54 - 7.39. The range of organic matter in the MSW is within 0.69 - 1.04%. Organic carbon in the waste is within the range of 0.40 - 0.60%. The amount of copper detected in the selected sample ranges between 3.20 - 6.80 mg/100g. and the amount of chromium found in the sample ranges within 3.50 - 4.60 mg/100g. The amount of lead found in the MSW sample ranges within 0.50 - 2.00 mg/100g.

Leachate composition: Maitumbi

The pH values obtained in this location ranges from 7.05 and 8.12. The range of organic matter in the MSW is within 1.17 - 2.55%. Organic carbon in the waste is within the range of 0.68 - 1.48%. The amount of copper detected in the selected sample ranges between 0.30 - 12.50 mg/100g, and the amount of chromium found in the sample ranges within 0.10 - 1.70mg/100g. The amount of lead found in the MSW sample ranges within 0.00 - 2.00 mg/100g.

S/No	Parameters	Units	Paper	Nylon	Plastics
1	pH	-	7.39	6.78	6.54
2	Organic Carbon	%	0.40	0.60	0.51
3	Organic Matter	%	0.69	1.04	0.88
4	Organic Nitrogen	%	0.39	0.83	0.45
5	Cu	mg/100g	6.30	6.80	3.20
6	Pb	mg/100g	1.00	2.00	0.50
7	Cr	mg/100g	4.10	4.60	3.50

Table 4: Leachate composition in Samples: Tunga.

S/No	Parameters	Units	Paper	Nylon	Plastics
1	Ph	-	7.22	7.05	8.12
2	Organic Carbon	%	1.48	0.68	0.87
3	Organic Matter	%	2.55	1.17	1.50
4	Organic Nitrogen	%	0.51	0.45	0.32
5	Cu	mg/100g	12.50	0.30	2.40
6	Pb	mg/100g	2.00	0.0	1.50
7	Cr	mg/100g	1.30	0.10	1.70

Table 5: Leachate composition in Samples: Maitumbi.

Discussions and Conclusions

The pH values obtained in this research work ranges from 6.54 and 8.54 which remains comparatively within the acceptable WHO range of 7.0 - 8.5. Based on the WHO guidelines, the pH of the entire sampling location would not adversely affect its use for domestic uses [2].

The range of organic matter in the samples is within 0.41 - 12.07%. These results obtained shows that the percentage of organic matter is low, a condition that almost abide with the highly industrialized countries, which have organic matter values of almost 10% [3].

Organic carbon in the waste is within the range of 0.40 - 5.99%. The higher value reported for the polluted area was as a result of the organic component of the municipal waste. High organic carbon can probably lead to high C:N ratio which negatively affects soil fertility. Microbes will first utilize the nitrogen and make little available for plant growth. Municipal solid waste increases soil organic matter and nutrients (Erickson, 1999).

The amount of copper detected in the selected MSW ranges between 0.42 - 12.50mg/100g. The copper concentration is acceptable with the WHO recommended health based guideline value of 2mg/l (20mg/100g), which prevents the risk of gastrointestinal irritation among the waste management staffs [2].

The amount of chromium found in the MSW ranges within 0.10 - 4.60mg/100g. The Chromates act as irritants to the eye, nose and throat, and chronic exposure may lead to liver and kidney damage [4].

The amount of lead found in the sample ranges within 0.00 - 2.00 mg/100g, which is above the acceptable concentration recommended by [2].

In surmmary, all parameters indicate low organic compositions of leachate and the pH tends towards alkaline phase. Various heavy metal concentrations analyzed above were found to be relatively within the acceptable level in the environment.

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