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Physiochemical Evaluations of a Typical Dumpsite in a Basement Complex Terrain, Southwest, Nigeria

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Abstract
Physiochemical evaluations of 20 water samples from Igbatoro dumpsite taken for both physiochemical parameters and physiochemical characterization using a multi-parameter tester 35 series and standard pore water chemistry respectively has been conducted. Physiochemical parameters such as; electrical conductivity (EC), total dissolved solids (TDS), and pH were all measured directly on the field. The results from the study shows average pH of the samples taken from each depths range from 8.85 – 9.4 indicating alkalinity. This value is verified by the concentration of bicarbonate which range from 61- 549 mg/L. The average EC of the samples from each points range between 8 and 1490ms which is confirmed by the concentration of some anionic species such as SO_4, NO_3, Cl and HCO_3. Pore water chemistry indicate that the dump is acutely interacting with agent of weathering and thus undergoing leaching but this is attenuated by carbonate materials. The pore water chemistry indicates alkalinity and less leaching of heavy metals from the dump.

Key Words: Physiochemical, Alkalinity, Leaching, and Attenuation

I. Introduction

Solid waste comprises unwanted solid materials such as garbage, paper, plastics, and other synthetic materials, metals and wood that needs to be recycled, disposed on land, incinerated, or composed. Dumpsites are areas where wastes are dumped or buried. They are the cheapest and most common disposal method for solid waste but they quickly become overfilled and may contaminate air, soil and water. During selection and construction of dumpsites, adequate attention should be given to ways of reducing pollution of both surface and groundwater to the barest minimal.

The common practice in most of the developing countries around the world (including Nigeria) is open dumpsite. This practice however, encourages direct interaction of lecheates from the sites with groundwater system as surface erosion aid their transportation (Bayode et al 2012).

The rapid industrialization, growing population and changing lifestyle are the root causes of increasing rate of solid waste generation in developing countries (Merwan *et al;* 2013).

Improper waste management results in high possibility of leachate leakage with subsequent impact on soils, plants, groundwater, aquatic organism and human beings (Akujieze and Oteze, 2007, Omorogieva *et al.*, 2013).

The more the facilities in any community, the higher the human population and the more the activities, the more the waste being generated and the more the environment is becoming susceptible to pollution. The precious and delicate nature of the environment calls for a pro-active approach.

Ehirim et al. 2006, used 2-D resistivity imaging of profile lines to isolate pollutants such as rock material contaminated with leachate plume and land fill gases as anomalously low or high resistive structures respectively. In their study, microbial and physiochemical analyses also revealed low pH values and excessive amount of micro-organisms (Bacteria, fungi, and coliform), in samples as contaminants. The low pH values of the borehole samples indicated that the groundwater was slightly acidic, while excessive amount of micro-organisms indicated leachate contamination.

Research on groundwater contamination by landfills have also focused on the microbiology and chemistry of groundwater (Hussein et al, 1989, Asmuth and Stranberg, 1993), based on the laboratory analyses of groundwater samples.

The integrated use of geophysical and hydro-physiochemical methods are often recommended in landfill studies (Benson et al, 1983, Mathias et al, 1994, kayabali et al, 1998).

This study aimed at assessing the physiochemical parameters of Akure main dumpsite, Igbatoro and its impacts on the immediate environment.

II. Location of study area

The dumpsite site in the present study is located along Igbatoro road, Akure, Ondo State.

It is approximately 3km away from the state house of assembly complex and covers a total area of about 700m^2. The dumpsite is located near the Federal Housing estate and the Federal secretariat complex (Fig. 1.1).

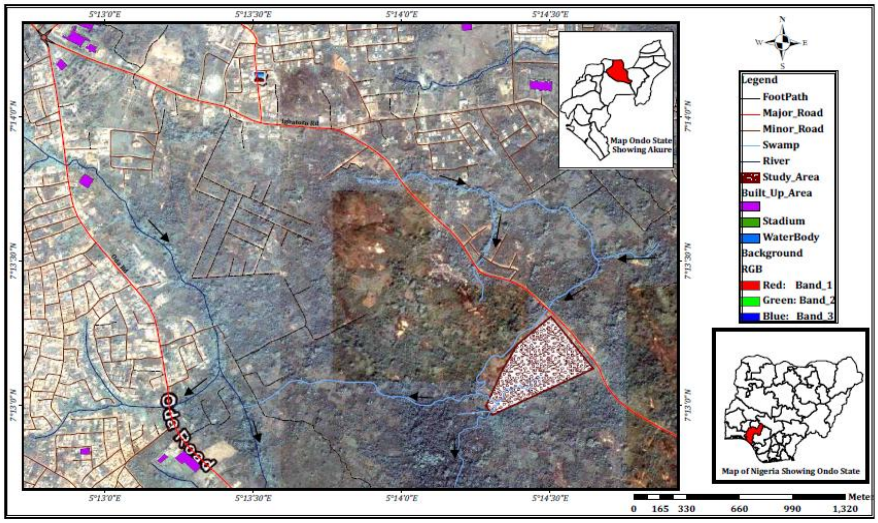

Fig. 1: Map of some Part of Akure Highlighting the Study Area

III. Methodology

After a brief reconnaissance survey of the study area was conducted, water bodies and existing wells and or boreholes within the environment were monitored. Water samples were taken for physiochemical analysis. Physiochemical parameters such as; electrical conductivity (EC), temperature, total dissolved solids (TDS), salinity and pH were all measured on the field using a multi-parameter tester 35 series. Physicochemical characterization was conducted using standard pore water chemistry

IV. The base map

The base map (Fig. 3.1) shows the area extent of the field, vertical electrical sounding points, traverse lines for profiling, cross section lines, stream network and flow directions, location of existing boreholes, hand dug well and access road to the dumpsite.

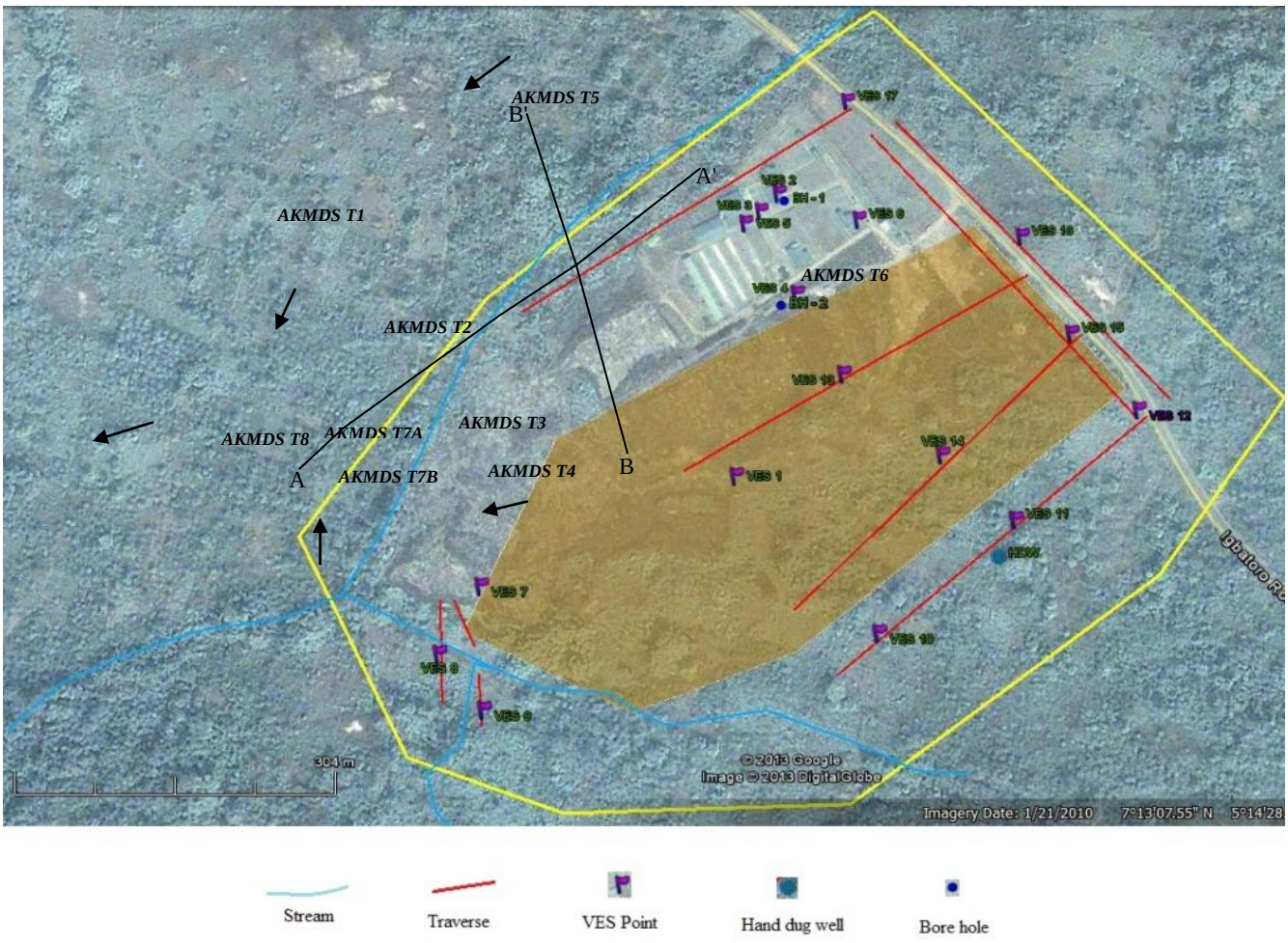

Fig. 2: Base Map of the Study Area.

Laboratory result of soil and water samples were interpreted for possible environmental implications.

V. Results

20 water samples were taken (at average intervals of 50m) for both physiochemical parameters and physiochemical characterization using multi-parameter tester 35 series and standard pore water chemistry respectively. The results are presented as tables (Tables 1, 2, 3 & 4) below.

Table 1: Physiochemical Parameters in Groundwater Samples

S/No	CODE	Description	Distance to Dumpsite(m)	PH	TDS	EC/ms
1	HDWell 1	Upstream	150	6.93	3.00	4.00
2	HDWell 2	Upstream	100	7.73	7.50	10.00
3	HDWell 3	Upstream	50	8.85	9.00	12.00
4	Borehole	Within Dumpsite	0	8.75	6.00	8.00
5	Stream spl 1	Upstream	50	7.45	4.50	6.00
6	Stream spl 2	Upstream	100	7.68	6.00	8.00
7	Steam spl 7	Upstream/close to dumpsite	150	8.64	27.75	37.00
8	Steam spl 3	Downsteam/ajacent	50	8.27	198.00	264.00
9	Steam spl 4	Downsteam/ajacent	100	8.55	198.75	265.00
10	Steam spl 5	Downsteam/adjacent	100	8.65	200.25	267.00
11	Steam spl 6	Downsteam/ajacent	100	8.63	169.50	226.00
12	Steam spl 8	Downsteam/close	50	7.81	32.25	43.00
13	Steam spl 9	Downsteam/close	50	8.02	20.25	27.00
14	Steam spl 10	Downsteam/close	25	7.93	20.25	27.00
15	Steam spl 11	Downsteam/close	50	8.15	8.25	11.00
16	Pond	Adjacent	25	8.05	4.50	6.00
17	Leachate	Within Dumpsite	0	9.54	525.75	701.00
18	Leachate	Within Dumpsite	0	9.11	774.75	1033.00
19	Leachate	Within Dumpsite	0	8.99	1117.5	1490.00
20	Leachate	Within Dumpsite	0	9.4	648.00	864.00

Table 2: Statistical Summary of some Major ions and Physiochemical Parameters in Groundwater Samples

Parameters (mg/l)	N	Minimum	Maximum	Mean	Std. Deviation
HCO_3	20	30.50	549.00	112.5500	131.15047
Cl^-	20	144.00	28656.00	4241.4000	7155.75826
SO_4	20	0.13	25.26	7.0508	8.23323
NO_3	20	1.11	5.64	2.7870	1.22177
pH	20	6.93	9.54	8.3565	.67201
EC	20	4.00	1490.00	265.4500	421.98497

Table 3: Comparism of some Major ions and Physiochemical Parameters in Groundwater Samples with existing Standard

Parameters mg/l	MIN	MAX	AVER	STDEV	WHO Highest Desirable	Maximum Permissible	NAFDAC STD
HCO_3	30.500	549.000	112.550	131.150	100.000	500.000	100.000
Cl	144.000	28656.000	4241.400	7155.760	200.000	250.000	100.000
SO_4	0.128	25.256	7.051	8.233	250.000	500.000	100.000
NO_3	1.107	5.641	2.787	1.222	10.000	50.000	10.000
PH	6.930	9.540	8.357	0.672	7.000-8.900	6.500-9.500	6.500-8.500
EC/ms	4.000	1490.000	265.450	421.985	900.000	1200.000	1000.000

Table 4: Pore water chemistry

Sample no	pH	EC/ms	mg/ l Bi-carbonate	mg/l Cl^-	mg/l SO_4^{2-}	mg/l NO_3-
PF3	9.11	1033	549	14400	18.077	2.566
PF2	8.99	1490	180	28656	25.256	3.567
PF1	9.4	864	244	13032	8.333	2.577
BH2	8.85	12	122	180	0.385	1.8221
BH1	8.75	8	61	288	0.128	1.107

VI. Discussions

The average pH of the samples taken from each depths range from 8.85 – 9.4 indicating alkalinity. This value is verified by the concentration of bicarbonate which range from 61- 549 mg/L. (Tables 1, 2, 3 & 4)

Average EC of the samples from each points range between 8 and 1490ms which is confirmed by the concentration of some anionic species such as SO_4, NO_3, Cl and HCO_3.

Pore water chemistry indicate that the dump is acutely interacting with agent of weathering and thus undergoing leaching but this is attenuated by carbonate materials as indicated by calcite and dolomite in the XRD spectra analysis.

The pore water chemistry indicate alkalinity and less leaching of heavy metals from the dump.

Other chemical species show decreasing trend with the depths indicating a natural attenuation of those species by precipitated carbonate materials or partially due to erosion caused by fluctuations of water table in the study area.

VII. Conclusion

The pore water chemistry indicates alkalinity and less leaching of heavy metals from the dump. It was also observed that samples taken within the vicinity of the dumpsite had been impacted negatively.

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