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Short Communication

Analysis of Dumpsite soil pH in selected Dumpsites of Kaduna Metropolis, Nigeria

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Abstract

The pH either directly or indirectly affects several mechanisms of metal retention by soils. In this research work, the pH values of the refuse waste soils of some dumpsite in Kaduna Metropolis were determined so as to assess the bioavailability, mobility and solubility of the metals in the soils. The pH was measured using a microprocessor pH meter model 210. The pH values of the soil samples from Kurmin Mashi (KM) and Narayi (NY) were acidic and that from Tudun wada (TW) was alkaline and a significant difference was indicated in the P^H values across the three locations. From the Duncan multiple range test, it was established that the soil from Tudun Wada (TW) dumpsite has the highest pH, followed by Narayi (NY) and Kurmin Mashi (KM).

Keywords: pH analysis, dumpsite soil, bioavailability, Kaduna metropolis

Introduction

In a developing country like Nigeria where the emission and disposal of all sorts of waste into the environment is not monitored, the contribution of heavy metals pollutants to the environment by anthropogenic sources is overwhelming, hence, repeated evaluation of the pollution status of the environment especially the soil is imperative[1]. Many soils especially those in hazardous waste sites are contaminated with heavy metal e.g. lead, copper, chromium and cadmium. The free metal ion concentration not only depends on the total metal content in soils, but also on the pH of the soil[2].

On the basis of pH measurement it is possible to divide analysed samples into the following groups: acid and sub-acid soils, neutral soils and alkaline soils. Acid soils belong to the sandy soils, neutral to sandy loamy soils and alkaline one to the loamy soils. Acid soils are prone to increased leaching of important components and decreased assimilation of such macro elements as P, K and Mg by plants. Plants growing on alkaline soils can have trouble with assimilation of Fe, Cu and Mn. The effect of acidifying of soils is visible in decreasing their saturation with exchangeable cations and successive loss of Ca and Mg and simultaneous activation of toxic compounds of Al, Mn Fe and accumulation of heavy metals like Pb, Cu, Ni and Zn by plants[3].

The pH of the system is a very important parameter, directly influencing sorption/desorption, precipitation/dissolution, complex formation and oxidation reduction reactions. In general, maximum retention of anionic metals occurs at pH >7 and maximum retention of anionic metals occurs at pH<7. Cationic metal mobility has been observed to increase with increasing pH due to the formation of metal complexes with dissolved organic matter[4].

In the research work, the pH measurements of soil samples from the dumpsites were made with microprocessor pH meter model 210 and all weightings were done on Mettler Toledo PB203 weighing balance. All the analyses were carried out in the Analytical Laboratory of the Department of Applied Science, College of Science and Technology, Kaduna Polytechnic, Kaduna, Nigeria.

Material and Methods

Preparation of samples: The research covered three dumpsites locations in Kaduna, Nigeria. The locations are: Kurmin Mashi (KM), Narayi (NY) and Tudun Wada (TW). These dumpsites are surrounded by residential, commercial and industrial neighbourhoods. Due to rapid urban development the locations are presently within developed locality of the metropolis.

The samples were collected between September – October, 2011, from the different locations enumerated at a depth of about 10cm below the surface[5] (figure-1).

pH Determination: The samples were crushed, sieved and dried 85^0C. A quantity (20g) of dried sample was weighed into a $50cm^3$ beaker and $20cm^3$ of distilled was added. The mixture was allowed to stand for 30minutes with occasional shirring using a glass rod. The electrode of the calibrated pH meter was inserted into the partly settled suspension and the pH value was read from the meter[6]. All the analyses were carried out in the Analytical Laboratory of the Department of Applied Science, College of Science and Technology, Kaduna Polytechnic, Kaduna-Nigeria.

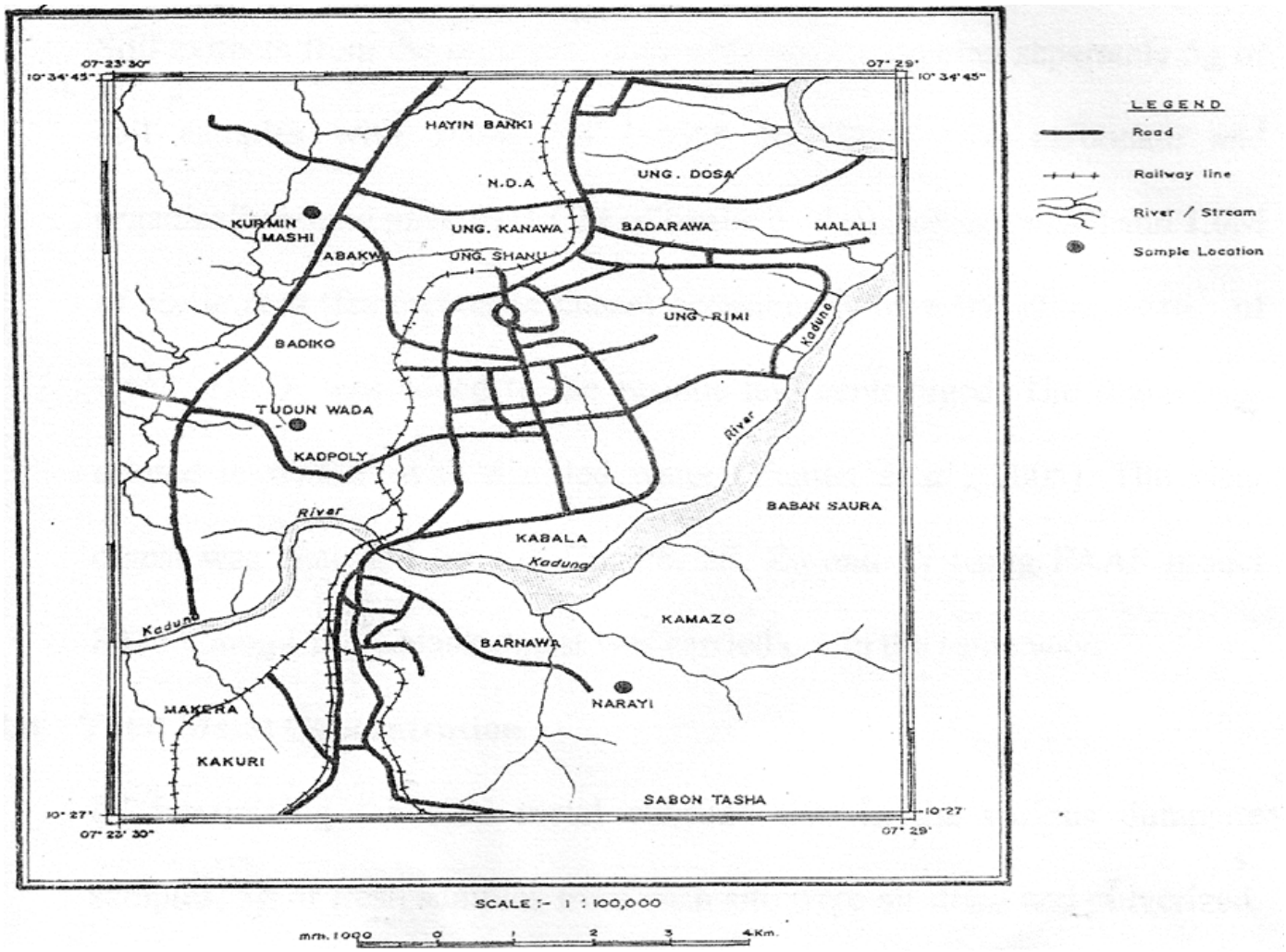

Figure-1
Map of Kaduna Metropolis showing sampling locations

Results and Discussions

The pH values of the dumpsite samples vary from one location to another and the results were treated statistically (table 1-3).

Analysis of pH in the dumpsites soils: The pH of the dumpsites in Kurmin Mashi (KM) and Narayi (NY) appeared acidic, while that from Tudun Wada (TW) was alkaline. This could be attributed to the various anthropogenic activities around the sampling locations[7-12].

Table-1
ANOVA for Soil pH by Locations

Sources of variation	Sum of Squares	df	Mean Square	F	Sig.
Location	20.282	2	10.141	202.822	0.000
Error	0.300	6	0.050		
Total	20.582	8			

Table-2
Duncan Test for Soil pH by Locations

Locations	N	Subsets	
		1	2
Kurmin Mashi	3	5.1333	
Narayi	3	5.2333	
Tudun Wada	3		8.3667
Means for groups in homogeneous subsets are displayed			

Table-3
Descriptive Statistics for Soil pH by Locations

Locations	N	Mean	SD
Kurmin Mashi	3	5.13	0.153
Narayi	3	5.23	0.153
Tudun Wada	3	8.37	0.321
Total	9	6.24	1.604

The bioavailability of metals from soils decreased with increasing pH value[13-15].

The ANOVA (0.000<0.05) in table1 indicated that there is a significant difference in the soil pH across the three locations.

The real differences of soil pH was further analyzed by a post-hoc test using the Duncan Multiple Range Test (table-2), where means of homogenous subgroups were clearly displayed. Moreover, the mean plots clearly depicted the mean values of the soil pH across the various locations.

From the Duncan Multiple Range tests, it is established that dumpsites from Tudun Wada has the highest pH, followed by Narayi and Kurmin Mashi as depicted in table-2 and figure-2.

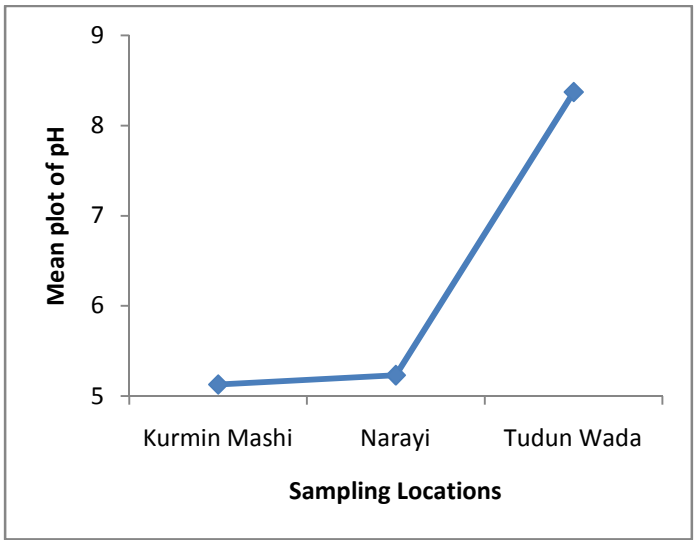

Figure-2
Mean plot of the soil pH in the dumpsites

Conclusion

The pH of the soil dumpsites from KM and NY were found to be acidic while that from TW was alkaline as a result of the anthropogenic activities around the sampling locations. The ANOVA (P=0.000<0.05) indicated a significant difference in the soil pH across the three dumpsites while the Duncan Multiple range tests indicated that dumpsite from TW had the highest pH followed by NY and KM.

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