Chemsearch Journal 3(1): 1 – 6, June 2012
Publication of Chemical Society of Nigeria, Kano Chapter
Date Received: December, 2011
Date Accepted: February, 2012
ISSN: 2276 – 707X

PHYSICO-CHEMICAL PARAMETERS OF SOIL IN SOME SELECTED DUMPSITES IN ZARIA AND ITS ENVIRONS

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ABSTRACT

Physico-chemical parameters of soil were found to have influence on the availability of heavy metals in plants. pH values recorded in the control site ranges from 7.8 to 9.2 indicating that all the soils studied were alkaline. The control site has a value of 7.16. The conductivity values range from 4.2 x 10^{-2} to 4.0x10^{5}μScm^{-1} . The highest conductivity value was recorded in site B, while site D had the least value. Moisture content in the 10 dumpsites studied ranged from 17.87 to 82.49%. Organic matter contents in the dumpsites ranged from 3.20 to 5.30% and are higher than values obtained for uncontaminated/control site. These higher values may be due to the aging of the dumpsites. The cation exchange capacity values ranged from 132.83(R) to 469.5(G)CmolKg^{-1}. These values are reasonably high due to the relatively higher conductivity values obtained in the dumpsites and this may also affect the bioavailability of the heavy metals in plants. Correlation analysis revealed that pH, electrical conductivity and moisture content were negatively correlated.

Keywords: Bioavailability, dumpsite, heavy metal, physico-chemical parameter, Zaria

Introduction

The quality of soil depends both on its physical properties (colour, texture, moisture contents, pH, organic matter content etc) and chemical properties (cation exchange capacity, organic matter contents, phosphate phosphorous, nitrate nitrogen, nitrite nitrogen etc). The physical and chemical; properties largely determine the suitability of a soil for its planned use and management requirements to keep it most productive to a limited extent, the fertility of a soil determine its possible uses and to larger extent its yields (Jaiswal, 2004). Soil physico-chemical properties play a vital role in determining the extent to which the heavy metals pollution of soil occurred

When a soil is examined, its colour indicates its condition. The surface soil varies from almost white through shades of brown and grey to black. Light colour indicates law organic matter content while clave colour indicates a high organic matter content (Jaiswal, 2004)..

pH is generally acknowledged to be the principal factor governing concentration of sociable and plant available metals (Brallier *et al*., 1996). Metal solubility tends to increase at lower pH and decreases at higher pH values (Garia – Miragana, 1984).

It was found that cation exchange capacity increases as the clay content in the soil increases and also as the organic matter increases in the soil. It was also found that the cation exchange depends on the negative charges on the surfaces of soil colloids and the relative charges on the metal species in solution and on the soil surface (Evans, 1989).

The presence of higher levels of nitrite and nitrate nitrogens in the soil is a clear indication of humans-rich nitrogenous substances, which could be favourable to plant growth but may have implication for the ground with quality (Godson *et al*., 2004)

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The objective of this study was to determine the levels some physic-chemical parameters in dumpsite soils in Zaria Metropolis.

MATERIALS AND METHODS

Sample collection: The dumpsites to be sampled in each location were divided into four quadrants, the refuse waste soils were collected from each site with the aid of clean stainless steel spoon, washed with soap and raised with distilled water after each sampling. The soil samples were placed in polythene bags, labeled and taken to the laboratory for treatment and analysis (Nounamo *et al*., 2000).

Samples Pre-Treatment: Soil samples from each site were homogenized and air-dried in a circulating air in the oven at 30^{o}C over might and then passed through a 2mm sieve. The sieved soils were placed in polythene bags ready for analysis**(Nounamo *et al*., 2000)**.

Quality Assurance: All glass waves, plastic containers, crucibles, mortar and refuse were washed. Glasses were washed with liquid soap, raised with distilled water and then soaked in 10% HNO3 solution for 24hours (Todoroui *et al*., 2001). They were then washed with distilled water and dried in Mammary drying oven at 80^{o}C for 5 hours.

Measurement of Physico-chemical Parameters

a. pH: 20g of each air-dried soil was weighed into 50 ml beaker and 20 ml of distilled water was added. It was stirred with a glass rod and allowed to stand for 30 minutes. Calibrated HANNA PH meter (Model H 1991000) was inserted into the shiny and pH recorded (Black, 1965)..

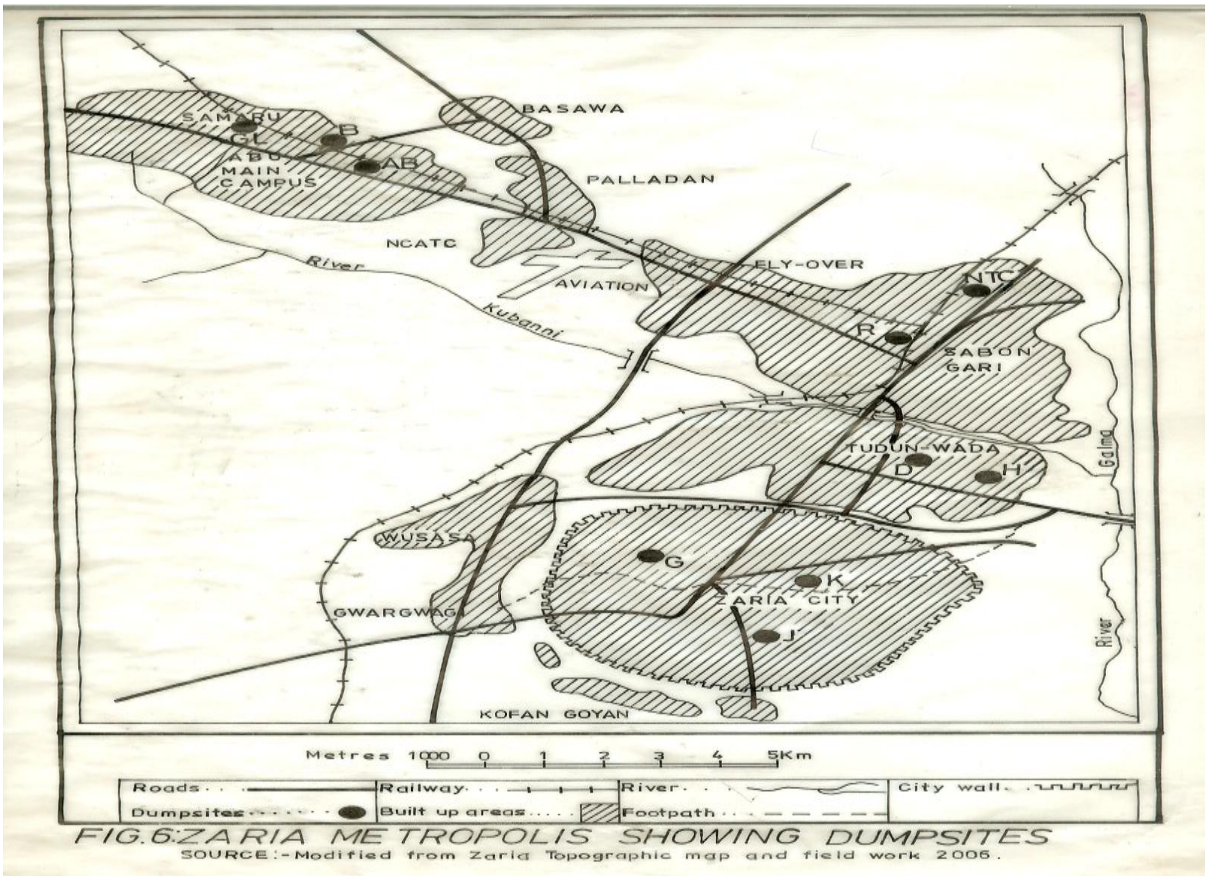

Figure 1: Map of Zaria Metropolis showing locations of the dumpsites

b. Electrical conductivity: 25 g of air dried soil sample was placed into a 250 ml beaker. Distilled water was added slowly drop by drop uniformly over the entire soil surface until the soil appears to have been wetted. A stainless steel spatula was used to form a homogeneous soil saturated paste. The beaker was then covered with a petri-dish. 50ml distilled water was added and shaken for 1hour. 40ml of the diluted extract was placed into 100ml beaker and the conductivity meter was inserted and the electrical conductivity of the soil recorded in $uScm^{-1}$.

c. **Colour:** Refuse waste soil sample were compared to colour standards and suitably graded.

d. **Organic Carbon:** The organic carbon content of the soils were determined by wet oxidation of Walkley and Black in which organic carbon is oxidized by $K_2Cr_2O_7$ in the presence of sulphuric acid (H_2SO_4) according to the following reaction (Todoroui *et al*., 2001):

$$2K_2Cr_2O_7 + 8H_2SO_4 \longrightarrow 2Cr_2(SO_4)_3 + 8H_2O + 3O_2$$

$$3C + 3O_2 \longrightarrow 3CO_2$$

The soil samples were sieved using 0.5mm sieve often which, they were weighed in duplicate and transferred to a 250 ml Erlenmeyer Flash. Exactly 10 ml of 1m potassium heptaoxodichromate (VI) ($K_2Cr_2O_7$) was pipetted into each flash and swirled gently to dispose the soil followed by adding 20 ml concentrated sulphuric acid. The flask was swirled gently until soil and reagents were thoroughly mixed. The mixture was thus allowed to stand for 30 minutes on a glass plate. 100ml of distilled water was added followed by addition of 3-4 drops of ferrois indicator, after which it was titrated with 0.5m, ferrous sulphate solution. A blank titration was similarly carried out. The percentage organic caution is given by the equation(Todoroui *et al*., 2001):

$$\%\text{organic carbon} = \frac{(M_eK_2Cr_2O_7 - M_e\,Fe\,SO_4) \times 1.331 \times 100 \times F}{\text{Mass (s) of soil level}}$$

F = Correction factor

M_{eq} = Molarity of solution transferred multiplied by volume in ml of solution used.

% organic matter in the soil = % organic carbon X 1.729.

e**. Cation exchange capacity (CEC):** 10 g of soil sample was weighed into 100 ml plastic beaker. 40 ml of 1.0 $moldm^3$ ammonium acetate solution (pH 7) was added and the suspension stirred with glass rod and left overnight. It was the suction-filtered with 55 mm Buchner funnel. The residue from filtration was leached with four 25ml portions of 1 $moldm^3$ NH_4Cl solution (pH 7). The solution was discarded and the electrolyte washed out of the sample with 150 ml ethanol. The sample was allowed to drain completely and leached gradually with acidified NaCl to 250 ml. 50 ml of 2% boric acid was measured into 250 ml comical flash and 3 drops of mixed indicator were added.

The acidified NaCl leachate was poured into 500 ml Kjeldahl flask and 10 ml of 1.0 moldm^{3} NaOH and anti-bumping granules were added. The leachate was distillated over the boric. 1.5 ml of ammonium borate distillate was titrated with standard 0.1 moldm^{3} HCl and the CEC determined as follows (Todoroui *et al*., 2001):

$$\text{CEC (C mol kg}^{1}) = \frac{\text{(Titre – Blank) x M x 100}}{\text{Weight of sample}}$$

f. **Moisture content:** 1g of sieved soil sample was weight into dry crucible. The crucible was then placed in an air circulated oven at 105^{o}C and dried to constant weight (for 6 hours). The sample was cooled in a desicator and re-weighed. The percentage air dried moisture from the loss weight was then determined as fellows **(**Nounamo *et al*., 2000):

$$\text{\% moisture content} = \frac{\text{Loss in weight x 100}}{\text{Initial weight}}$$

RESULTS AND DISCUSSION

The pH value in the dumpsites soil ranged from 7.8 to 9.2 (Fig. 2). This implies that all the soils studied were found to be alkaline in nature. The highest pH value was recorded in G-dumpsite soil, while the least value was recorded at H-dumpsite. The control site was found to have a pH value of 7.16 as can be seen in Fig. 3. The conductivities recorded in the study areas ranged from 4.2 X 10^{-2} to 4 x 10^{5} µScm^{-1} with the highest value obtained at B-dumpsite. This might be attributed to the high metallic contents recorded after characterizing the dumpsites. The least conductivity value was recorded at D-dumpsite.

Fig. 4 is a representation of the moisture content of the study areas. From the figure, it can be seen that the moisture content at the 10 dumpsites were found to range from 17.81 to 82.49%. J-dumpsite had the highest value while G-dumpsite had the least value. A value of 15.33% for the moisture content was recorded at the control site. The highest moisture content obtained at J-dumpsite might be attributed to the aging of the dumpsite. The results obtained in this study showed positive correlation between electrical conductivity and soil moisture content.

Fig. 5 displays the organic matter content recorded at the 10 dumpsites that range from 3.2 to 5.3%. From this figure, it can be seen that B-dumpsite soil had the highest value, while NTC-dumpsite soil had the least organic matter content. The highest value recorded at B-dumpsite might be attributed to the aging of the dumpsite. It was also found that the older the dumpsite, the higher the rate of decomposition of its constituents comprising the waste soil.

In Fig. 6, the cation exchange capacity (CEC) of the study areas is displayed. CEC values of the dumpsites studied ranged from 132.83(R) to 469.54 (G) Cmolkg^{-1}. The highest conductivity value of G-dumpsite may be attributed to high electrical conductivity value recorded at this site and also the presence of high metallic content. The control site had a value of 95.20 Cmolkg^{-1}. The high CEC's at the dumpsites could also be attributed to the decomposition of the refuse wastes which yield more of the exchangeable bases thereby raising its fertility status. Pearson correlation coefficient shows high positive correlation between the CEC and the analyzed metals. The findings of this study were found to agree with the results obtained by some workers. For example,

Bamgbose and co-workers (Bamgbose *et al*., 2005), reported that the pH of the waste soils at Ita-Osun and Ibereuodo dumpsites in Imo State (Nigeria) ranged from 7.44 to 10.10. They have also reported that the organic matter content of the contaminated site ranged from 5.79 to 7.59% (Bamgbose *et al*., 2005)

. Moisture content, according to Veihmeyer and Hendrickson, signifies the upper level of water available to plants in the soil Veinhmeyer *et al*., 1931). Similar observation was made by Rhoades and his co-workers (Rhoades *et al*., 1989).

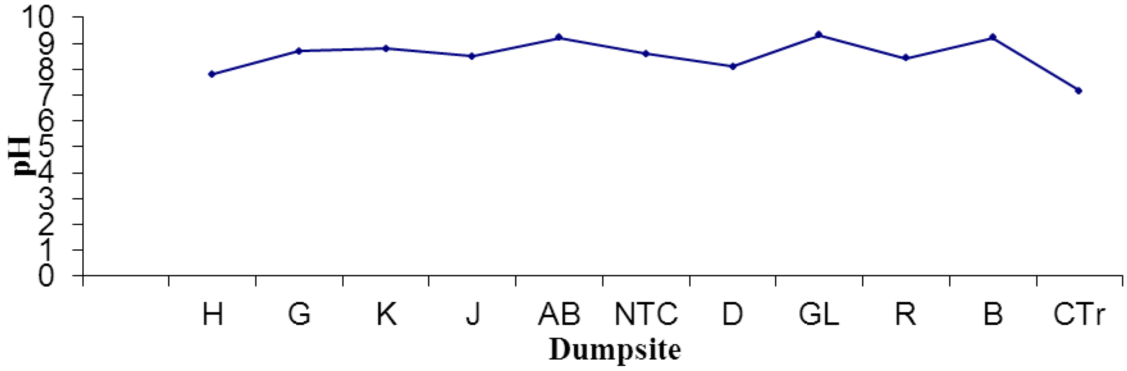

Fig. 2: pH values of some dumpsite soils used as manure in Zaria Metropolis

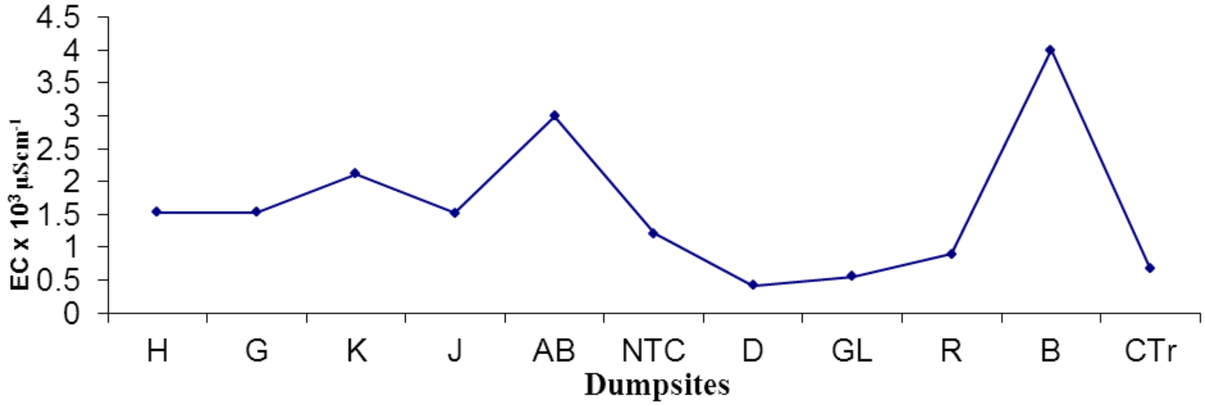

Fig. 3: Electrical conductivities of some dumpsite soils used as manure in Zaria Metropolis

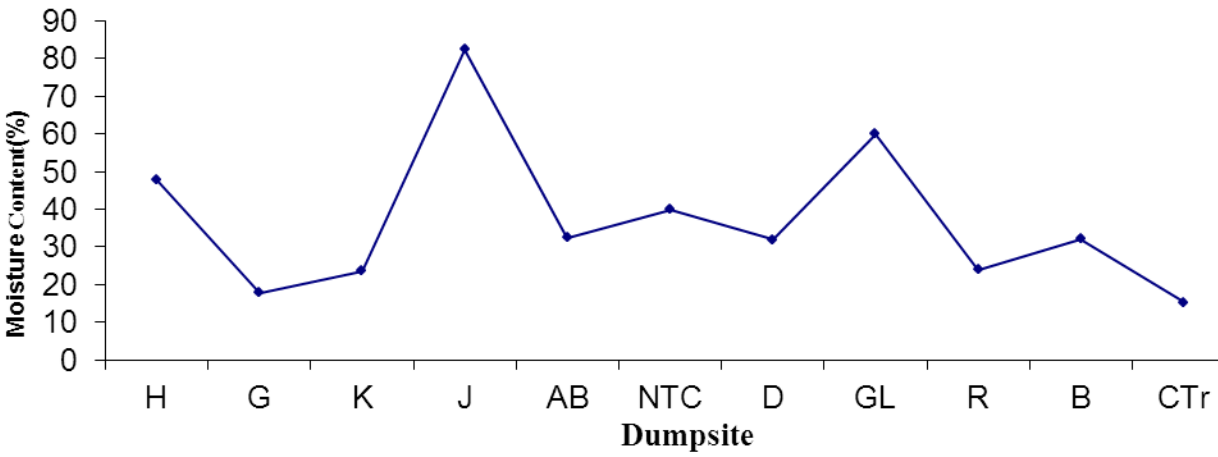

Fig. 4: Moisture contents of some dumpsites soils used as manure sin zaria Metropolis

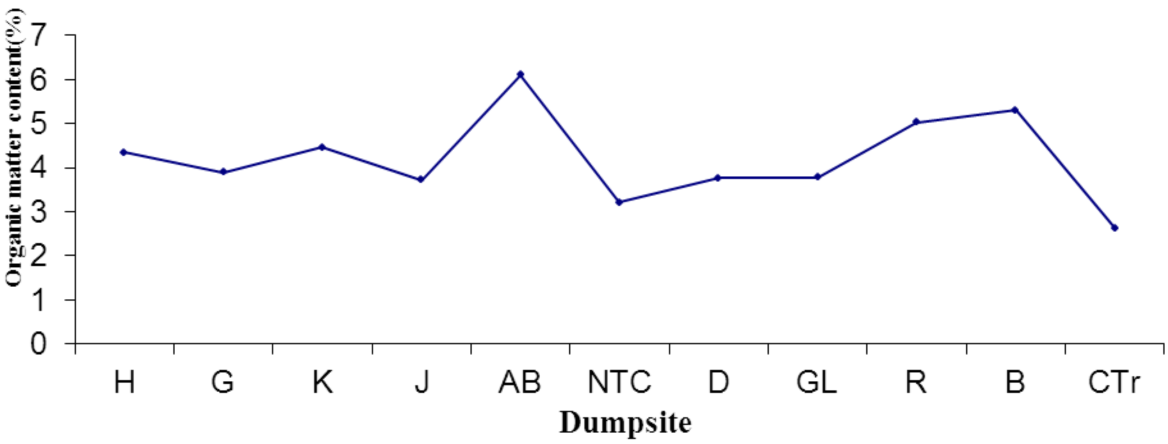

Fig. 5: Organic matter content of some dumpsite soils used as manure Zaria Metropolis

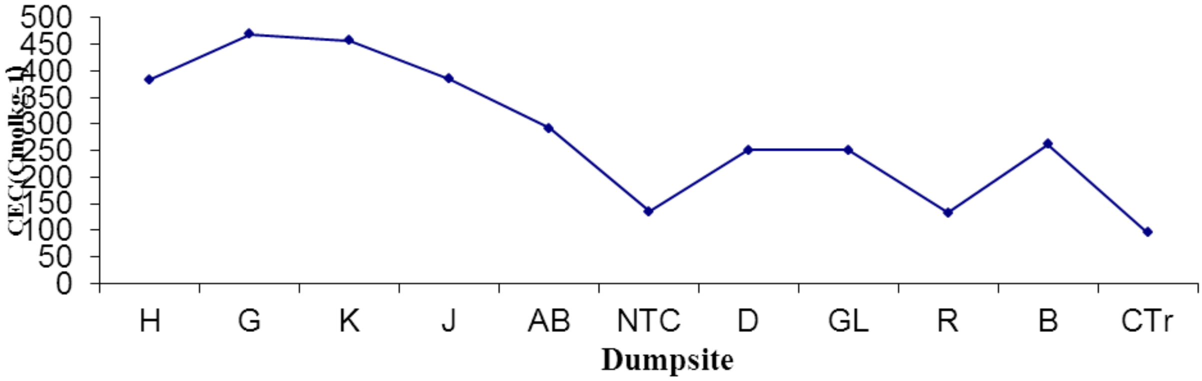

Fig. 6: Cation exchange capacity of some dumpsites used as manure in zaria Metropolis

CONCLUSION

All the parameters studied had shown higher mean values in the dumpsites than in the control site. Significance difference (P<0.05) in pH, organic matter, CEC from both the study areas and the control site were found.

The high CEC's of the dumpsites could be attributed to the decomposition of the wastes which yield more of the exchangeable bases thereby raising its fertility status. High moisture content signifies that the water available to the plants in the soils is also high. High organic matter content indicates humans-rich soil. This implies that all the soils studied were highly fertile. However, when the waste soils are used as manure, there is fear of heavy metals accumulation.

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