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Physicochemical Characteristics and Heavy Metals Concentration in Sub Surface Soil at Different Dumpsites in Rufus Giwa Polytechnic, Owo, Ondo State, Nigeria

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Abstract: The physiochemical characteristics and heavy metal concentrations in sub-surface soil at five different dumpsites in Rufus Giwa Polytechnic, Owo, Ondo State, Nigeria were investigated with a view to ascertain the level of pollution. Standard analytical methods for soil analysis were used for the physicochemical parameters while atomic absorption spectrophotometer (AAS) was used for the heavy metals analysis. The result showed that the pH value in soil sample from these sites ranged between 6.20±0.20-7.82±0.05. Percentage organic carbon and organic matter were in the range of 1.00±0.02-1.93±0.01 and 1.69±0.01-3.27±0.02 respectively. Heavy metal concentration for Pb and Zn were ranged between 0.21±0.01-0.46±0.01 mg kg^{-1} and 0.50±0.02-7.25±0.03 mg kg^{-1}. Cadmium was not detected from all the sites including the control. Cr concentration ranged between 1.22±0.02-2.03±0.06 while Fe concentration ranged between 294.60±0.20-408.47±0.23 mg kg^{-1}. Nickel concentration ranged between 0.01±0.01-0.02±0.01 mg kg^{-1}. The results showed that concentrations of heavy metals and physicochemical parameters of soil samples from dumpsites location at Rufus Giwa Polytechnic, Owo, were within limits of Department of Petroleum Resources (DPR) and Food and Agriculture Organisation (FAO) standards.

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1. Introduction

Dumpsite is where waste materials are disposed and is the oldest form of waste treatment. Historically, dumpsites have been the most common method of un-organized waste disposal and remain so in many places around the world. Most dumpsites are located within the environment of living communities (Abdus-Salam et al., 2011). The dumpsites are often not lined nor basement prepared for selective adsorption of toxic substances. Therefore it is prone to release pollutants to nearby water and to the air through leachates and dumpsite gases respectively. Industrialization, population growth and un-planned urbanisation have partially or totally turned the environment to dumping sites for waste materials which is unhealthy (Alimba et al., 2006; Ikem et al., 2002). Many water resources have been rendered unsafe and hazardous to man and other living systems as a result of indiscriminate dumping of refuse (Bakare et al., 2005).

Dangers pose by leachates from municipal dumpsites depends on the waste composition, volume, life time, temperature, moisture, availability of oxygen, soil morphology, and the relative distance of the sites to nearby living community and water body (Longe and Balogun, 2010; Ogundiran and Afolabi, 2008; Slake et al., 2005).

Considering various aspects human health is closely linked to the soil quality and especially to its scale of pollution (Romic and Romic, 2003, Li et al., 2001; Bityukova et al., 2000). Soil can be considered a sink, but also a pollution source with the ability to transfer pollutants, present in it, to the underground water, food chain and ultimately human body (Birke and Rauch, 2000; Paterson et al., 1996; Burghardt, 1994). Soil, particularly in urban and industrial areas, influences both the quality of life and the health of the people living in such an environment (Van-Kamp et al., 2003; Kimble et al., 1999; Burghardt, 1994).

The general belief that wastes are sometimes hazardous to health cannot be overemphasized.

Hazardous waste has caused pollution, damage to health and even death to living systems. Exposure to multiple chemical combinations in inhabitants near waste dumpsites has led to series of diseases and health disorders (Palmer et al., 2005; Vrijheid, 2000). It has been reported that heavy metals and anions in dumpsites leachates can cause chromosomal disorder and inhabitants in the vicinity of landfill sites are prone to mutagenic effects (Alimba et al., 2006). The level of contamination arising from percolation of leachates is determined by a number of factors that include the physico-chemical properties of the leachates and soil and the hydrological condition of the surrounding site.

The environmental challenges posed by soil waste ranges from health hazards, soil and water pollution, repulsive sight, offensive odour and occupancy to increase in ambient temperature levels. These experiences are as a result of lack or poor waste management systems. The resultant of these is the degradation of our environmental quality. In Nigeria, it is generally believed that individuals, government and environmental agencies pay little or no attention to the environmental impact of the waste disposal and management, even when it is a statutory responsibility of the parties concerned. Agencies like the Federal Environmental Protection Agency (FEPA), Ministry of Environment, Department of Petroleum Resources (DPR) and even local authorities are responsible for planning a defined line of action for the disposal and management of wastes generated on daily basis, both domestic and industrial wastes.

Figure 1: Map of the sampling locations

Figure 2: A typical dumpsite

Determining the potency of the wastes and some pollutants effects on soil through soil analysis will go a long way to provide useful information needed for the development of techniques for tackling the problem of soil pollutants and the effect of solid wastes on the environment. The focus of this study is aimed at determining the physicochemical characteristics and heavy metal concentrations of soils at different dumpsites in Rufus Giwa Polytechnic (RUGIPO), Owo, Ondo State Nigeria in order to ascertain the extent of pollution in the institution's premises. RUGIPO is a tertiary institution in Ondo State, Nigeria training students in the sciences, business studies and engineering.

2. Materials and Methods

2.1 Sampling and sampling sites

Three sub soil samples each were collected from five different dumpsites (A-E) at Rufus Giwa Polytechnic, Owo, Ondo State, Nigeria. Equal proportions of homogenised soil samples taken from specific dumpsite were weighed to represent soil sample from each dumpsite. Dumpsite at the back of the health centre (A), back of Banking and Finance Department (B), back of Information Communication Technology ICT (C), back of the School Library (D), back of Marketing Department (E) while soil sample from the Bursary area (undisturbed location) was the control. Three soil samples were collected from each dumpsite using standard procedure described by Udosen et al., (1990) with the aid of a graduated soil auger into polyethylene bags, at depth of 15-30cm below the earth surface. The samples were taken to the laboratory; air-dried and sieved using a 2mm sieve. The sampling sites description is given in Table 1. Satellite acquiring equipment GPSmap 76CSx model was used for coordinates.

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2.2. Soil sampling extraction

Aqua-regia was used for the soil digestion as described by Tessier et al., (1979). Aqua-regia is a mixture of nitric acid (HNO_3) and hydrochloric (HCl) acid in the ratio of 1:3. One gram of soil sample previously air-dried, cleaned, gently crushed using an agate mortar and pestle and sieved through a standard sieve of 2 mm mesh size was weighed and digested with aqua-regia. The mixture was heated slowly in a fume-hood at a temperature between 50-60^{o}C for 30 minutes. The resulting mixture was filtered into a cleaned plastic container using Watman filter paper and make up to 50mL with double-distilled water.

The digested products were stored in a plastic vials prior to metals analysis. Metal analysis was carried out using atomic absorption spectrometer (AAS) equipment bulk scientific model 210 VGP. The pH of the supernatant solution of mixture of soil samples in distilled water (ratio of 1: 2 w/v) was measured by digital pH meter Jenway 3505 model. The soil organic matter was determined by Walkley Black method (Walkley and Black, 1934). The moisture content was determined using a standard procedure described by Shrivastava and Benerjee (2004). Calcium and magnesium were determined using EDTA titrimetric method (Cheng and Bray, 1951).

2.2 Statistical Analysis

All data obtained were determined in triplicate and they were subjected to Statistical Analysis of Variance (ANOVA) at 5% significant level using SPSS version 16.00 and the means were separated using the Duncan Multiple Range Test (Daniel, 2003).

3. Results and Discussion

The physicochemical characteristics of soil samples at five different dumpsites and undumpsite (control) in Rufus Giwa Polytechnic, Owo, Ondo State, Nigeria is presented as in Table 1 while Table 2 depicts some FAO standards on classification of soil macro and micro nutrients. Table 2 is imported in order to properly discuss the result in table 1. The mean values for pH in all the five dumpsites ranged between 6.20±0.20-7.82±0.05 as against pH value of 6.57±0.02 for the undumpsite (control).This was as a result of various wastes deposited at these dumpsites. Significant differences in the pH values of dumpsites including A, D, E, However, there was no significant difference in pH of dumpsites B and C. Soil pH is an important soil property having great influence on solute concentration and sorption/desorption of contaminants in soil particles (Oguntimehin et al., 2005; Kadem et al., 2004). The highest pH value 7.82±0.05 was obtained from soil sample at site E (back of the Marketing Department) while the least was 6.20±0.02 from site A (back of the Health Centre). The pH values obtained were within 5.70-8.90 reported by Parth et al., (2011) for soil around hazardous waste disposal site in India and 5.79-8.55 reported by Oguntimehin and Ipinmoroti, (2008) from soil at different Automobile workshops in Akure, Ondo State, Nigeria. According to the classification of soil macro and micro nutrients (FAO, 1990), the pH of soil samples at dumpsites A and the undumpsite (control) fell into the class of medium (6-7) while dumpsites B, C, D and E fell into the high class (>7) (FAO, 1990).

The percentage organic carbon (%) ranged between 1.00±0.02-1.93±0.01%. The highest value was from site C (1.93±0.01%) while the least was from site A (1.00±0.02%), whereas percentage organic carbon of the undumpsite (control) was 0.91±0.01%. There was no significant difference in percentage organic carbon in dumpsites C, D and E. The percentage organic matter ranged between1.69±0.01-3.35±0.02%. The highest value was from site C while the least value was from site A.

Table 1: Physicochemical characteristics of soil samples from five different dump sites and the un-dumpsite (control sample) in Rufus Giwa Polytechnic, Owo, Ondo State, Nigeria.

Parameter	A	B	C	D	E	CONTROL
pH	6.20±0.20^{e}	7.61±0.09^{c}	7.62±0.02^{c}	7.72±0.02^{b}	7.82±0.05^{a}	6.57±0.02^{d}
% Organic carbon	1.00±0.02^{c}	1.04±0.02^{b}	1.93±0.03^{a}	1.92±0.03^{a}	1.93±0.01^{a}	0.91±0.01^{d}
% Organic matter	1.69±0.01^{e}	1.82±0.02^{d}	3.35±0.02^{a}	3.27±0.02^{c}	3.30±0.01^{b}	1.65±0.01^{f}
N%	0.11±0.01^{d}	0.13±0.01^{c}	0.26±0.01^{a}	0.25±0.01^{a}	0.25±0.01^{a}	0.21±0.01^{b}
P (mg kg^{-1})	17.10±0.10^{d}	12.11±0.01^{e}	44.13±0.03^{a}	38.35±0.02^{b}	26.81±0.01^{c}	4.73±0.03^{f}
K^{+}(cmol kg^{-1})	0.08±0.01^{b}	0.56±0.01^{a}	0.53±0.05^{a}	0.41±0.01^{ab}	0.32±0.02^{ab}	0.09±0.01^{ab}
Na^{+}(cmol kg^{-1})	0.06±0.01^{e}	0.11±0.01^{d}	0.49±0.01^{a}	0.42±0.01^{b}	0.32±0.02^{c}	0.08±0.01^{d}
Ca^{2+}(cmol kg^{-1})	1.32±0.03^{e}	1.01±0.01^{f}	4.70±0.03^{a}	3.12±0.03^{b}	2.00±0.11^{c}	1.63±0.03^{d}
Mg^{2+}(cmol kg^{-1})	0.87±0.11^{d}	0.71±0.01^{e}	3.25±0.05^{a}	2.11±0.01^{b}	1.01±0.01^{c}	0.52±0.03^{f}

Values are mean ± Standard deviation from triplicate determinations. Values with different superscript in a row are significantly different ($p<0.05$).

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Table 2:Some FAO Standards on Classification of Soil Macro and Micro Nutrients

Soil Characteristics	Low	Medium	High
pH	<6	6 – 7	>7
Cation Exchange Capacity (CEC) (cmol kg^{-1})	<8	8 – 15	>15
Base Saturation (%)	<50	50	>50
Exchangeable K (cmol kg^{-1})	<0.15	0.15 – 0.4	>0.4
Organic Matter (%)	1.5	1.5 – 3	>3
Total Nitrogen (%)	0.08	0.08 – 0.15	>0.15
Total Phosphorus (mg kg^{-1})	7	7 – 20	>20
Fe (mg kg^{-1})	23	90	360

Source: FAO (1990)

The undumpsite has organic matter of 1.65 ± 0.01% and there was significant difference in the percentage organic matter from all the sites analysed. This might be due to the closeness of this site to student hostels. The results obtained for percentage organic carbon and organic matter were higher than 0.028-0.409% and 0.048-0.707% respectively reported by Abdul-Salam et al., (2011) for dumpsites in Lokoja, Nigeria. The difference in these values might be as a result of the level of microbial activity, the percentage of organic refuse and the relative age of the dumpsites (Abdul-Salam et al., 2011).

The percentage organic matter of soil at dumpsites A, B and undumpsite (control) fell into the medium class (1.50-3.00%) while dumpsites C, D and E fell into the high class(>3) (FAO, 1990). Organic matter provides nutrition to living organisms. Organic matter acts as a buffer aqueous solution to maintain a neutral pH. One of the advantages of organic matter is that it is able to withhold water and nutrients, therefore giving plants the capacity for growth. Another advantage of humus is that it helps the soil to stick together which allows nematodes, or microscopic bacteria, to easily decay the nutrients in the soil (Craine et al., 2010; Sollins et al., 2007).

The percentage nitrogen was between 0.11±0.01-0.26±0.01%. The highest value was from site C while the least was from site A. This might be as a result of the type of waste associated within the dumpsite. The nitrogen content of control was 0.21±0.01%. The percentage nitrogen of dumpsite B and E with that of the control were significantly different at $p \leq 0.05$. This result was similar to 0.12-0.21% reported by Akinbile, (2012) for percentage N of soil samples within a landfill site at Akure, Nigeria. The percentage nitrogen of soil at dumpsites A and B fell into the low class, while soil at dumpsites C, D, E and undump site fell into the high class (>0.15) (FAO, 1990).

The highest value for phosphorus was 44.13±0.03 mg kg^{-1} from site C while the least value was12.11±0.01 mg kg^{-1} from site B, although that of the control site was 4.73±0.03 mg kg^{-1}. There was significant difference in the concentration of phosphorous from all the dumpsites including the control. This result was in-line with 11.36-33.52 mg kg^{-1} reported by Akinbile, (2012). The total phosphorous concentration at dumpsites A and B fell into the medium class (7-20 mg kg^{-1}). Soil samples from dumpsites C, D and E fell into the high class (>20 mg kg^{-1}) except for the control that fell into the low class according to FAO (1990). According to Bennett et al., (2001), phosphorus-rich soils are washed into lakes, where some of the phosphorus dissolves and stimulates growth of phytoplankton and aquatic plants.

Table 3: Heavy metal concentration of the soil samples from five different dumpsites and undumpsite (control) in Rufus Giwa Polytechnic, Owo, Ondo State, Nigeria.

Heavy Metals (mg kg^{-1})	**A**	**B**	**C**	**D**	**E**	**CONTROL**
Pb	0.36±0.01 c	0.41±0.01 b	0.21±0.01 e	0.29±0.01 d	0.46±0.01 a	0.18±0.02 f
Zn	0.54±0.01 e	0.50±0.02 f	6.20±0.01 b	4.63±0.01 c	7.52±0.03 a	3.61±0.01 d
Cd	BDL	BDL	BDL	BDL	BDL	BDL
Cr	1.29±0.01 d	2.03±0.06 a	1.79±0.01 b	1.51±0.01 c	1.22±0.02 e	0.63±0.01 f
Fe	294.60±0.20 f	329.73±0.30 c	408.47±0.23 a	348.13±0.06 b	310.53±0.40 d	302.20±0.20 e
Ni	BDL	0.02±0.01 a	0.01±0.01 a	0.01±0.01 a	BDL	BDL

Values are mean ± Standard deviation from triplicate determinations. Values with different superscript in a row are significantly different ($p<0.05$).

The concentration of potassium (K) was highest at dumpsite B (0.56 ± 0.01 cmol kg^{-1}) and least at dumpsite A (0.08 ± 0.01 cmol kg^{-1}) while the control was (0.09 ± 0.01 cmol kg^{-1}). There was no significant difference in the potassium concentration from dumpsites D, E and the control; and also there was no significant difference between the dumpsites B and C (0.56 ± 0.01 and 0.53 ± 0.01 cmol kg^{-1}).The obtained values for K were lower than 0.92-1.21 cmol kg^{-1} reported by Akinbile (2012).

There was significant difference in the sodium concentration for all the dumpsites and the undumpsite (control). The highest value of sodium concentration was in dumpsite C (0.49 ± 0.01 cmol kg^{-1}) while the lowest value was from dumpsite A (0.06±0.01 cmol kg^{-1}). The sodium ion concentration of the undumped site was 0.08 ±0.01 cmol kg^{-1}. The sodium concentration value for both dump and undumped sites at Rufus Giwa Polytechnic, Owo, were lower than 0.65-1.02 cmol kg^{-1} reported by Akingbile, (2012).

There was significant difference in Ca^{2+}concentration of all the dumpsites. The highest value of Ca^{2+} was from dumpsite C (4.70 ± 0.03 cmol kg^{-1}) while the least value was from dumpsite B0.01±0.01 cmol kg^{-1} and the control was 1.63±0.03 cmol kg^{-1}. Ca^{2+}concentration for dumpsite A, D and E were 1.32 ±0.03, 3.12 ±0.03 and 2.00 ± 0.11 cmol kg^{-1} respectively. Akinbile (2012) reported higher Ca^{2+} concentration (10.27-11.77 cmol kg^{-1} for soils at a landfill in Nigeria

Magnesium concentration differs significantly at all the dumpsites at $p < 0.05$. The dumpsite with the highest Mg^{2+} concentration was dumpsite C (3.25±0.05 cmol kg^{-1}) and the least was from dumpsite B (0.71±0.01 cmol kg^{-1}) while the un-dumpsite was 0.52±0.03 cmol kg^{-1}. There was higher Mg^{2+} concentration in dumpsites than undumpsite of Rufus Giwa Polytechnic, Owo. However, the magnesium concentration in Rufus Giwa Polytechnic, Owo was lower than 4.97-6.23 cmol kg^{-1} reported by Akinbile (2012) for land fill soils in Nigeria. Magnesium is the central core of the chlorophyll molecule in plant tissues. Thus, if Mg is deficient in soil, the shortage of chlorophyll results in poor and stunted growth of plants. Magnesium also helps to activate specific enzyme systems. Magnesium is abundant in the earth's crust and is found in many forms (Rahim et al., 2011).

Table 3 represents heavy metal concentration of soil samples from five different dumpsites and undump site (control) in Rufus Giwa Polytechnic, Owo while Table 4 shows the maximum allowable limits (MAL) of heavy metals from seven different countries- Austria, Canada, Poland, Japan G. Britain, Germany and Nigeria (DPR, 2002; Kabata-Pendias, 1995). Table 4 was imported to enhance the discussion of Table 3.

The concentration of lead (Pb) in the soil ranged between 0.21±0.01-0.46±0.01 mg kg^{-1}. Dumpsite C has the lowest Pb concentration while dumpsite E has the highest Pb concentration. There was significant difference in the concentration of Pb from all the dumpsites. The concentrations of Pb in all the dumpsites were higher than the undumped(control). The concentration of Pb values in the dumpsites of Rufus Giwa Polytechnic, Owo, was far lower than 24.70-54.20 mg kg^{-1} reported by Akinbile, (2012) for land fill site at Akure, Nigeria, Parth et al., (2011) also reported 42.90-1833.50 mg kg^{-1} Pb in soil waste disposal sites in Hyderbab city, India. The difference in Pb concentration might be due to the type and quantity of waste dumped, and the period of dumping of wastes in these sites. Lead poisoning can cause a number of adverse human health effects. It is particularly detrimental to the neurological development of children (Tokar et al., 2011; Jomova and Valko, 2011; Castro-González and Méndez-Armenta, 2008).

The concentration of Pb at the various dumpsite analysed were very low compared to the least on the table (85.0 mg kg^{-1}) for Nigeria and the highest was (500.0 mg kg^{-1}) for Germany while it was 100.0 mg kg^{-1} for Austria, Poland, and G. Britain. Maximum allowable limit of Pb in soil is 85.0 mg kg^{-1} for Nigeria, 100.0 mg kg^{-1} for Austria, Poland and G. Britain; and 500.0 mg kg^{-1} for Germany. The Pb concentration in Rufus Giwa Polytechnic, Owo is at a safe level.

Table 4: Maximum allowable limits (MAL) (mg kg^{-1}) for heavy metals in soil

Heavy Metals	Nigeria[a]	Austria[b]	Canada[b]	Poland[b]	Japan[b]	G. Britain[b]	Germany[b]
Cd	0.8	5	8	3	-	3	2
Cr	100	100	75	100	-	50	200
Ni	35	100	100	100	100	50	100
Pb	85	100	200	100	400	100	500
Zn	140	300	400	300	250	300	300

Source: [a]DPR, (2002); [b]Kabata-Pendias (1995)

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Zinc concentration was highest in dumpsite E (7.52±0.03 mg kg^{-1}) and lowest in dumpsite A (0.54±0.01 mg kg^{-1}). There was significant difference at $p<0.05$ of all the dumpsites and undumpsite. Zinc concentration of the control sample was 3.61±0.01 mg kg^{-1} and this was higher than the value obtained for dumpsites A and B which were0.54±0.01 mg kg^{-1} and 0.50±0.02 mg kg^{-1} respectively. The range of values obtained for zinc (Zn) in dumpsites A and B was very similar to the values (0.583-1.351 mg kg^{-1}) reported by Agber et al., 2003 for soil sample close to municipal refuse dumpsites in Markudi, Nigeria. High concentrations of Zn have adverse effects on crops, livestock and human (Kiekens, 1995).

It is clearly noticed that Zn concentration in all the dumpsites and undump site was much lower than maximum allowable limits of soils in Nigeria (140 mg kg^{-1}), Austria (300 mg kg^{-1}), Canada (400 mg kg^{-1}), Poland (300 mg kg^{-1}), Japan (250 mg kg^{-1}) and G. Britain (300 mg kg^{-1}) (DPR, 2002; Kabata-Pendias, 1995).

The concentration of cadmium (Cd) was below detection limit for the soil samples from all the dumpsites analysed including the undumpsite (control).Cadmium was not detected in all the dumpsites including the undumpsite (control). This was in agreement with the earlier reports (Azeez et al., 2013; Olarinoye et al., 2009). Contrary to our findings Omtunde et al., (2011) reported that the detection of Cd in some dumpsites in Lagos State, Nigeria. Nigeria is having the lowest Cd MAL of 0.80 mg kg^{-1} while the highest is 8.00 mg kg^{-1} for Canada. Germany is 2.0 mg kg^{-1}, G. Britain and Poland was 3.00 mg kg^{-1} while Austria is 5.00 mg kg^{-1}.

The concentration of chromium (Cr) in the dumpsite ranged between 1.22±0.01-2.03±0.06 mg kg^{-1}. The highest was from site B while the least was from site E. The Cr concentration in the un-dumpsite (control) was 0.63±0.01 mg kg^{-1}. There was significant difference ($p<0.05$) in Cr concentration in all the dumpsites. However, higher values of Cr concentration (131-249 mg kg^{-1}) was obtained (Adie and Osibanjo, 2009) from soil pollution by slag from an automobile battery manufacturing plant in Nigeria and this was very high due to the nature of the activities of the facility. Anthropogenic input of Cr comes from solid wastes, where approximately 30% of Cr originates from plastics packaging materials and lead-chromium batteries (Jung et al., 2006). Chromium and it's compounds are widely used in tanneries and processing of refractory steel, catalytic manufacture and electroplating cleaning agents. Sites near these industries and where their products are used are bound to have high concentration of Cr in their soils (Shanker et al., 2005).

The maximum concentration of Cr was 2.03±0.06 mg kg^{-1} from dumpsite B and this value is far below the MAL of Cr for Nigeria (100.0 mk kg^{-1}), Poland and Austria was same (100.0 mg kg^{-1}), Canada (75.0 mg kg^{-1}), G. Britain (50.00 mg kg^{-1}) and Germany (200.0 mg kg^{-1}) (DPR, 2002; Kabata-Pendias, 1995).

The concentration of iron (Fe) ranged between 294.60±0.20-408.47±0.20 mg kg^{-1}. The highest concentration value was from the back of the information communication centre (C) while the least was from back of the health centre (A). The Fe concentration of the control was 302.2±0.2 mg kg^{-1}. There was significant difference ($p<0.05$) in the concentration of Fe in all the sites. The values of Fe concentration obtained in all the sites were higher than 55.211-90.351 mg kg^{-1} and 19.76-47.29 mg kg^{-1} reported by Azeez et al., (2011) and Olarinoye et al., (2009) respectively. Iron is a natural component of soils, but its concentration can be influenced by anthropogenic activities. Yang et al., (2001) reported that urban soils showed different heavy metal characteristics.

The highest concentration of nickel (Ni) was 0.02±0.01 mg kg^{-1} recorded at dumpsite B. Dumpsites C and D was 0.01±0.01 mg kg^{-1}. However, Ni was not detected in soil at dumpsites at the back of the health centre (A), back of the Marketing department (E) and the control site. There was no significant difference in Ni concentration of dumpsite B, C and D. The value of Ni was remarkably lower than 0.45-5.24 mg kg^{-1} and 21.00-52.00 mg kg^{-1} of Ni reported by Adie and Osinbanjo, (2009) and Olarinoye et al., (2009) respectively. The maximum allowable limit of Ni was 35.00 mg kg^{-1} for Nigeria and 100.00 mg kg^{-1} for Austria, Canada, Poland, Japan and Germany while it was 50.00 mg kg^{-1} for G. Britain (DPR, 2002; Kabata-Pendias, 1995). The concentration of Ni in Rufus Giwa Polytechnic, Owo was extremely insignificant to the maximum allowable limit.

4. Conclusion

There is clear evidence from the study that there is no heavy pollution in Rufus Giwa polytechnic, Owo since the DPR limits for heavy metals in soil were not exceeded. The soil within the Rufus Giwa polytechnic, Owo can be used for agricultural purposes. However, extensive efforts are required for adequate awareness and legislation on the handling of wastes to hinder wastes related problems in the society.. Moreover, acquisition of modern facilities and selection of appropriate waste disposal sites

based on level of toxicity are dire need of time to avoid indiscriminate dumping of wastes within the environment in order to forestall heavy metal pollution in the future within the school compound so that there will be no threat to human health as a result of environmental pollution.

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