ASSESSMENT OF SELECTED METALS IN SOIL FROM AUTOMOBILE WORKSHOP IN EKITI-NORTH SENATORIAL DISTRICT, EKITI STATE, NIGERIA.

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Abstract-*Anthropogenic actions have often been reported as the causes of increasing background concentration of heavy metal in soil. With the measurement of soil parameters, we can specifically judge the geo-accumulation and transmission tendencies of these metals into the human food chain. Investigating Soil sample collected from automechanic workshops in Ekiti North Senatorial District of Nigeria; the concentration of heavy metal in the soil as well estimating degree of contamination (DOC), pollution load index (PLI) and geo-accumulation index (Igeo) were determined. However in most of the study sites the variation in heavy metal concentration was Fe > Pb > Cu > Co except in DEK, TUN has the highest concentration of Fe, Pb, Cu (411.38mg/kg),74.80mg/kg,21.13mg/kg) respectively and Co is highest in YEE(13.89mg/kg).The DOC is highest in TUN(2.43), with (1.62, 1.67, 1.36, 2.13) reported for KLE, YEE, DEK and YEK respectively which are < 8, implying a low contamination. Also, 0.42 is reported in TUN as the highest value of PLI and (0.29, 0.30, 0.25 and 0.31) were reported for KLE,YEE,DEK and YEK respectively which are < 1 hence no pollution of the study site. The observed geo-accumulation index values for all the study location are negative illustrating that the concentrations of metals in the sites are still at background concentration. More generally, result shows a relative degree of safety, and for future purposes automechanic workshops should be located away from farmland and other food production centres.*

Keywords: Soil, Heavy metal, pollution, Background concentration, Ekiti North.

1.0 INTRODUCTION

Innovation and advancement in technology has trickled down to improving human mobility and transportation. Human transportation via automobile is chiefly the most used means of transportation within the human community. Like all other means human transportation, they tends to develop fault or becomes wore-out, hence, the need for servicing, maintenance and repair. To this end the services of auto-mechanics, welder, panel beaters, painters are often been engaged.

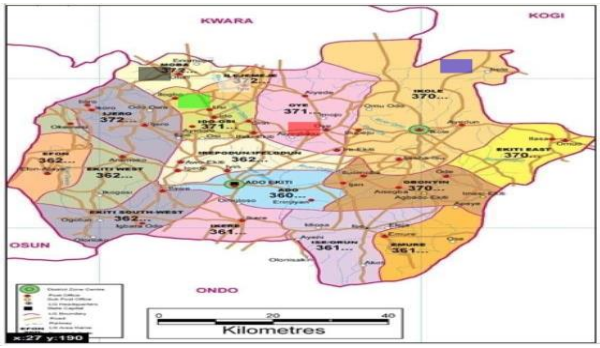
In the automechanic workshop, different maintenance operations are carried out in the workshop such as metal hammering, oil changing and refilling, painting, refilling and charging of battery electrolytes, discard of corroded parts, spent oil, lead acid discharged, peeling paints, metal scrapping Dolan *et al.,*(2006),Akbar *et al.,* (2006) etc. These processes directly involves dumping of metal waste on the soil which contributes to an elevated concentration of this metals in the soil around the auto-mechanic shop(Adelekan and Abegunde(2011);Ilemobayo and Kolade(2008).Like other forms of anthropogenic pollution, such increase in the concentration of metals above the background concentration can be controlled Aluko *et al.,* (2003).

Heavy metals are toxic Signh *et al.,* (2011) and could result to environmental and health maladies Vacha *et al.,*(2010), especially when become incorporate along the food chain. Their non-biodegradability makes them difficult to eliminate from nature, given that they tends to bioaccumlate and undergo rapid chemical reaction in nature (Speciation). Sieghardt *et al.,*(2005).Metals concentration from mechanic workshop soil becomes of significant interest to different researchers Orji *et al.,* (2018), Anegbe *et al.,* (2018), this is as a result of health risk associated with high concentration of metals as man get exposed via ingestion, inhalation, dermal contact Adelekan and Abegunde(2011) and through the food chain Weber *et al.,* (2004). This research work looks into concentration of metals in soil samples obtained from old and most frequently patronized automobile workshop in Ekiti North senatorial district of Ekiti State, Nigeria- looking to estimate the degree of contamination, pollution load index and geo-accumulation index to ascertain the level of heavy metal contamination in study sites

2.0 MATERIAL AND METHOD

2.1 Sample Collection

Soil samples were collected from old and frequently patronized auto-mechanic workshops from five local governments located in Ekiti-North senatorial district of Ekiti State, Nigeria.



The mechanic workshops put into consideration are old and highly frequented workshop in each of the local governments within the district. About 10-20g of soil samples were taken from each of the location by digging up to 0-15cm of the top soil layer, soil auger was used for collection of sample into well labeled plastic bag. Three samples were taken from each of these study sites.

2.2 SAMPLE DIGESTION

Digestion of the sample: 2g of each sample was accurately weighed into a washed and dried conical flask. 20ml of HNO_3/ $HClO_4$ was added to each sample and digested for 20minutes at about 70^{o}c.On completion; the samples were then brought out and allowed to cool. 5ml of deionized water was added to each sample and then transferred into volumetric flask. Afterward excess deionized water was added to make it up to 100ml mark. The digest was then carried-out in triplicate for metals (Co,Fe, Pb and Cu)determination using atomic absorption spectrophotometer (AAS) of model Buck SVG 210.

2.3 CONTAMINATION/POLLUTION INDEX

This is used to evaluate the level of pollution of a given sample matrix by comparing the ratio of concentration of metals in sample (soil) to the background concentration of the soil(Fe,Pb,Cu,Co) are (5000,85,36 and 20mg/kg) respectively as reported by (DPR (2002);((Fonge *et al.*, 2016). And the contamination factor is measured based on estimations into this four categories:

Contamination factor	Implications
<1	low contamination
1 < CF ≤ 3	moderate contamination
3 < CF ≤ 6	considerable contamination
>6	Highly contaminated

┼ DPR(2002);Sam et al(2015). It is expressed mathematically as;

$$CF = \frac{\text{concentration of metal in soil}}{\text{Background concentration}} \quad \ldots\ldots\ldots\ldots (1)$$

2.4 DEGREE OF CONTAMINATIONS

This is estimated to know the total pollution level in sites of study; it's evaluated by addition of contamination factor of all metals of interest.

Mathematically expressed as; DOC = $\sum$ n CF…… (2)

Where CF is the contamination factor of metal of interest. Also the degree of contamination is classified into four:

Degree of contamination	Implication
< 8	low degree of contamination
8-16	moderate degree of contamination
16-32	considerable degree of contamination
>32	high degree of contamination

Sam *et al.*,(2015)

2.5 THE POLLUTION LOAD INDEX (PLI)

Pollution load index (PLI) as is estimated as follows:

PLI = $(Cf1 \times Cf\,2 \times Cf3 \times \ldots\ Cfn)^{1/n}$……..(3)

Where, CF = contamination factor, n = number of metals.

The PLI value of > 1 is polluted, whereas < 1 indicates no pollution. (Harikumar *et al.*,2009***)***

2.6 GEO ACCUMULATION INDEX (Igeo)

This is used to estimate metal enrichment by comparing concentration of heavy metal in the soil sample as reported with that of the crust/control value. Bentum *et al.*, (2011),DRP (2002)

Mathematically expressed as; **Igeo**=Log_2Cn/ (1.5Bn)…… (4)

Igeo Value	Class	Soil Quality
≤ 0	**0**	Uncontaminated
0- 1	**1**	From Uncontaminated to moderately contaminated
1 – 2	**2**	Moderately contaminated
2 – 3	**3**	moderately contaminated
3 – 4	**4**	Strongly contaminated
4 – 5	**5**	extremely contaminated

3.0 RESULT AND DISCUSSION

3.1 RESULTS

Table 1: The result of metals concentration in mg/kg;

	METALS CONC Mg/Kg			
Samples	Fe	Pb	Co	Cu
KLE	295.05 (0.73)	65.53 (0.34)	7.63 (0.10)	14.77 (0.17)
YEE	347.88 (1.03)	54.21 (0.27)	13.89 (0.77)	9.70 (0.62)
DEK	273.96 (0.49)	44.68 (0.19)	8.59 (0.12)	12.53 (0.11)

TUN	411.38 (1.11)	74.80 (0.43)	8.16 (0.05)	21.13 (0.47)
YEK	268.73 (0.87)	68.91 (0.05)	6.92 (0.07)	18.32 (0.13)

┼Values in brackets are standard deviation of triplicate measurement.Ikole(KLE),Ido/osi(DEK),Moba(TUN),Ooye(YEE),Ilejemeje(YEK)

Table 2: Contamination/Pollution Index, Degree of Contamination and Pollution Load Index

Samples	Fe	Pb	Co	Cu	DOC	PLI
KLE	0.06	0.77	0.38	0.41	1.62	0.29
YEE	0.07	0.64	0.69	0.27	1.67	0.30
DEK	0.05	0.53	0.43	0.35	1.36	0.25
TUN	0.08	0.88	0.41	1.06	2.43	0.42
YEK	0.05	0.81	0.35	0.92	2.13	0.34

┼Ikole(KLE);Ido/osi(DEK);Moba(TUN);Ooye(YEE);Ilejemeje(YEK); DOC (Degree of Contamination), PLI (Pollution Load Index)

Table 3: **Geo Accumulation Index**

Samples	Fe	Pb	Co	Cu
KLE	-4.64	-0.97	-2.00	-1.89
YEE	-4.32	-1.22	-1.21	-2.47
DEK	-5.06	-1.51	-1.79	-2.12
TUN	-4.32	-0.76	-1.89	-0.49
YEK	-5.06	-0.89	-2.12	-0.71

┼Ikole(KLE); Ido/osi(DEK); Moba(TUN); Ooye(YEE); Ilejemeje(YEK)

3.2 DISCUSSION

3.2.1 HEAVY METAL:

Surface soil are better indicator of Metallic indicator Needleman (2004). The high concentration of Fe and Co could pose health risk such as metabolic acidosis, depression (Soghoian,2011). Although, Fe is essential in our diet, for physiological growth, metabolism, respiration and nitrogen fixation, however increase in concentration of Fe are mainly due to anthropogenic activities, which could result to inhibition of oxygen transportation to tissue from the lung, thus leading to hemochromatosis (pietrangelo 2010) which on long time exposure increase risk of colon cancer, liver problem etc(Fleming *et al.*, 2012). Cobalt is an integral part of Vitamin B_{12},complex at high concentration resulted to asthma, weight loss etc. Copper, is used in the manufacture of plugs and other engine component. Copper causes hyperactive and anti-social behavior at high concentration. Lead is toxic at low concentration as it result to decrease in intelligent quotient, mental and physical growth (Iwuegbe *et al*., 2006). Occupational exposure is the main cause of Lead poisoning which could lead to speaking & hearing problem, degeneration of nerve cell, fatigue and symptoms of irritability as it find it way to food chain (Iwuegbe *et al*., 2006).

In Ikole (KLE), the concentration of Fe, Pb, Co and Cu found in sample from Ikole LG are respectively 295.05mg/kg, 65.53mg/kg,7.63mg/kg and 14.77mg/kg. As shown in Table 1. For KLE, the concentration of Fe is observed to be the highest, while Co is the least which is well supported by the relative abundance of this two metals in the earth crust DPR (2002). A trend of decreasing metal concentration is observed with Fe>Pb> Cu >Co: This is similar to trend reported in variations in concentration of these metals by Ilemobayo and Kolade(2008) for similar study of 0-15cm depth in auto mechanic workshop in neighboring state (Oyemekun and Oke-Iju) in Akure, and Orji *et al.*, (2018) in Abuja, However value reported in KLE is lower compared to what was reported by these researchers. Fe reported in KLE is higher than as found in DEK (273.96) and YEK(268.73 mg/kg). This is as a result of amount of lubricants, spent oil (anonymous 1995) dumped directly to the soil which at higher concentration sure causes vomiting and depression. Pb and Cu is higher than sample from YEE and DEK, and as reported by Osakwe(2014) 1.1mg/kg, high concentration in Cu causes Anemia, gastrointestinal disorder (Soghoian 2011) and lead causes liver and kidney malfunctions (USEPA 1999).

In Ooye-Ekiti (YEE) a similar trend of decreasing metal concentration was observed only with a little switch in placement for Cu and Co Fe>Pb>Co>Cu were the result as shown in Table 1. High Value of Fe and Co reported in this site compared to other study site can be attributed to both lithological(Iron are naturally high in soil) and anthropogenic sources(Aluko et al,2003) such as welding, paneling of vehicles bodies, filling of metals, rusting etc while Co can be due to lechates of materials been used. Fe concentration for YEE has the 2nd highest concentration in this study, being higher than the concentration of Fe in sample from (KLE, DEK, YEK) but lower than 411.38mg/kg observed in TUN. YEE has the highest concentration of Co (13.89mg/kg) and as well the lowest concentration of Cu (9.70mg/kg).

In Ido/Osi Eiti (DEK), similar trend of Fe>Pb>Cu>Co was still observed in valued reported from DEK but of lower concentration compared to what is reported by Abidemi(2011) and Oguntimehin and Ipinmoroti(2008).Among the heavy metal in DEK, Iron has the highest concentration (273.96 mg/kg) and long term exposure above the concentration required by the red blood cell for transportation of oxygen has oftentimes be considered extremely detrimental to human health. (Nwachukwu *et al.*, 2011),(Lange 1999). However, the concentration of Pb(44.68mg/kg) was found to be lower in site DEK compared to other site of study this may be attributed to the age of the workshop, proper disposal of spent oil, lead accumulator battery discharges and fossil products containing lead as anti-knocking agents (Deborah (2017);Ilemobayo and Kolade(2008) compared

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to other sites.

For Moba (TUN), the decreasing trend of Fe>Pb>Cu>Co was observed and some of the metals examined were found to have a higher concentration compared to other sites studied. For instance, Fe (411.38mg/kg),Pb(74.80mg/kg),Cu(21.13mg/kg) had a high concentration, with only Co(8.16mg/kg) lower than 13.89mg/kg of Co in YEE. This result is justified by the age of the sampled workshop, as the concentration of heavy metals in Automobile workshop depends directly on its age, frequency of usage and level of exposure as TUN has the oldest, most patronized of all the five workshop been considered for this study.

In Ilejemeje (YEK), the decreasing trend of Fe>Pb>Cu>Co was observed. The site of consideration in Ilejemeje LG has the lowest concentration for Fe 268.73mg/kg and Co 6.92mg/kg.

3.2.2 C**ONTAMINATION/POLLUTIONINDEX**

In Table 2. Fe has the highest concentration as reported in each of the study sites, it however has the least contamination factor compared to other metal been analyzed, with the highest in TUN (0.08) and lowest in DEK(0.05).This is due to the fact that iron are relatively high in background concentration of soil sample/ natural soil Aluko(2003). The contamination factor(CF) of Fe reported in this study are similar to Orji *et al.,* (2018) but lower than as reported by Anegbe *et al.,*(2018) which implies low contamination of Fe in these sites hence no potency of causing environmental or health hazard as earlier discussed when been exposed at high concentration.

From Table 2. Pb show overall high value of CF, with TUN and YEK are 0.88 & 0.81 respectively and lowest in DEK(0.53) High level of Pb CF compared to other metal analyzed are as a result of lead accumulator battery discharges and fossil products containing lead as anti-knocking agents (Deborah 2017) informal recycling, charging of used lead acid batteries(Lo *et al.,* 2012 although CF of Pb reported in this study is similar to Orji *et al.,* (2018) but lower than as reported by Anegbe *et al.,* (2018). More generally, value reported in this study is less than 1 which implies low contamination. While for Co, the lowest CF in ILJ (0.35) and highest in YEE (0.69). Overall, the CF of Co in this study is less than 1 hence are low contamination. However, the CF of Co in this study from all the study sites is higher than Fe CF. Cu CF in TUN is higher than as reported in the other 4 sites of study (1.06) which is higher than 1 according to Table 2.This implies that soil sample from TUN are moderately contaminated compared to other study sites which are below 1.0 (low contamination) as only 0.92 reported in YEK is slightly closer to 1.CF of Cu in this study are relatively higher than as reported by Osakwe (2014) but lower than as reported by Anegbe *et al.,* (2018) and Orji *et al.,* (2018).

3.2.3 DEGREE OF CONTAMINATION AND POLLUTION LOAD INDEX

It was estimated from the study that TUN has the highest (DOC and PDI) and lowest in DEK such that (TUN > YEK> YEE > KLE > DEK). The highest value of DOC reported in this study (2.43) from TUN is less than 8.00 which implies low contamination and as well PLI from this study are less than 1 with the highest value reported (0.42) which implies that the study sites is not polluted. Furthermore, the values in this study are lower than those reported by Orji *et al.,*(2018) and Anegbe *et al.,* (2018).

3.2.4 GEO ACCUMULATION INDEX

A negative value from this study implies that there is no accumulation of heavy metal by the soil samples as it is still at the background concentration. This is similar to what is reported by Orji *et al.,* (2018) and lower than values reported by Anegbe *et al.,* (2018)

4.0 CONCLUSION/RECOMMENDATION

The results give us a strong indication that the different study sites are relatively safe. The concentration of metals reported in this study are still within the background concentration and relative to other pollution evaluated parameter such as; the pollution load index (PLI), Degree of contamination(DOC),Geo-acccumulation index(Igeo). Values recorded are also below the contamination level, which implies no pollution of the study sites. However, for future purposes automechanic workshops should be located away from farmland and other food production centres as metal have tendencies to find its way to food chain (bioaccumulation) which can lead to health maladies. In addition, regulations and law enforcement on improper waste disposal should be put in place and they should be enlightened about potential health risk associated with increases in metals concentration above the permissible level.

ACKNOWLEDGEMENT

We the author would like to thank Dr. W.B Tomori as well as the member of staff of the Department of Chemistry, Federal University of Technology, Akure, Ondo.

COMPETING INTEREST

The Authors declare no competing interest among each other.

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