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The Threat of Soil Pollution by Heavy Metals from Mechanic Workshops on the Ecosystem in Ibadan North Local Government, Oyo State, Nigeria

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Abstract

Pollution of soils by heavy metals from mechanic workshops, beyond acceptable standards, is creating serious environmental and health concerns. This study assessed the degrees of soil contamination of heavy metals from four automobile stations. Twelve (12) composite soil samples were collected within and around the workshops in Ibadan North Local Government of Oyo State at depths above 10cm. The soil samples were digested and analysed to uncover the concentrations of Pb, Ni, Cr, Cd and Zn in the samples and other parameters such as pH and organic carbon. The concentrations of the heavy metals were compared with standards and the pollution/contamination factors were also analysed. The concentrations of Pb, Ni, Cr, Zn and Cd in the soil samples range from 2.0-58100mg/kg, 0.0-33.0mg/kg, 0.0-18.0mg/kg, 0.0-90.0mg/kg and 0.0-0.0mg/kg respectively. Heavy metals contamination/pollution was discovered to depend on size, soil composition, functions and age of automobile stations. The order of heavy metals contamination was Pb>Ni>Zn>Cr>Cd. It is concluded that mechanic workshops constitute health risk to human beings and a threat to sustainable eco system.

La Menace de la Pollution du Sol Par Des Métaux Lourds Des Ateliers Mecaniques Sur L'écosystème au Gouvernement Locale, nord D'ibadan de L'état Nigeria

Résumé

La pollution des sols par les métaux lourds provenant des ateliers de mécanique, au-delà des normes acceptables, crée de graves problèmes d'environnement et de santé. Cette étude a évalué le degré de contamination des métaux lourds par le sol provenant de quatre stations automobiles. Douze (12) échantillons de sol composites ont été recueillis dans et autour des ateliers du gouvernement local nord d'Ibadan, dans l'État d'Oyo, à des profondeurs supérieures à 10 cm. Les échantillons de sol ont été digérés et analysés pour révéler les concentrations de Pb, Ni, Cr, Cd et Zn dans les échantillons et d'autres paramètres tels que le pH et le carbone organique. Les concentrations de métaux lourds ont été comparées avec les normes et les facteurs de contamination / contamination ont également été analysés. Les concentrations de Pb, Ni, Cr, Zn et Cd dans les échantillons de sol vont

de 2.0-58100mg / kg, 0.0-33.0mg / kg, 0.0-18.0mg / kg, 0.0-90.0mg / kg et 0.0-0.0mg / kg respectivement. La contamination / pollution des métaux lourds dépend de la taille, de la composition du sol, des fonctions et de l'âge des stations automobiles. L'ordre de contamination par les métaux lourds était Pb> Ni> Zn> Cr> Cd. On en conclut que les ateliers de mécanique constituent une menace pour l'être humain et une menace pour un écosystème durable.

Introduction

Automobile wastes have caused serious soil problems detrimental to soil dwelling organisms as well as human beings (Iwegbue, 2007; Adewoyin *et al.,* 2013, Oladipo, 2015). Heavy metals toxicity, persistent and non-degradable attributes in the environment have made them dangerous pollutants (Nwuche and Ugoji, 2008; Aina *et al.,* 2009; Mohiuddin *et al.,* 2010). The major pollutants emitted from mechanic villages include metals, hydrocarbon (HC), Volatile Organic Compounds etc. These pollutants have damaging effects on aesthetics, human health and ecology. The various efforts to remove man-made pollutants from the natural environment have been unable to keep pace with the increasing amount of waste materials generated from anthropogenic sources (Angela, 2009; Ozulu *et al*, 2013). Heavy metals are naturally present in soils but anthropogenic activities have resulted in high concentrations in the environment (He, *et al*, 2004).The significance of trace elements in soil chemistry is increasingly becoming an issue of global concern (Lim *et al*, 2008).

Soil pollution can be assessed using contamination/pollution index (C/PI) (Liu *et al*, 2007, Ololade 2014).Metal enrichment factor (EF) has been particularly used to assess metal enrichments in sediments of rivers and estuaries (Zhang *et al.,* 2009) with normal crustal values as base (Karbassi *et al.,* 2008). The pollution index represents the metal content effectively measured in soil by chemical analysis and the reference value of contamination obtained using a standard table formulated by the Department of Petroleum Resources of Nigeria, (DPR) for maximum allowable concentration of heavy metals in soil (Ololade, 2014). This study assessed the impact of heavy metals from automobile stations on soils using C/PI.

Study Areas

The selected automobile stations are Trans Amusement Park Mechanic Village, Oranyan Mechanic Workshop, University of Ibadan Maintenance Mechanic Village, and Agodi Gate Mechanic Village (Fig 1). The selection of the four Automobile Stations was based on their categorical differences in terms of vehicular loads, size, location and soil configuration. Trans Amusement Park Mechanic Village was established in the year 1996. Work in the village basically involves repairing of vehicles such as motor cycles, cars, trailers etc. The number of workshops within this mechanic village is about 25. There are eight groups of workshop, each group with different activities. They include; battery chargers, mechanics, blacksmiths, panel beaters, rewires and part sellers, auto electrical and vulcanizers.

Oranyan Mechanic Workshop was established in the year 1998. Work in the village basically involves repairing of vehicles such as motor cycle and cars. The number of workshops within this mechanic village is below 10. There are four groups of workshop, each group with different activities, they include; battery charger, mechanic, vulcanizers, panel beater and rewire. University of Ibadan Maintenance was established in the year 1984. Work in the village basically involves repairing of vehicles such as motor cycles, buses and cars. The number of workshops within this mechanic village is about 20. There are seven (7) groups of workshop, each group with different activities, they include; battery charger, auto electrical, mechanic, blacksmith and welder, vulcanizers, spring painter, panel beater and rewire. Gate mechanic village was established in the year 1964. Work in the village involves dismantling, repairing, reassembling, reforming and selling of vehicles

and vehicles parts such as motor cycles, buses, cars, trailers etc. The number of workshops within this mechanic village is over 200. There are nine (9) groups of workshop, each group with different activities, they include; battery chargers, auto electricians, mechanics, blacksmiths and welders, vulcanizers, spring painters, panel beaters, rewires and part sellers.

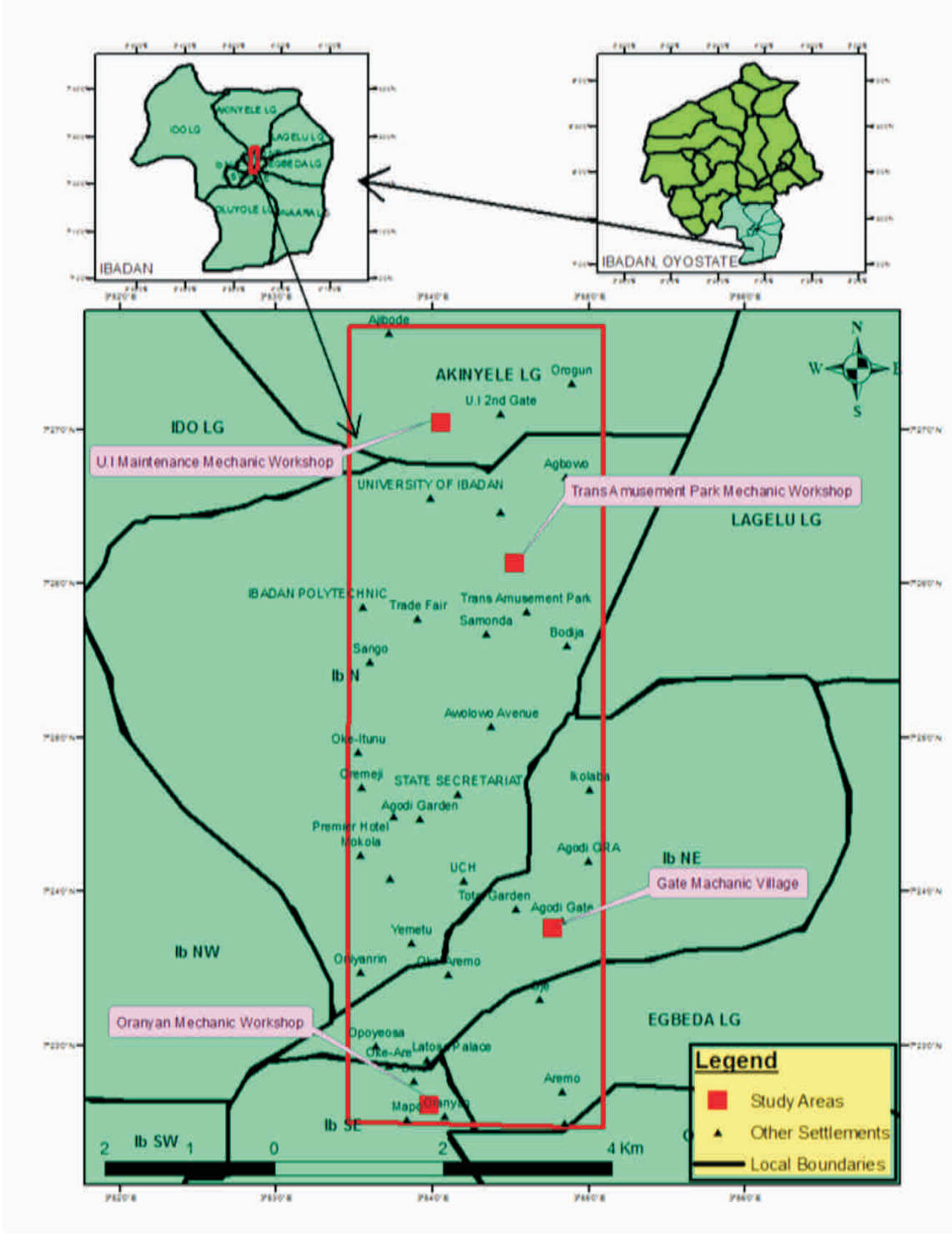

Figure 1: Map of the Study Areas showing the sampling locations

Materials and Methods

General procedure adopted is shown in Fig. 2. Soil samples were collected within and around the automobile station at strategic three locations at depths ranging from 10 to 20cm. A composite soil sample was collected within the station and two other samples at the vicinities. The collected soil samples were air dried, pulverized, sieved and digested with 10ml of nitric acid 2:1 and HCl acid1:1. The digested samples were allowed to cool to room temperature and washed into a standard volumetric flask (Okoro *et al,* 2013). The heavy metals laboratory analyses were determined using atomic adsorption spectrophotometer (AAS Model 210 VGP). The pH was determined by an electronic Jenway glass electrode pH meter (Model 3510). Statistical analyses also involved comparing analysis results with Department of Petroleum Resources (1991). Pearson correlation test and contamination/pollution factor (C/P Value) analyses were also performed. According to Ozulu *et al.,* (2013).

$$\text{C/P Value} = \frac{\text{Actual measurement of metal concentration in soil}}{\text{Target values from reference}}$$

Results and Discussion

Laboratory Results

Table 1 shows the results of the analyses performed on the soil samples. The organic carbon content of the soil samples ranged from 0.2% - 3.63%. Gate soil samples SD3 and SD1 recorded the least and highest percentage of organic carbon in soil. The heavy metals analysis results showed an excessive amount of lead concentration in Soil at U.I Maintenance Mechanic Workshop with an outrageous concentration value of 58100.00mg/kg. This is possible because of the mineralogical composition of soil at the site as explained by Ozulu *et al.*, (2013). U.I Maintenance Mechanic Workshop is a paved workshop with unpaved surrounding. The heavy metals wastes from this workshop are therefore, being washed easily from the paved areas to the loose sandy soil surroundings. All the automobile sites recorded some degree of lead contamination and the concentration of lead in soil is the highest as compared to that of other elements. This is as a result of high usage of lead as anti-knock agent in gasoline and as additives in paints and solvents. Similar researches carried out by Ojiako and Okonkwo (2013) and Abii (2012) showed the highest concentration of lead in soil as compared to other heavy metals.

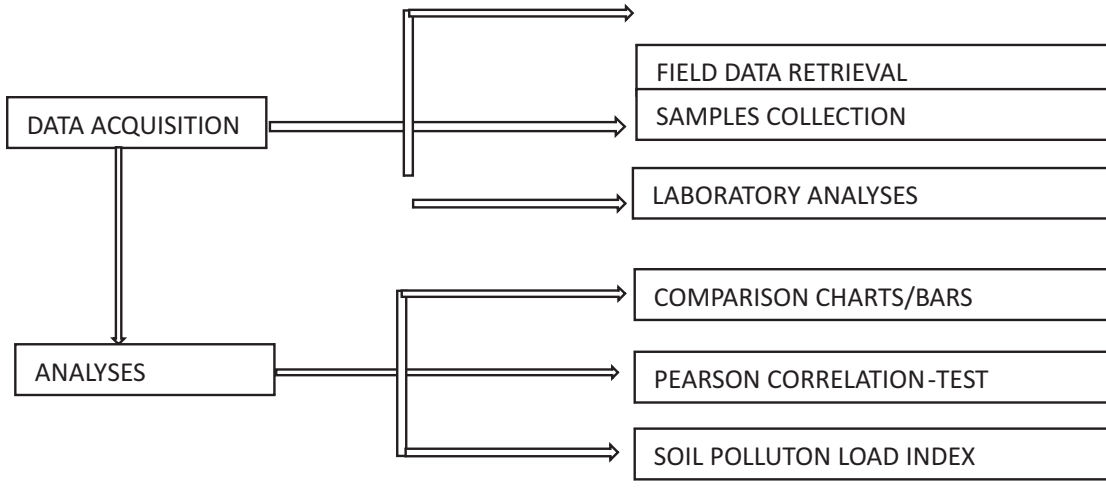

Figure 2: General Methodology of the Research

The four automobile stations recorded zero concentration of cadmium in soil. This is perhaps due to the non/very minute usage of the element as additive in battery, solvent and materials used by the automobiles' stations users in Ibadan. Two of the mechanic workshops, Trans and U.I Maintenance record traces of chromium in soil. This is perhaps due to the large size and greater operations which call for the use of chromium solvents and materials. Next to lead, Zinc 90mg/kg (SD1– Gate) and Nickel, 33mg/kg (SD1- Gate) concentrations in soil samples showed the highest concentration. Oranyan workshop recorded zero zinc and zero chromium. This because of its size, the load of vehicle is far smaller than that of gate workshop. Zinc are mostly found in car scraps and vehicle parts. Nickel is found in all the mechanic villages except the Trans Amusement Park Mechanic Village. This perhaps is partly due to low carbon content in its soil. There are other factors that may contribute to zero nickel concentration at Trans Mechanic Workshop, such as vehicular, battery and solvent composition; however, soil composition is a contributory factor. Carbon serves as great adsorption agent. The order of magnitude of heavy metals contamination is as follows- Pb>Zn>Ni>Cr>Cd.

Table 2 shows the correlation table of the analysed soil samples parameters. The concentration of lead and zinc are found to be significantly negatively correlated with el pH value. The lead to pH correlation value is –0.597 at a significant level of 0.02, while that of zinc to pH is -.0625 at 0.015 significant level. This shows that as pH value increases, there are corresponding decrease in lead and zinc concentrations and *vice-versa.* The pH of soil therefore affects the concentration of lead and zinc in soil. Lead and zinc concentration increased with increasing acidity, and decrease with increasing alkalinity. This perhaps is due to the high affinity of lead and zinc to acidic substance and solution. Lead is also being used as a major composition in acidic batteries. The concentration of nickel in soil is found to be a function of the chemical composition of the soil in term of organic carbon content because of the high correlation between them- P value- 0.742 with a significant level of 0.003. Nickel concentration increased with increasing organic carbon content and *vice-versa.* This perhaps explains the absence of nickel in Trans Mechanic Workshop. Zinc is found to be significantly positively correlated with other heavy metals, nickel (P – 0.724, Sig- 0.040) and chromium (P- 0.519 and S-0.042); however, that of zinc to nickel is greater. The presence of zinc in soil is therefore, greatly positively dependent on the amount of organic carbon in soil, followed by the concentration of nickel and then chromium.

Table 1: Soil Samples Laboratory Results

S/N	Soil Sample Code	Location	pH	Organic Carbon (%)	Pb (mg/kg)	Ni (mg/kg)	Cr (mg/kg)	Cd (mg/kg)	Zn (mg/kg)
1	SA1	Trans Amusement Park	6.87	0.12	152.00	0.00	5.00	0.00	20.00
2	SA2	Trans Amusement Park	6.90	0.11	089.00	0.00	2.00	0.00	10.00
3	SA3	Trans Amusement Park	6.89	0.12	00.00	0.00	0.00	0.00	0.00
4	SB1	Oranyan	6.74	2.27	73.00	14.0	0.00	0.00	0.00
5	SB2	Oranyan	6.88	2.22	23.00	11.0	0.00	0.00	0.00
6	SB3	Oranyan	6.91	1.92	0.00	0.00	0.00	0.00	0.00
7	SC1	U.I Maintenance	6.45	1.76	58100.00	2.00	0.00	0.00	40.00
8	SC2	U.I Maintenance	6.54	1.84	4910.00	13.00	0.00	0.00	30.00
9	SC3	U.I Maintenance	6.91	1.47	431.00	1.00	0.00	0.00	10.00
10	SD1	Gate	6.63	3.63	485.00	33.0	10.00	0.00	90.00
11	SD2	Gate	6.59	1.72	122.00	12.0	18.00	0.00	30.00
12	SD3	Gate	6.66	0.2	2.00	10.0	0.00	0.00	20.00

Source: Field Survey, 2017

Table 2: Soil Samples Parameters Correlation Table

		pH	Organic Carbon	Pb	Ni	Cr	Zn
pH	Pearson Correlation	1					
	Sig. (1-tailed)						
	N	12					
Organic Carbon	Pearson Correlation	-.366	1				
	Sig. (1-tailed)	.121					
	N	12	12				
Pb	Pearson Correlation	-.597*	.103	1			
	Sig. (1-tailed)	.020	.375				
	N	12	12	12			
Ni	Pearson Correlation	-.468	.742**	-.176	1		
	Sig. (1-tailed)	.063	.003	.292			
	N	12	12	12	12		
Cr	Pearson Correlation	-.298	.253	-.174	.437	1	
	Sig. (1-tailed)	.173	.214	.295	.078		
	N	12	12	12	12	12	
Zn	Pearson Correlation	-.625*	.524*	.251	.724**	.519*	1
	Sig. (1-tailed)	.015	.040	.215	.004	.042	
	N	12	12	12	12	12	12

*Correlation is significant at the 0.05 level (1-tailed).
**Correlation is significant at the 0.01 level (1-tailed).

Comparison with Standard

The heavy metals in soil are compared with their corresponding target values provided by the Department of Petroleum Resources (DPR), 1991. Figure 2, 3, 4 and 5 show the bar charts comparing respectively the, lead, nickel, and chromium and zinc concentrations in the soil samples with their corresponding target levels. The target value of cadmium in soil is 0.8mg/kg. All the automobile stations recorded zero cadmium concentration in soil. The sites are therefore completely safe and free from cadmium. Figure 2 indicates that the lead concentration in SA3 (Trans), Oranyan soil samples (SB1, SB2 and SB3) and SD3 (Gate) are beneath the lead target concentration (85mg/kg). SA1, SA2, U.I Maintenance Soil samples (SC1, SC2 and SC3), SD1 and SD2 are above the target. SC1 and SC2 are outrageously above this target. The DPR target values for nickel, chromium and zinc concentrations in soil are 35mg/kg, 100mg/kg and 140mg/kg respectively. The nickel, chromium and zinc in all the soil samples were found to be lower than their corresponding targets. This indicates that the soil samples are safe from nickel, chromium and zinc. However, some of the soil samples are not free from the three heavy metals. Only SA3 (Trans) and SB3 (Oranyan) are safe and free from the five heavy metals.

Table 3 shows the soil samples contamination /pollution factor explaining the degree of contamination/pollution of each heavy metal in each soil sample. The contamination/pollution factor/value (C/P Value) for each element and soil sample was calculated and recorded. When C/P value is zero (0), the soil sample is said to have no contamination. When C/P value/factor is between zero (0) and one (1), the soil is contaminated. A C/P factor greater than one (1) means the soil sample is polluted. Most of soil samples are within contamination level and some have no contamination. The few wells that are polluted are the U.I Maintenance soil samples (SC1, SC2 and SC3), SD1 (Gate) and SD2 (Gate). The only polluting element is lead. SC1 and SC2 have excessive pollution factors of 683.53 and 57.76 respectively indicating an outrageous lead pollution. SC3 and SD1 indicate lead pollution with pollution factors of 5.07 and 5.71 respectively. Sd2 is slightly polluted with lead and has a C/P value of 1.44. These polluted soil sites should be given special intervention to encourage healthy soil resources within and around the affected automobile stations - U.I Maintenance Workshop and Gate Mechanic Village.

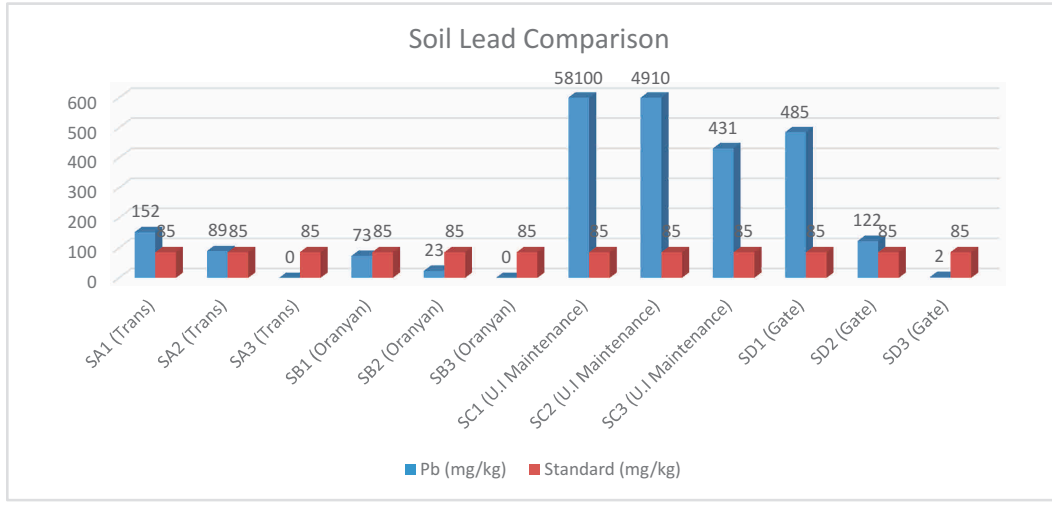

Figure 2: Comparisons of Lead Concentrations in Soil Samples with Standard

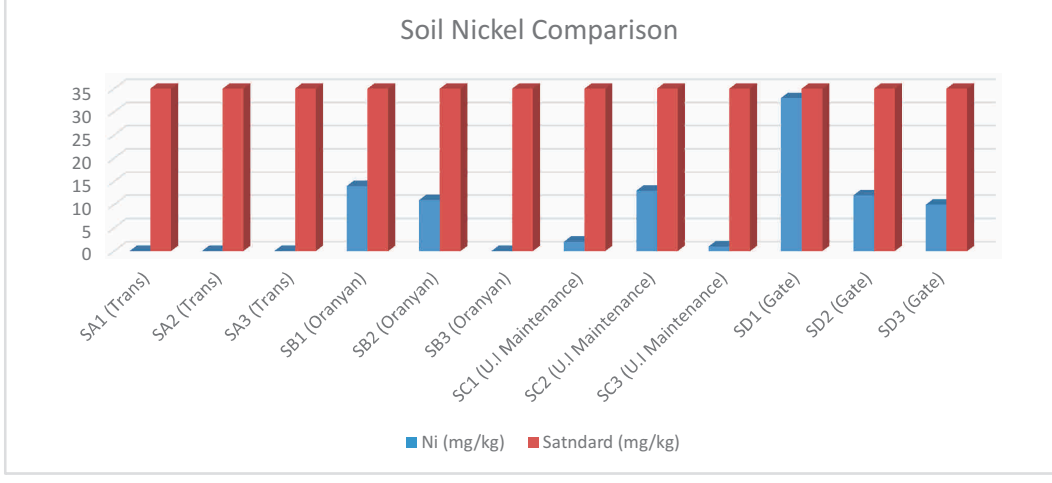

Figure 3: Comparisons of Nickel Concentrations in Soil Samples with Standard

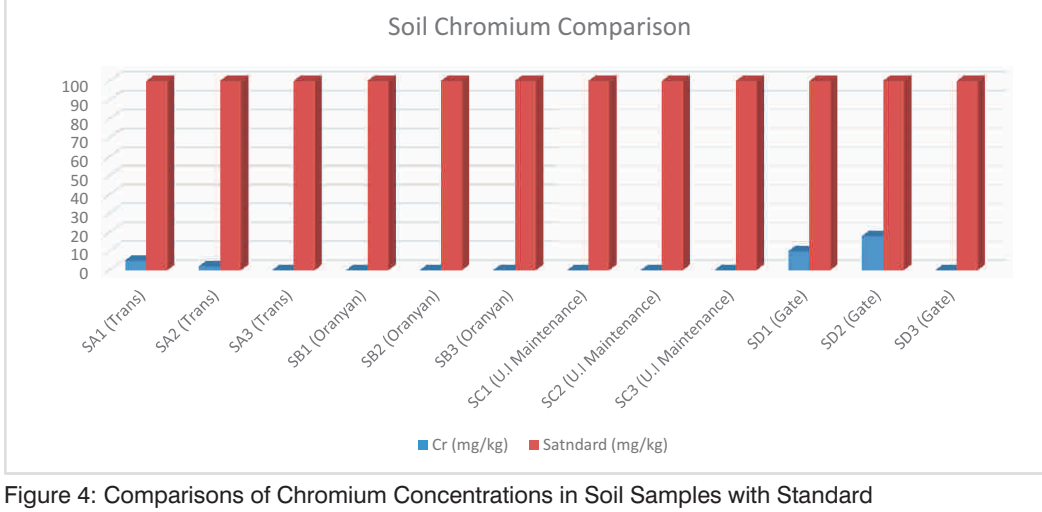

Figure 4: Comparisons of Chromium Concentrations in Soil Samples with Standard

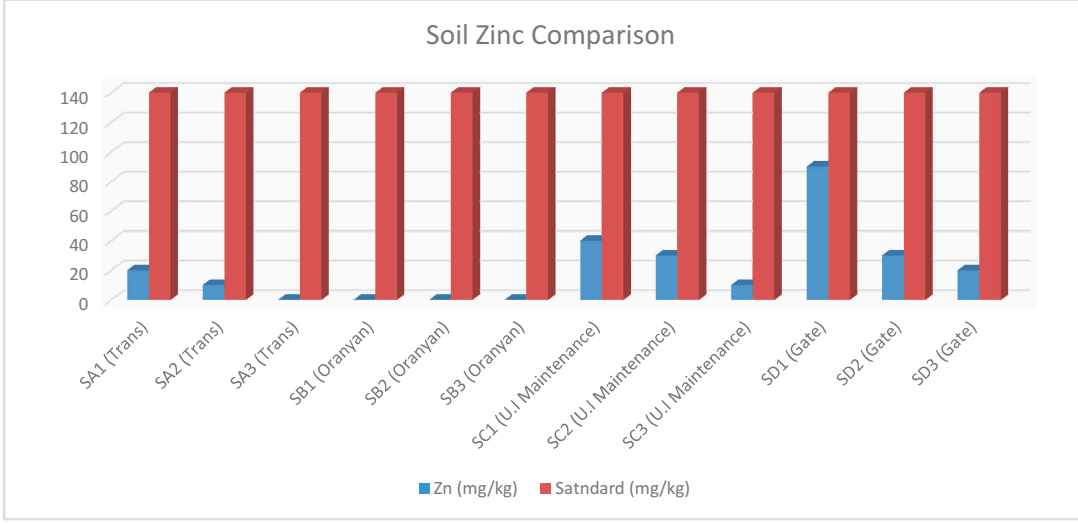

Figure 5: Comparisons of Zinc Concentrations in Soil Samples with Standard

Table 3: Soil Sample Contamination and Pollution Factor

S/N	Soil Sample Code	Location	Contamination/Pollution Factor (CP)								
			Pb	Remarks	Ni	Remarks	Cr	Remarks	Cd	Zn	Remarks
1	SA1	Trans Amusement Park	1.79	SLP	0.00	NC	0.05	VSLC	NO CONTAMINATION	0.14	SLC
2	SA2	Trans Amusement Park	1.05	SLP	0.00	NC	0.02	VSLC		0.07	VSLC
3	SA3	Trans Amusement Park	0.00	NC	0.00	NC	0.00	NC		0.00	NC
4	SB1	Oranyan	0.86	VSC	0.40	MC	0.00	NC		0.00	NC
5	SB2	Oranyan	0.27	MC	0.31	MC	0.00	NC		0.00	NC
6	SB3	Oranyan	0.00	NC	0.00	NC	0.00	NC		0.00	NC
7	SC1	U.I Maintenance	683.53	EP	0.06	VSLC	0.00	NC		0.29	MC
8	SC2	U.I Maintenance	57.76	EP	0.37	MC	0.00	NC		0.21	SLC
9	SC3	U.I Maintenance	5.07	SP	0.03	VSLC	0.00	NC		0.07	VSLC
10	SD1	Gate	5.71	SP	0.94	VSC	0.10	SC		0.64	SC
11	SD2	Gate	1.44	SLP	0.34	MC	0.18	SC		0.21	SLC
12	SD3	Gate	0.02	VSC	0.29	MC	0.00	NC		0.14	SLC

Note: C/P <0.1 = Very Slight Contamination (VSLC);
0.26 – 0.50 = Moderate Contamination (MC);
0.76-1.0 = Very Severe Contamination (VSC);
C/P at 2.1-4.0 = Moderate Pollution (MP);
CP at 8.1 -16.0 = Very Severe Pollution (VSP)
(Ozulu, *et al*, 2013)
0.1-0.25=Slight Contamination (SLC)
0.51-0.7 =Severe Contamination (SC)
C/P at 1.1-2.0 =Slight Pollution (SLP)
C/P at 4.1-8.0 = Severe Pollution (SP)
C/P > 16.0 =Excessive Pollution (EP)

Conclusion and Recommendations

The order of heavy metals contamination is Pb>Ni>Zn>Cr>Cd. The heavy metals of concern are lead and nickel due to their significant contamination of soil around medium and large scale mechanic workshops. High lead/nickel concentration is carcinogenic and negatively affects reproductive health. High concentration of these heavy metals raises significant environmental concern and calls for urgent attention. It is recommended that there should be reduced used of lead and nickel batteries, products and materials by automobile technicians. Indiscriminate disposal of spoilt and used gasoline should be avoided or limited. Stricter environmental laws should be enacted in this regard to curb indiscriminate disposal of automobile wastes by automobile technicians. There is also a need for constant monitoring of these heavy metal concentrations in soils where automobile activities are carried out in order to limit improper disposal of harmful substances.

References

Abii, T. A. (2012). Levels of Heavy Metals (Cr, Pb, Cd) Available for Plants within Abandoned Mechanic Workshop in Umuahia Metropolis. *Research Journal of Chemical Sciences.* Vol. 2 (2); 79 – 82.

Adewoyin, O. A.1, Hassan, A. T. and Aladesida, A.A (2013). The impacts of auto-mechanic workshops on soil and groundwater in Ibadan metropolis. *African Journal of Environmental Science and Technology* Vol. 7(9), pp. 891-898, September 2013.

Aina, M.; Matejka, G.; Mama, D.; Yao, B.; Moudachirou, M., (2009). Characterization of stabilized waste: Evaluation of pollution risk. *Int. J. Environ. Sci. Tech.*, 6 (1), 159-165.

Angela Kesiena Etuonovbe (2009). The Devastating Effects of Environmental Degradation - A Case Study of the Niger Delta Region of Nigeria. TS 1D – Environment and Land Use Planning. FIG Working Week 2009 Surveyors Key Role in Accelerated Development Eilat, Israel, 3–8 May, 2009.

Department of Petroleum Resources, DPR (1991). Environmental, Guidelines and Standards for the Petroleum Industry in Nigeria, Revised Edition 2001, P.53-57.

He, Z. L., Zhang, M. K., Calvert, D. V. (2004). Transport of Heavy Metals in Surface Runoff from Vegetable and Citrus Fields, Soil Science Society, America, 68, p.1662-1669.

Ipeaiyeda, A. R. and Dawodu, M., (2008). Heavy metals contamination of topsoil and dispersion in the vicinities of reclaimed auto-repair workshops in Iwo Nigeria. *Bull. Chem. Soc. Ethiopia*, 22 (3), 339-348.

Iwegbue, C. M., (2007). Metal fractionation in soil profiles at automobile mechanic waste dumps around Port-Harcourt. Waste Manage. Res., 25 (6), 585-593.

Karbassi, A. R., Monavari, S. M., NabiBidhendi, G. R., Nouri, J., Nematpour, N., (2008). Metal pollution assessment of sediment and water in the Shur River. Environ. Monit. Assess., 147 (1-3) 107–116 .

Lim, H., Lee. J., Chon, H. and Sager, M. (2008) Heavy Metal Contamination and Health Risk Assessment in the Vicinity of the Abandoned Songcheon Au-Ag Mine in Korea. *Journal of Geochemical Exploration*, 96, 223-230. http://dx.doi.org/10.1016/j.gexplo.2007.04.008.

Liu, C.; Zhang, Y.; Zhang, F.; Zhang, S.; Yin, M.; Ye, H.; Hou, H.; Dong, H.; Zhang, M.; Jiang, J.; Pei, L., (2007). Assessing pollutions of soil and plant by municipal waste dump. Environ. Geol., 52 (4), 641-651.

Mohiuddin, K. M.; Zakir, H. M.; Otomo, K.; Sharmin, S.; Shikazono, N., (2010). Geochem distribution of trace metal pollutants in water and sediments of downstream of an urban river. *Int. J. Environ. Sci. Tech.,* 7 (1), 17-28.

Nwuche, C. O.; Ugoji, E. O., (2008). Effects of heavy metal pollution on the soil microbial activity. *Int. J. Environ. Sci. Tech.,* 5 (3), 409-414.

Ojiako, E. N and Okonkwo, M. N. (2013). Analysis of Heavy Metals in Soils of Mechanic Workshops in Onitsha Metropolis. *Advances in Applied Science Research.* 4 (1): 79 – 81.

Okoro , A.C; Chukwuma, G.O; Chukwuma, E. C; Nwachukwu , P.C and Ezeh, K.A., (2013). Investigating The Effects of Selected Heavy Metals on Topsoil at the Vicinities OfTwo Automobile Mechanic Villages, Owerri Municipal, Nigeria. *The International Journal of Engineering and Science* (IJES) ||Volume||2 ||Issue|| 11||Pages|| 19-26||2013|| ISSN(e): 2319 – 1813 ISSN(p): 2319 – 1805.

Ololade, I.A. (2014). An Assessment of Heavy-Metal Contamination in Soils within Auto Mechanic Workshops Using Enrichment and Contamination Factors with Geoaccumulation Indexes. *Journal of Environmental Protection*, 5, 970-982. http://dx.doi.org/10.4236/jep.2014.511098.

Olaniyan O. S., Ige J. A., Akolade A. S., Adisa O. A., (2015). Application of GIS in Water Management of Eleyele Catchment, South-Western Nigeria Civil and Environmental Research. ISSN 2224-5790 (Paper) ISSN 2225-0514 (Online). Vol 7, No 3, 2015.

Oladipo O. S. (2015). Blood Sample Analysis of Auto Technicians (Battery Chargers) in Ibadan. Medical Science Research Journal. Vol. 2 (2); 79 – 82.

Ozulu G. U., Usiobaifo O. B. and Usman A. A., (2013). Assessing the Impact of Waste Gasoline on the Physicochemical Properties of Soils at Selected Automobile Workshops in Obiaruku, Southern Nigeria. *Universal Journal of Environmental Research and Technology*. Volume 3, Issue 4: 427-435.

Zhang, W.; Feng, H.; Chang, J.; Jianguo, Q.; Hongxia, X.; Lizhong, Y.; (2009). Heavy metal contamination in surface sediments of Yantze intertidal zone: An assessment from different indexes. *Environ. Pollut.,* 157 (5), 1533-1543.

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