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ASSESSMENT OF HEAVY- METALS (Zn, Pb, Cu, Ni, Cd) ON STREET DUST: A CASE STUDY OF OSHODI - ISOLO AREA, LAGOS - STATE, SOUTHWESTERN - NIGERIA.

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ABSTRACT
This research reports the results of Heavy metals content of Street dust in Oshodi - Isolo Area of Lagos state. The dust samples were collected randomly once a week August - December, 2019 at ten different locations in Oshodi - Isolo Area. Samples were obtained by sweeping surface dust into plastic waste packer using plastic brush and transferred into pre-labeled polythene bags. Samples collected at each location were filtered through 75 µm stainless steel sieve, weighed and digested with appropriate amount of HNO_3 and H_2O for 2 hours. The concentrations of Heavy metals were analyzed using using Atomic Absorption Spectrophotometer (AAS) PG - 990. Results of the analysis shows that the percentage contribution of each Heavy metals at Oshodi - Isolo Area were Zn - 51.52 %, Pb - 36.78 %, Cu- 8.65 %, Ni - 2.79 % and Cd - 0.25 % .The most abundant pollutant Heavy Metals was Zn-1445.43 mg/kg while the least was Cd - 6.99 mg/kg. The most polluted site is Agege-motor road (AGM)-1372.11 mg/kg while the least polluted site is Adewumi Ogefon (ADO)-15.41 mg/kg with percentage contributions 48.91 % and 0.55 % respectively. The sequence and distribution follows the pattern thus: Zn > Pb > Cu > Ni >Cd . There is a significant difference in the levels of each heavy metal in the dust of Oshodi-Isolo ($P < 0.05$). The concentration of heavy metals obtained exceeded the recommended limits of the Federal Ministry of Environment (FME), European communities (EC) and United Nations Environmental Programme (UNEP) permissible level for heavy metals in the atmosphere suggesting that the study area is polluted.

KEYWORDS: Dust, Environment; Heavy metals, Atomic Absorption Spectrophotometer (AAS), Significant C difference (SD)

INTRODUCTION
The quality of air in major cities around the world especially in developing city like Lagos State, Nigeria particularly Oshodi - Isolo Area is rapidly deteriorating as a result of the presence of Heavy metals arising from energy generation, vehicular traffic, combustion of fossil fuel and poor waste management policies. Dusts are fine particles of solid matter. Dust is believe to come from sources such as soil, dust lifted by wind and pollutions. Street dust can be describe as fine powder consisting of small pieces of sand or earth which can be found in the street. Direct inhalation of fine dust by people traversing the streets and those residing in the vicinity could be by ingestion through hand - to - mouth, eating poorly washed fruits and vegetables and dermal exposure are the routes of human exposure to road dust (Lorenzo *et al*., 2011). Chemical composition of road dust can be used as an indicator for environmental pollution (Han *et al*., 2006), dust is a valuable medium for characterizing urban environmental quality (Liu *et al*., 2014), and exposure health risk assessment (Hussain *et al*., 2015).

Street dust is one of the useful indicator of environmental quality in urban area, which could be used to assess heavy metals and other pollutants in the environment (Amato *et al*., 2009, Lu *et al*., 2010). Atmospheric aerosols and their contaminants from anthropogenic sources finally settle on the surfaces by atmospheric dry and / or wet deposition and are then transferred to the

surface of the soil or incorporated into the surface dust.

The chemical contents of the surface road dust and airborne particulates contents and their chemical composition in both road dust and air borne particulates are similar (Liu *et al*., 2007). Vehicle exhaust, tire dust, spillages and leaks from vehicles, road surface erosion material and vegetative plant fragments, garden soil and litter are the sources of deposited surface road side dust (Mostafa *et al*.,2009).

The term Heavy metals could be describe as to include any metal that is poisonous or toxic with a relatively high density. They are usually road traffic source contaminants in the local ecological environments and thus dangerous to public health (Mohsen *et al*., 2012). Heavy metals are natural components of the earth's crust. They cannot be degraded or destroyed. Heavy metals are dangerous because they tend to bio-accumulate (Bawuro *et al.*, 2018).To a small extent they enter our bodies via food, drinking water and air. As trace elements, some heavy metals (e.g Copper, Lead, Zinc) are essential to maintain the metabolism of the human body. However, at higher concentrations they can lead to poisoning. Heavy metals can thus penetrate into the human body and pose a great threat to human (Aeolian *et al.*, 2008; Lu *et al.*, 2010). Automobile repair workshops release waste products such as engine oil, transmission oil, brake fluid, damaged tires, battery electrolytes, wire carbide, spent batteries and cells into their surrounding areas. Although, there are enormous studies on the levels of Heavy metals on Street dust in the world (Kui, Cai and Chang, Li (2019); Lu *et al.*, 2010; Ahmad *et al.*,2015, Faiz *et al.*,2009; Al - Khashman (2004) and (2007); Addo *et al*., 2012) but currently there are little or no literature on Heavy metals on Street dust in Lagos State, particularly in Oshodi - Isolo Area. Therefore, the main objectives of the present study were to : (1) assess and evaluate the levels of Heavy metals on Street dust of Oshodi - Isolo Area (2) determine the baseline levels of Heavy metals (3) determine whether there are significant differences in the levels of Heavy metals from each of the study area. It is hopeful that this study will provide the percentage contributions of each Heavy metals to pollution in Oshodi - Isolo Area.

Table 1 : Sampling sites, Characteristics and their Coordinates

LOCATION /SITES	CODE	LATITUDE	LONGITUDE	SITE DESCRIPTION
Oshodi road	OSR	N6^0.55609	3.334551E	This is a Major road with high vehicular and traffic emissions. Few garages with lots of abandoned vehicles.
Church street	CHS	N6^0.55609N	3.3451E	It is a Commercial area with high traffic congestion, filling station and vulcanizing activities
Brown street	BRS	N6^0.55912N	3.34877E	This is a Commercial area where traders from different ethnic groups from Nigeria sells foodstuffs and non-edibles like wears, electrical/electronic materials, the market creates lots of traffic bottleneck for motorist and commuters
Shopeju	SPS	N6^0.5680	3.3435E	It is a Residential area with little vehicular emissions, not associated with traffic congestion with fumes from generator from the residents
Adewumi Ogefon	ADO	N6^0.56774	3.34231E	Residential area with no traffic congestion, generator fumes used by all the shops in the area.
Agege motor road	AGM	N6^0.5655	3.3487E	It is a major road; there is traffic congestion in this area with lots of emissions from vehicles. There is lot of filling stations in this area, vulcanizing activities
Ariyibi oke	ARS	N6^0.5610	3.3489E	It is a commercial area with few residents, high traffic congestion especially due to the activities of buyers and sellers, a lot of vehicular emissions and mechanic workshop
Osolo Way	OSW	N6^0.539	3.33241E	Site with nylon and plastic recycling industries, abandoned cars, market and panel beater workshop
Aswani road	ASR	N6^0.54077	3.33405E	An industrial area with industry such as Emzor, there is traffic congestion, spillage of petrol and diesel.
Apapa oshodi express	APE	N6^0.53986	3.33691E	Site with industries such as Chellarams, Nylon company, vehicle emissions, due to vehicular activities.
YCT Botanical garden(control)	BG (CTL)	N6^0.51626	3.37369E	There is little or no Anthropogenic activity. A site where different agricultural crops are grown.

MATERIALS AND METHOD

Selection of Sampling Sites

The eleven sites including the control were carefully chosen based on accessibility, availability of open spaces and of course area with maximum influence from anthropogenic activities such as vehicular traffic density, human activities as well as industrial activities. The geo-referencing was carried out by using GPS MAP 76S (Garmin).

Sampling Location

The study was conducted in the following areas of Oshodi-Isolo (N^{0}6.56777 and E^{0}3.34231 - N06.5162 and E03.37369) area of Lagos state which include Shopeju street (SPS), Adewumi Ogefon (ADO), Aswani road (AWR),Osolo way (OSW), Agege-motor road (AGM), Church street (CHS), Oshodi road (OSR), Ariyibi oke (ARS), Brown street (BRS) and Apapa - Oshodi express way (APE) and the control site, Botanical garden yaba college of technology (BG).

Sample Collection

Dust samples were collected from eleven sites within the study area, at least 100m apart once a week from August to December, 2019. Samples were collected in the morning while the dust has settled well throughout the night and before heavy morning traffic movement that can disrupt the dust. The samples were randomly collected from both sides of the road by sweeping surface dust into plastic waste packers using plastic brush and transferred into pre- labeled polythene. All irrelevant materials such as cigarette ends, papers, plastics etc. were carefully hand- picked. Thereafter, samples collected at each location were filtered through 75 µm stainless steel sieve. The samples were then taken to the laboratory for further treatment and analysis.

PREPARATION AND ANALYSIS OF ROAD SIDE STREET DUSTS

Digestion of dust Samples for Heavy metals

2.0g of sieved dust was weighed using an analytical balance and transferred into a conical flask for digestion. 30ml nitric acid and 10ml concentrated hydrochloric acid prepared in the ratio 3:1 was added. The solution was mixed thoroughly and heated on magnetic heated stirrer, then refluxed at 90ºc for 20 minutes. After the disappearance of brown fumes, the digested solution was cooled and then filtered through Whatman type 589/2 filter paper. The filtrate was diluted to 50 cm3 with de-ionized water. The metal contents in the filtrate were determined using an atomic absorption spectrophotometer (AAS) PG - 990.

Statistical analysis

The analysis of variance (ANOVA) together with mean and standard deviation of each Heavy metals was carried out on the data obtained from the street dust.

Table 2: Heavy metals concentration at Oshodi - Isolo area of Lagos – State[1]

Location/ Sites	Pb (mg/kg)	Zn (mg/kg)	Cu (mg/kg)	Cd (mg/kg)	Ni (mg/kg)
SPS	6.46 ± 0.11	26.24 ± 0.11	2.32 ± 0.11	0.075 ± 0.07	0.73 ± 0.11
ADO	2.11± 0.07	12.11 ± 0.12	0.87 ± 0.11	0.003 ± 0.01	0.32 ± 0.12
ASR	79.05± 0.11	162.08 ± 0.06	57.89 ± 0.11	-0.108 ± 0.06	12.25 ±0.21
APE	39.11 ± 0.66	88.00 ± 0.01	32.13 ± 0.12	-0.02 1± 0.10	5.25 ± 0.31
OSW	19.89 ± 0.12	136.75 ± 0.51	24.38 ± 0.67	-0.303 ± 0.07	1.51 ± 0.11
CHS	1.83 ± 0.11	24.69 ± 0.121	1.25±0.12	0.043 ± 0.01	0.03 ± 0.01
AGM	641.52 ± 0.12	651.03 ± 0.01	56.72 ± 0.08	0.79 ± 0.12	22.05 ± 0.06
OSR	57.10 ± 0.10	38.11 ± 0.10	5.12 ± 0.07	2.49 ± 0.01	16.104 ± 0.10
ARS	174.45 ± 0.11	274.77 ± 0.12	58.27 ± 0.12	2.38±0.17	18.69 ±0.04
BRS	9.41 ± 0.17	28.40 ± 0.16	3.25 ± 0.117	0.74 ± 0.045	1.241 ± 0.16
BG(CTL)	0.80 ± 0.16	3.25 ± 0.16	0.57±0.17	0.121±0.156	0.024 ± 0.01
TOTAL	**93.79 ± 182.89**	**131.40 ±185.19**	**22.07±24.26**	**0.487 ± 0.97**	**7.11 ± 8.22**

[1]Value represent mean±SD ***Mean difference is significant at P<0.05***

Table 3: Heavy metals concentration in street dusts of Oshodi - Isolo and other selected cities of the world (mg/kg)

CITY	Pb	Zn	Cu	Cd	Ni
Oshodi - Isolo (this study)	**103.17**	**144.54**	**24.28**	**0.70**	**7.85**
Ottawa (Rasmussen *et al.*, 2001)	68.00	184.00	188.00	19.00	0.60
Madrid (De Miguel *et al.*, 1997)	1927.00	476.00	188.00	144.00	-
Oslo (De Miguel *et al.*, 1997)	180.00	412.00	123.00	41.00	1.40
Mutah (Manasreh *et al.*, 2010)	143.00	132.00	69.00	1.70	1.30
London(Schwar *et al.*, 1988)	1030.00	680.00	155.00	-	3.50
Kuala Lumpur (Ramlan *et al.*, 1988)	2466.00	344.00	35.50	-	2.90
Birmingham(Charlesworth *et al.*, 2003)	48.00	534.00	466.90	41.10	1.60
Amman((Jiries (2003))	976.00	401.00	249.60	16.30	1.10
Kavala(Christoforidis *et al.*, 2009)	386.90	354.80	172.40	67.90	0.20
Tehran (Mohsen *et al.*, 2012)	257.4	873.2	225.3	10.7	34.8

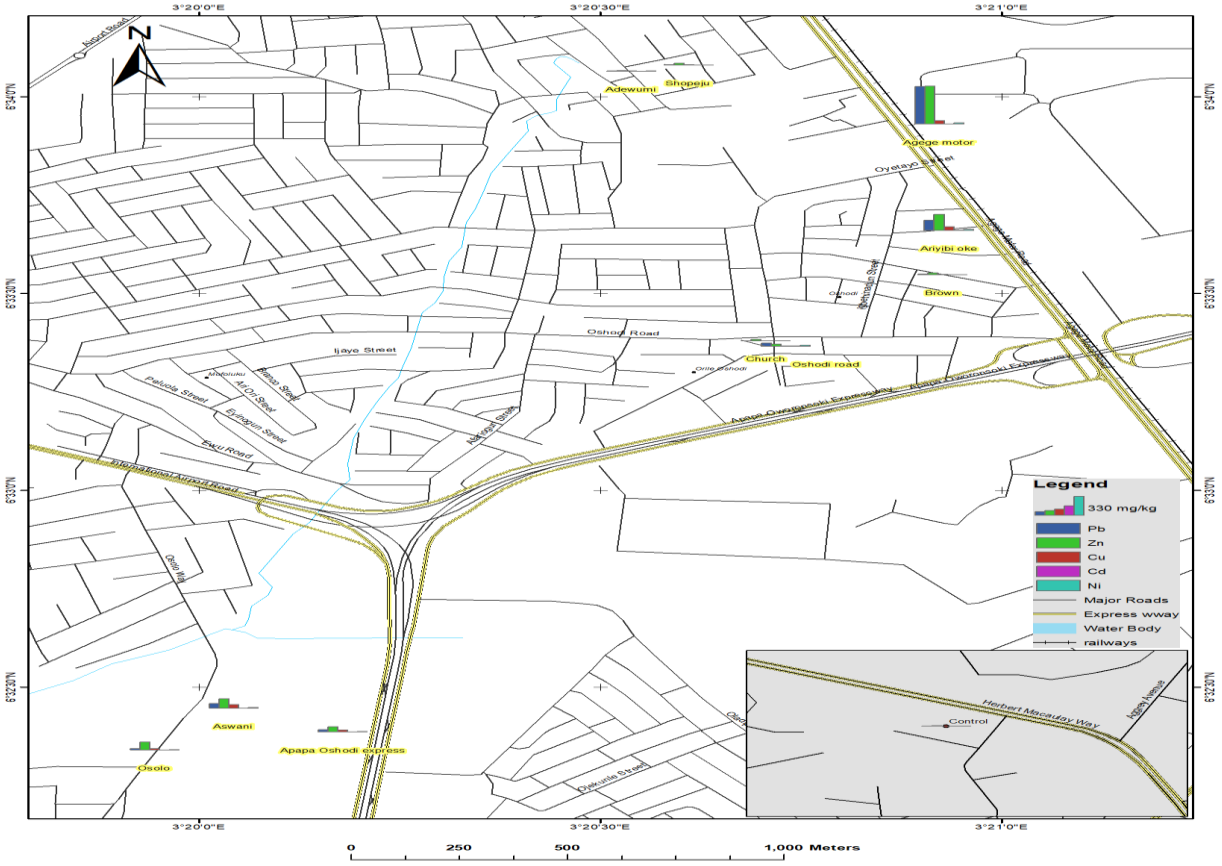

Figure 1: GPS Map of Oshodi - Isolo showing average mean concentration of Heavy metals in the study Area.

RESULTS AND DISCUSSION

Table 4: Mean Concentration of Heavy metals (mg/kg) of all the sites in Oshodi-Isolo Area for August - December, 2019.

Sample Location/ Sites	Pb (mg/kg)	Zn (mg/kg)	Cu (mg/kg)	Cd (mg/kg)	Ni (mg/kg)	Total
SPS	6.46	26.24	2.32	0.08	0.70	35.80
ADO	2.11	12.11	0.87	0.003	0.32	15.41
ASR	79.05	162.08	57.89	-0.11	12.25	311.38
APE	39.11	88.00	32.13	-0.01	5.25	164.51
OSW	19.89	136.75	24.38	-0.30	1.51	182.83
CHS	1.83	24.69	1.25	0.04	0.33	28.14
AGM	641.52	651.03	56.72	0.79	22.05	1372.11
OSR	57.10	38.11	5.12	2.49	16.104	118.92
ARS	174.45	274.77	58.27	2.3	18.69	528.48
BRS	9.41	28.40	3.25	0.74	1.241	43.04
BG(CTL)	0.80	3.25	0.57	0.12	0.024	4.78
Total	1031.73	1445.43	242.77	6.99	78.47	2805.39
Average	103.70	144.543	24.277	0.70	7.85	
Percentage %	36.78	51.52	8.65	0.25	2.79	100

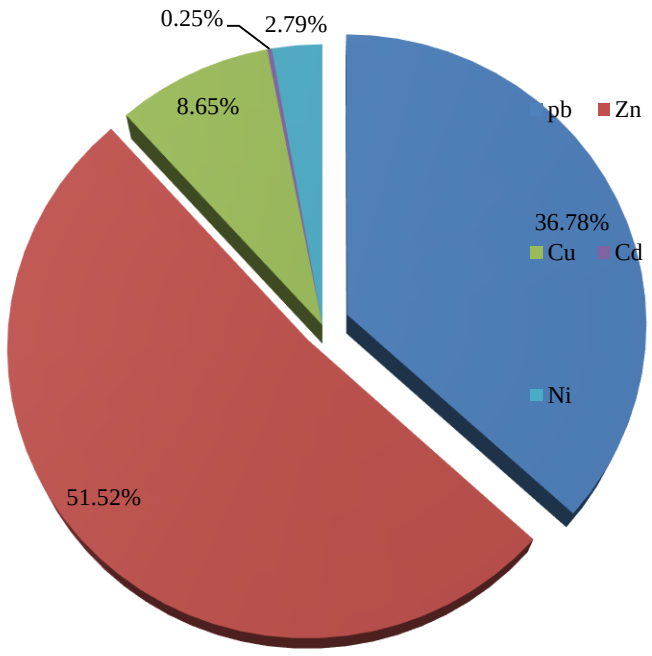

Figure 2: Percentage Contribution of Heavy metals in Oshodi- Isolo Area

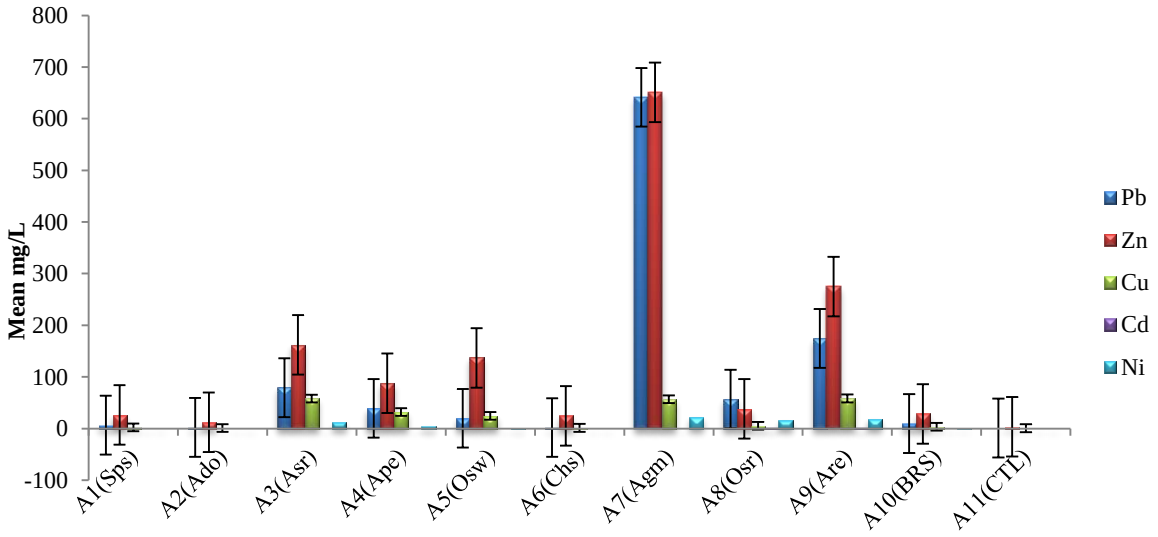

Figure 3: Average Concentration of Heavy metals in Oshodi - Isolo Area

The results of this research shows that the main contributors to the dust pollution in Oshodi- Isolo area are Zn- 51.52 %, Pb -36.78 %, Cu-8.65 % and to a lesser extent Ni -2.79% and Cd- 0.25 % (Figure 2). The most abundant Heavy metal in the dust of Oshodi- Isolo is Zn 1445.43 mg/kg followed by lead while Cd 6.99 mg/kg is the least abundant (Figure 3). The high presence of Zn may be due to emission of zinc originating from wearing of brake lining; losses of oil and cooling liquid, corrosion of galvanized steel safety fence, wearing of tyres etc; while nickel could be due to the combustion of fossil fuels, smelting of metals/steel and oil activities. Lead levels be could be attributed to emissions from vehicles which use leaded gasoline and to exhaust gas coming from fuel and from worn metal alloys which might have accumulated over times owing to its long residence time in the environment. The highest concentration of zinc was recorded at Agege motor road - 651.04 mg/kg while the least concentration was recorded at Adewumi Ogefun- 12.11 mg/kg. The highest concentration of lead was also recorded at Agege motor road - 641.63 mg/kg whereas the least concentration was recorded at Church Street - 1.94 mg/kg (Table 4). The high presence of lead at Agege motor road may be due to the high commercial, automobile and vehicular activities in the area, spillage of petroleum products, smoking of cigarettes, paint chips from the walls of industrial buildings, careless discard of lead acid batteries used in automotives as well as the use of industrial grade and non - domestic paints by the surrounding industries. The level of Lead at Agege motor road were significantly different ($p < 0.05$) from all other sites. The highest concentration of copper- 57.99 mg/kg and nickel- 22.12 mg/kg was recorded in Aswani road and Agege motor road respectively. Adewumi Ogefun has the least concentrations of copper -0.98 mg/kg and nickel- 0.43 mg/kg. The presence of copper may be due to the manufacturing of electrical cables, mining of metal, production of cans and the use of pesticides, combustion of fossil fuels, smelting of metals, vehicular emission, traffic congestion and industrial processes that uses these metals or their compounds. Furthermore, the presence of nickel in this site may be as a result of fuel combustion from generators as well as frequent bush burning in the surroundings. The highest concentration of cadmium was recorded at Oshodi road- 2.60 mg/kg while the least concentration was recorded at Osolo way - -0.39 mg/kg (Figure 2). The high significant levels of Zn, Pb and Cu obtained in the samples from Oshodi-Isolo is an indication of their concentration in the dust while the low concentration of

Cadmium Cd and Nickel Ni suggest low contributing factors to their spread and as well as dust inability to preferentially accumulate these metals (Figure 1). There is significant difference in the level of heavy metals in the study area ($P_v < 0.05$) (Table 1) . The sequence and pattern of distribution of Heavy metals content of Oshodi - Isolo dust is as follows: Zn > Pb > Cu > Ni > Cd, with the mean concentration of - 131.40, 93.79, 22.07, 7.11 and 0.48 mg/kg respectively (Table 2). The most polluted site is Agege motor road - 1372.11mgkg while the least polluted site is Adewumi Ogefun- 15.41 mg/kg. This could be as a result of both vehicular, human, commmercial and Industrial activities in the area. The trend and percentage contribution of each site to pollution of Oshodi - Isolo dust is as follows: AGM - 48.91 % > ARS- 18.84 % > ASR- 11.10 % > OSW- 6.52 % > APE- 5.86 % > OSR - 4.34 % > BRS-1.53 % > SPS- 1.28 % > CHS- 1.00 % > ADO- 0.55 % > BG(CTL)-0.17 % (Table 3). The result of this research agrees with the results obtained in some Nigerian cities and other cities in the world and also showed that concentration of heavy metals depends on the nature of activities in the sites (Adie *et. al.* 2014 ; Ekpo *et. al.*, 2012 ; Mohsen et al. 2012; Christoforidis *et al.*, 2009; Lu *et al.*, 2010; Karbassi et al. 2005 ; Ojiodu *et. al.* 2017; 2018a, 2018b). Though, the concentrations of Heavy metals (Zinc, Lead, Copper, Cadmium and Nickel) in Oshodi - Isolo dust may be high when compared with the values other cities in world (Table 3). This may be due to differences in vehicular and human activities (burning / dumping of waste), environmental management policies and technologies employed, frequency of city street cleaning and local meteorological conditions such as rains, temperature, windspeed which can affect the Heavy metals in the dust (Mohsen et al. 2012). The level of heavy metals in the study area were far greater than the recommended limits of the Federal Ministry of Environment (FME), European Communities (EC) and United Nations Environmental Programme (UNEP) permissible level for heavy metals in the atmosphere (EC, 2006). The concentration of heavy metals in all the sites was higher than the control value . This may be due to the fact that the control environment is an area with little or no anthropogenic activity.

CONCLUSION

It is evident that the dust of Oshodi - Isolo is highly polluted with the heavy metals Zinc Zn-144.54 mg/kg, Lead Pb-103.173 mg/kg, Copper Cu-24.277 mg/kg, Nickel Ni- 7.847 mg/kg and Cadmium Cd-0.699 mg/kg. The high concentration of these heavy metals could be attributed to vehicular, human, commmercial and Industrial activities in the area. Therefore, there is need for environmental Monitoring, safety and management of Oshodi - Isolo area due to the high concentration of these metal pollution which could be very hazardous to human and plants existence.

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