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Research Paper

Assessment of Spare part Sourcing and Recycling Activities Impact on the Availability of Lead, Cadmium and Total Petroleum Hydrocarbon in Evbareke Spare Parts Market Soil in Benin City, Nigeria

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Abstract

Recycling of spare parts obtained from dismantled unserviceable automobiles may be economical; however, it contributes to environmental degradation. The research was aimed at assessing the soil contamination intensity at Evbareke spare parts market automobile disassembling site. soil sample collection was separately pull together from top soil (0-20 cm) at automobile disassembling location and Evbareke senior secondary school serving as a reference/control site, using grid sampling method. The soil contamination level assessment index used include: relative pollution potential of the metals (RPP), single pollution index (SPI), geo-accumulation index (I_{geo}), average pollution index (API), total soil contamination index (TSCI) and pollution load index (PLI). The assessment was done with reference to data obtained from the control site soil as geochemical background value (C_B). The contaminated soil particle size was categorized as loamy sand with coarse texture. The contaminated site soil had high total organic carbon content (TOC) due to high value of the total petroleum hydrocarbon (TPH) (107,304.59 mg/kg). Lead and cadmium content in the geochemical fractionation of contaminated soil was more than that in reference site soil, due to human influenced contamination. RPP value revealed that the soil was contaminated at the impact point with lead and cadmium. The soil from the contaminated site soil was excessively contaminated with lead (37.11) and slightly contaminated with cadmium (1.57) based on SPI assessment. I_{geo} showed that the contaminated site soil was strongly contaminated with lead (3.21) and lightly contaminated with cadmium (0.05). The API assessment indicated that the soil was very highly contaminated by lead and cadmium (19.37). TSCI and PLI assessment showed that the contamination degree of the contaminated soil with lead and cadmium (38.68 and 13.98 respectively) was very high and the contaminant deteriorated the site. The impact of their activities has immensely contributed to lead, cadmium ions and petroleum hydrocarbon contamination in Evbareke spare parts market vehicle dismantling site soil.

1. Introduction

The activities of spare parts dealer to augment scarcity of spare parts of some vehicle has brought about sourcing for them by dismantling unserviceable vehicles and recycling the parts which has not worn out for reuse in repair of faulty vehicle. This activity may sound economical; however, it contributes to environmental degradation through spilling of unusable engine oil, fluids from condemned batteries and other electronic devices which find their ways into the soils through leaching (Moses and Obasigie, 2020). These wastes

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emanating from the activities of sourcing for spare parts can be very harmful to man on the long run due to the release of organic wastes and potentially toxic metal such as cadmium and lead into the soil environment (Menkiti et al., 2017).

Soil contamination by means of heavy metals has severe health consequence with respect to humans, animals and plants. However, some heavy metals are essential for their growth and normal functions at trace quantity such as Fe, Zn, Mn, Cu, Co and Ni but large quantity; they may instigate acute or chronic toxicity. Enduring consequence of lead (Pb) vulnerability to man and higher animals may trigger plumbism, anemia, nephropathy, gastrointestinal colic and central nervous system symptoms, while prolonged exposure to Cd can have detrimental consequences for instance lung cancer, bone fractures, kidney dysfunction and hypertension. (Addis and Abebaw, 2017; Bakshi *et al*., 2018; Proshad, *et al*., 2019). Pb and Cd have been discovered to hinder plant growth, intrude ion uptake and conveyance, including impeding enzyme activation and photosynthesis (Afolayan, 2018).

The subsequent release of heavy metals accumulated in soils or sediments to ground or surface water throw up an environmental hazard. Heavy metals contamination degree in these media is reliant on their sources, redox conditions, microbial activities and physicochemical properties of solid and aqueous phases. Heavy metals in soil generally refer to their bioavailability in the environment so that it can be absorbed or accumulated and have toxic effects on the biological traits of organisms (Meng, 2017; Bakshi *et al*., 2018). The heavy metals accumulated in soil possibly will be held, exchanged, precipitate or co-precipitate as sulphides, carbonate, oxide or hydroxide of iron (Fe) or manganese (Mn) by soil outside tolerable levels requests for worry because of damaging consequences of noxious metals on human, animals and plants. (Sarkar *et al*., 2014; Bakshi *et al*., 2018).

Owing to these activities of spare parts dealers, we found it necessary to carry out an evaluation of the effect of spare part sourcing bustles on availability of lead, cadmium and total petroleum hydrocarbon. in Evbareke spare parts market soil to enables us decide how to manage the contaminated site in a cost-effective manner while preserving public and ecosystem health.

2. Materials and Methods

2.1 Study Area

The research study area was the automobile disassembling site situated in Evbareke spare parts market (Latitude 6.3653^0 , Longitude 5.60850) and Evbareke senior secondary school (Latitude 6.3651^0 , Longitude 5.6113^0) was used as the control site, both in Edo State, Egor Local Government area - Nigeria (Figure 1). The distance between the contaminated site and the control site is 708.58 meter (Google, n.d)

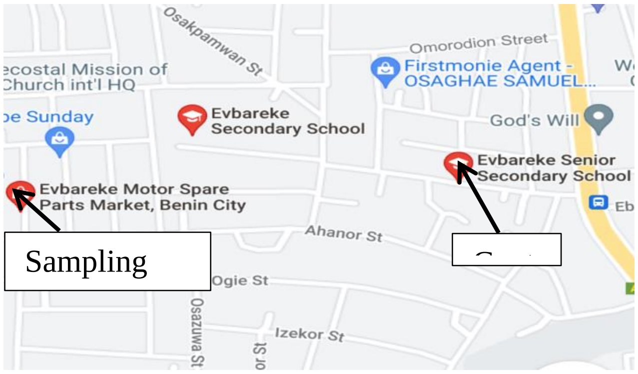

Figure 1: Map showing Evbareke spare parts market and Evbareke senior secondary school (Google, n.d).

2.2 Soil Sample Collection and Processing

The grid sampling method was employed for collecting soil sample. Samples were taken at regularly spaced intervals. A set of sixty (60) samples out of a possible sixty-four (64) sampling points of contaminated soil samples were gathered at the deepness of 0-20 cm using soil auger, on a land area of about 450m2. The soil samples collected were combined together to form a compound sample. The debris in the composite sample was removed after which it was air-dried at environmental temperature, crushed and sieved to give ≤ 2 mm particle size. The left over moisture was got rid of by heat up at 105±5 ^{0}C for 6 hours in an oven. Composite sample was kept in clean polyethylene bag, tied and stored prior to analysis. Same procedure was followed for the control site soil collection.

The soil composite sample from each site were individually physicochemically characterized for pH, Particle size analysis – Hydrometer method, electrical conductivity (EC), cation exchange capacity (CEC), total phosphorus (TP), total petroleum hydrocarbon

(TPH), total Organic carbon (TOC) and moisture content (MC) using standard method (North Central Region-13, 1998). Heavy metals in soil was determined using sequential extraction procedures (Fractionation), adopted from Tessier *et al.,* (1979). The heavy metal content in each fraction was analyzed using atomic absorption spectrophotometer (AAS).

2.3 Evaluation of Heavy Metal Contamination Degree in Soil

Heavy metal contamination degree was evaluated by means of relative pollution potential of the metals (RPP), single pollution index (SPI), geo-accumulation index (I_{geo}), average pollution index (API), total soil contamination index (TSCI), pollution load index (PLI) for the soil from Evbareke spare parts Market as a result of automobile disassembling bustles (Su *et al*., 2014; Moses and Obasigie *et al.*, 2020).

2.3.1 Relative Pollution Potential of the Metals (RPP)

Relative Pollution Potential of a Pollutant is a measure of the degree of chemical contact in the midst of the pollutant and the receiver. It is evaluated employing equation (1):

$$\mathrm{RPP} = \frac{C_{M} - C_{B}}{C_{M}} \qquad (1)$$

Where, CM is heavy metal concentration in contaminated soil site and C_B is heavy metal concentration in untouched soil at the control site. If the results give positive values for the metals in question on the contaminated sites, it indicates that the soil was contaminated at the point of impact (Anapuwa, 2014).

2.3.2 Single Pollution Index (SPI)/ Contamination factor (CF)

Single Pollution Index/Contamination factor of every single metal is a valuable way of measuring level of contamination comparative to either average earth crust constitution of particular metal or to the quantified background worth from geologically alike as well as unpolluted area. It is articulated as the relative amount of heavy metal concentration (CM) in soil to the acceptable degree of the country's standards or reference point worth. Heavy metal concentration in untouched soil at the control site was employed as background value (C¬¬B) (Gushit *et al*., 2018; Uzoije and Nwigwe, 2018): the SPI value is obtained using equation (2a) or (2b):

$$\mathrm{SPI} = C_m / C_B \text{ (with reference to control site)} \qquad (2a) \text{ or}$$

$$\mathrm{SPI} = C_m / T_L \text{ (with reference to NESREA standard)} \qquad (2b)$$

Where, T_L is acceptable degree or highest acceptable concentration (HAC) established on standards for soil quality as stated by the National Environmental Standard and Regulations Enforcement Agency (NESREA, 2009) - Nigeria (Rabe *et al*., 2018; Uzoije and Nwigwe, 2018; Proshad et al., 2019). The degree of contamination was assessed employing SPI predicting scale: <0.1 (Very slight contamination), 0.1-0.25 (Slight contamination), 0.26-0.50 (Moderate contamination), 0.51-0.75 (Severe contamination), 0.76-1.0 (Very severe contamination), 1.1-2.0 (Slight pollution), 2.1-4.0 (Moderate pollution), 4.1-8.0 (Severe pollution), 8.1-16.0 (Very severe pollution), >16.0 (Excessive pollution) (Weissmannova and Pavlovsky, 2017; Gushit *et al.,* 2018; Chonokhuu *et al.*, 2019).

2.3.3 Average Pollution Index (API)

Average Pollution Index (API) evaluates degree of contamination by taking into consideration the link consequence of all metal contaminant in soil. API is gotten via computing the ratios of the average metal concentration with the worth obtained from control site as geochemical background value. It is gotten applying equation (3a), (3b) and (3c) (Adedosu *et al*., 2013; Uzoije and Nwigwe, 2018):

$$\mathrm{API} = 1/n\,(\mathrm{SPI}_1 + \mathrm{SPI}_2 + \mathrm{SPI}_3 + \ldots\ldots + \mathrm{SPI}_n) \qquad (3a)$$

$$\mathrm{API} = 1/n\,(C_{m1}/C_{B1} + C_{m2}/C_{B2} + C_{m3}/C_{B3} + \ldots + C_{mn}/C_{Bn})$$
$$\text{(with reference to control site)} \qquad (3b)$$

$$\mathrm{API} = 1/n\,(C_{m1}/T_{L1} + C_{m1}/T_{L2} + C_{m1}/T_{L3} + \ldots. + C_{mn}/T_{Ln})$$
$$\text{(with reference to NESREA standard)} \qquad (3c)$$

where, C_{m1}, C_{m2}, C_{m3}………., C_{mn} are the average concentrations of the metal contaminants; T_{L1}, T_{L2}, T_{L3}…….., T_{Ln} are acceptable concentration for every single metal contaminants established on standards for soil quality as stipulated by NESREA, (2009); n is the total number of metals. Degree of contamination was projected by means of the following scale: API <1= low level pollution, 1≤API <3 = moderate level pollution, 3≤API <6 = considerable level of pollution, API≥6 = very high pollution (Cai *et al*., 2015; Chonokhuu et al., 2019).

2.3.4 Total Soil Contamination Index (TSCI)

The total soil contamination index (TSCI) most precisely describes the degree of contamination of soil by heavy metals or other microelements. The degree of contamination (DC) of one decided space is the addition of entire Contamination factors (CF)/single pollution index (SPI) (Bello *et al.*, 2016) TSCI is evaluated using equation (4).

$$\text{TSCI} = \sum_{i=1}^{n} SPI \text{ , where SPI} = C_m/C_B \qquad (4)$$

The degree of contamination is predicted as follows $DC<1$ (low), $1 \leq DC<3$ (moderate), $3 \leq DC<6$ (Considerable), $DC \geq 6$ (Very high) (Bello et al., 2016; Kowalska *et al.*, 2018).

2.3.5 Geo-accumulation index (I_{geo})

Geo-accumulation index is a calculation of heavy metal contamination degree linked by means of the soil from automobile dissembling site. Igeo value is achieved via equation (5) (Weissmannova and Pavlovsky, 2017; Chonokhuu et al., 2019):

$$I_{geo} = \log_2 (C_m/1.5C_B) \qquad (5)$$

Where, C_m is heavy metal concentration in contaminated soil and CB is geochemical background worth from control site.

The degree of contamination was projected applying: $I_{geo} \leq 0$ = uncontaminated, $0<I_{geo} \leq 1$= light to moderately contaminated, $1<Igeo \leq 2$ = moderately contaminated, $2<I_{geo}<3$ = moderately to strongly contaminated, $3<I_{geo} \leq 4$ = strongly contaminated, $4<I_{geo} \leq 5$= strongly to extremely serious contaminated, $5<I_{geo} \leq 10$= extremely seriously contaminated (Bello et al., 2016; Rabe et al., 2018; Chonokhuu et al., 2019).

2.3.6 Pollution Load Index (PLI)

Pollution load index evaluates level of contamination. It signifies the number of times the amount of metal in soil goes above the average natural background concentration and provides a combined suggestion of total heavy metal toxicity degree in specific sample. Control site soil sample was chosen to denote natural background. PLI can give an assessment of metal contamination standing and needed proceedings to follow. PLI is gotten from individual metal single pollution index with regard to natural background worth in soil using equation (6) (Ololade, 2014; Rabe et al., 2018):

$$\text{PLI} = (\text{SPI}_1 \times \text{SPI}_2 \times \text{SPI}_3 \times \ldots\ldots., \text{SPI}_n)^{1/n} \qquad (6)$$

PLI is categorized as PLI <1 = Soil Perfection; PLI=1= Baseline level of pollutants (Both class are unpolluted); moderately polluted (PLI = 1–3), highly polluted (PLI = 3–5) or very highly polluted (PLI > 5) (Darko et al., 2017; Kowalska et al., 2018; Uzoije and Nwigwe, 2018).

2.4 Mobility Factor (MF)

Metals mobility in soil can be assessed based on total and comparative measure of fractions weakly combined to soil constituent. Metal mobility relative index was evaluated as mobility factor (MF) based on equation 7:

$$\text{MF} = \frac{F_1+F_2+F_3}{F_1+F_2+F_3+F_4+F_5+F_6} \times 100 \qquad (7)$$

where, F_1 = Exchangeable, F_2 = Carbonate, F_3 = Fe/Mn Oxide, F_4 = Organic and F_5 = Residual

This equation is mainly the potential mobility of metals in soil (Topcuoglu, 2016; Topcuoglu, 2017).

3. Results and Discussion

3.1 Results

3.1.1 Physicochemical Characterization of Soil Samples

Results of physicochemical and geochemical characterization of the soil samples are shown in Table 1, depicting the quality of the contaminated soil as well as the control soil where automobile disassembly was not taking place.

Table 1: Results of Physicochemical Characterization of the Soil Samples

Parameters	Units	Contaminated soil	Control Soil
pH	-	6.24	5.43
Electrical conductivity	mS/cm	1.04	0.235
Total phosphorus	mg/kg	372.58	202.20
Total petroleum hydrocarbon	mg/kg	107,304.59	4.04
Cation exchange capacity	Cmol/kg	9.89	4.34
Total organic carbon	%	3.63	1.11
Moisture content	%	1.05	0.84
Particle size analysis	Clay (%)	4.38	5.88
	Silt (%)	3.60	7.60
	Sand (%)	92.02	86.52

3.1.2 Geochemical Characterization of Soil Samples for Lead and Cadmium

Geochemical characterization results for Lead and Cadmium in the contaminated soil as well as the control soil where automobile disassembly was not taking place is presented in Table 2.

3.1.3 Bioavailability and Mobility Factor of Lead and Cadmium in the Soil Samples vis-à-vis Highest Acceptable Concentration (HAC) by NESREA.

The results of evaluation of the bioavailability and mobility factor of lead and cadmium ion in the contaminated soil as well as the control soil site where dismantling activities was not taking place is presented in Table 3 and 4.

3.1.4 Mobility Factor Determination

Mobility Factor of Lead and cadmium in Soil Samples is presented in Table 4.

3.1.5 Level of Soil Contamination Assessment

The results of the level of soil contamination assessment with respect to control site soil and NESREA Tolerance limit as Background Values is presented in Table 5.

Table 2: Results of Geochemical Characterization of Soil Samples for Lead and Cadmium.

Fraction	Contaminated soil (mg/kg)		Control soil (mg/kg)	
	Lead	Cadmium	Lead	Cadmium
Soluble	0.21	0.03	BDL	BDL
Exchangeable	1.07	0.20	BDL	BDL
Carbonate-bound	7.50	0.20	0.71	BDL
Fe-Mn oxide bound	21.07	0.47	0.71	BDL
Organically bound	3.21	0.20	BDL	0.07
Residual	19.64	BDL	BDL	BDL
Total	52.70	1.10	1.42	0.70

BDL=below detectable level

Table 3: Bioavailable Lead and Cadmium of the Geochemical Fraction in the Soil Samples vis-à-vis highest acceptable Concentration (HAC) by NESREA.

Fraction	Contaminated soil (mg/kg)		Control soil (mg/kg)	
	Lead	Cadmium	Lead	Cadmium
Soluble	0.21	0.03	BDL	BDL
Exchangeable	1.07	0.20	BDL	BDL
Carbonate-bound	7.50	0.20	0.71	BDL
Total	8.78	0.46	0.71	BDL
HAC (NESREA, 2009)	10	3.0		

BDL=below detectable level

Table 4: Mobility Factor of Lead and cadmium in Soil Samples.

Fraction	Contaminated soil (%)		Control soil (%)	
	Lead	Cadmium	Lead	Cadmium
Soluble	0.40	2.73	0.00	0.00
Exchangeable	2.03	18.18	0.00	0.00
Carbonate-bound	14.23	18.18	50.00	0.00
Fe-Mn oxide bound	39.98	42.73	50.00	0.00
Organically bound	6.09	18.18	0.00	100.00
Residual	37.27	0.00	0.00	0.00
Mobility Factor	16.66	39.09	50.00	0.00

Table 5: Heavy Metals Assessment of Contaminated Soil with Respect to Control site soil and NESREA Tolerance limit as Background Values

Parameters	Contaminated soil Assessment			
	Pb^{2+}	Cd^{2+}	Pb^{2+}	Cd^{2+}
	Control site (as Geochemical background value-C_B)		NESREA tolerance level (T_L) (as Geochemical background value-C_B)	
RPP	0.97	0.36	0.80	-8.09
SPI	37.11	1.57	5.27	0.37
I_{geo}	3.21	0.05	1.26	-1.41
API	19.37		2.82	
TSCI	38.68		5.64	
PLI	13.98		0.76	

3.2 Discussion

3.2.1 Physicochemical Characterization of Soil Samples

The soil from the contaminated site had a higher total organic carbon content (TOC) likened to control site, attributable to its high hydrocarbon material waste product from disassembled automobiles. The high content of the hydrocarbon material waste product can help to increase the soil adsorption strength hence contributing to decrease in metal mobility as well as bioavailability. The higher quantity of the TOC was corroborated by the value of the total petroleum hydrocarbon (TPH) value of 107,304.59 mg/kg from contaminated soil likened to 4.04 mg/kg from the control site soil (Table 1). The contaminated site soil also had a higher CEC value of 9.89 Cmol/kg, however, because this value falls between 6 - 12 Cmol/kg as opined by Hazelton and Murphy, (2007), the cation exchange rating was low, signifying that the capability of contaminated soil to hold and exchange cation was higher than that of control site soil which had a CEC value lower than 6 Cmol/kg (4.34 Cmol/kg; Table 1). The value of electrical conductivity obtained from the contaminated site and control site soil revealed that they both possess some level of salts (or salinity) and they both fell within a range safe for all crops. Hanlon, 2012 stated that the values of 0-200mS/cm are safe for all crops (Table 1).

Flynn (2015) classified a pH variety of 6.2 – 6.7 for soil as slightly acidic as well as a variety from 3.0 – 5.6 as strongly acidic. This denotes that contaminated site soil was slightly acidic whereas the control site soil was strongly acidic. Metals have a tendency to be more accessible at lower pH as the pH increases toward 6.5 to 7 its availability reduces (Li and Thorton, 2001), this signified that metals availability in contaminated soil will be less owing to its higher pH worth of 6.24 compared to the control site with 5.43 pH value (Table 1). Particle size analysis showed that the contaminated soil fell into loamy sand class with coarse texture and control site soil fell into sandy loam class with moderately coarse general texture. In sandy loam soils, organic matter breakdown quicker than in fine-texture soils as a result of greater amount of oxygen on hand for their decomposition, while the breakdown of organic matters is slower in loamy sand. The content of total phosphorus in the forest soil characterized by Lemanowicz (2018), ranged from 157mg/kg to 376 mg/kg. The total phosphorus obtained from the contaminated site and the control site soil studied fell within this range an indication that the value of the total phosphorous obtained – 372.58 mg/kg and 202.20 mg/kg in that order (Table 1), were within safe zone for plants.

3.2.2 Geochemical Characterization of Soil Samples for Lead and Cadmium.

In the contaminated soil, the lead and cadmium quantity in the mobile phase fraction, that is, the sum of soluble, exchangeable and carbonate bound (8.78mg/kg and 0.43 mg/kg respectively, Table 2) are less than the lead and cadmium amount in the immobile phase of the fractionation, that is, the sum of Fe-Mn oxide bound, organic bound and residual (43.92mg/kg and 0.67mg/kg respectively, Table 2). In both the mobile phase and the immobile phase of the fractionation, the quantity of lead was very high compared to the quantity of cadmium. In the soil obtained from the control site, the lead in the mobile amounted to 0.71mg/kg while the cadmium was below detectable level. The quantity of the lead and cadmium in the immobile phase were 0.71mg/kg and 0.07mg/kg respectively. On the overall, the content of lead and cadmium in the geochemical fractionation of contaminated soil is greater than that of control site soil, this was an indication of anthropogenic contamination of the contaminated soil as a result of automobile disassembling activities.

3.2.3 Bioavailability and Mobility Factor of Lead and Cadmium in the Soil Samples vis-à-vis Highest Acceptable Concentration (HAC) by NESREA

An assessment of the sum of the lead and cadmium concentration in their soluble, exchangeable and carbonate fraction with highest acceptable concentration (H.A.C) from NESREA, (2009), revealed that lead and cadmium content in its mobile or bioavailable form in contaminated soil were below that of NESREA, likewise in control site soil the lead and cadmium were below the NESREA, (2009) tolerant level (Table 3). The mobility factors of lead and cadmium in contaminated soil - 16.6% and 39.09% respectively (Table 4), revealed that the cadmium had a higher mobility factor compared to lead. The mobility as well as bioavailability of lead and cadmium in the contaminated site soil are low. The low lability was due to the high amount of the organic waste from the automobile disassembling pursuits at the spare parts market, the low lability revealed that the organic waste had formed complexes with the heavy metals which are insoluble, resulting in reduced mobility and bioavailability. Nevertheless, the mobility factor of lead as well as cadmium in control site soil was 50% and 00% respectively (Table 4).

3.3 Level of Soil Contamination Assessment

The level of lead and cadmium contamination of the soil owing to automobile spare parts disassembling bustles was assessed using RPP, SPI, I_{geo}, API, TSCI and PLI. The values obtained for RPP revealed that the soil was contaminated at impact point with lead and cadmium as a result of the motor vehicle spare parts dismantling activities at the site with respect to control site values as the geochemical background value (C_B). However with NESREA tolerance limit as the geochemical background value (C_B), it was observed that the cadmium contaminant in the contaminated soil was not as a result of the bustles of motor vehicle spare parts dismantling because of the negative value obtained from its evaluation (-8.09; Table 5), the RPP value of the lead contaminant in the contaminated site using NESREA tolerance limit as the geochemical background value (C_B) confirmed that lead contaminant in the contaminated site soil was as a result of the motor vehicle spare parts dismantling activities at the site (0.80; Table 5).

Judging from the predicting scale of SPI, it was observed that soil from contaminated site where the automobile disassembling bustle occurred was excessively contaminated with Pb^{2+} (37.11) and slightly contaminated with cadmium (1.57) using Control site values as the geochemical background value (C_B). However, when NESREA tolerance level (T_L) was used as the geochemical background value-C_B), it revealed that the lead contaminant (5.27) severely contaminated the soil and the cadmium contaminant (0.37) moderately contaminated the soil (Table 5).

The predicting scale of geo-accumulation index revealed that the contaminated site soil was strongly contaminated with lead (3.21) and lightly contaminated with cadmium (0.05) using Control site values as the geochemical background value (C_B). However, using NESREA tolerance limit values as the geochemical background value (C_B), revealed that the lead contaminant (1.26) moderately contaminated the soil while there was no cadmium contaminant (-1.41) in the soil (Table 5).

The API assessment revealed that both lead and cadmium (19.37) very highly contaminated the soil with respect to control site as geochemical background value-C_B, while both contaminants (2.82) moderately contaminated the soil when NESREA tolerance level (T_L) was used as geochemical background value-C_B (Table 5). TSCI assessment revealed that the degree of contamination of the contaminated soil with lead and cadmium (38.68) was very high with respect to Control site as geochemical background value-C_B and their degree of contamination with respect to NESREA tolerance level values as geochemical background value-C_B was considerable (5.64) (Table 5).

The PLI employed to judge the contamination degree, revealed that amount of lead and cadmium in the contaminated site soil deteriorated the site in relation to control site as geochemical background value-C_B, while the use of NESREA tolerance level values as geochemical background value-C_B revealed that the lead and cadmium contamination did not in any way deteriorate the soil, in other words, the soil is in a perfect state.

4. Conclusion

The Activities of sourcing for spare parts through dismantling of unserviceable vehicle for reusable parts has contributed immensely to Cd^{2+}, Pb^{2+} ions and petroleum hydrocarbon contamination of Evbareke spare parts market vehicle dismantling site soil. The contaminated site's soil had high total organic carbon content (TOC) due to high value of the total petroleum hydrocarbon (TPH) value. The mobility as well as bioavailability of lead and cadmium in the contaminated soil, with a mobility factor of 16.6% and 39.09% respectively, is low, due to high amount of organic waste from the automobile disassembling bustles at the spare parts market. The assessment parameters revealed that the soil was contaminated at the point of impact with lead and cadmium. The contaminated soil was excessively or strongly contaminated with Pb^{2+} and slightly or lightly contaminated with cadmium. The lead and cadmium very highly contaminated the soil and their degree of contamination of the contaminated site soil was very high and the contaminant deteriorated the contaminated site soil with reference to control site soil.

Implication

National Environmental Standards and Regulations Enforcement Agency of Nigeria (NESREA) should as a matter of urgency promulgate laws which carries heavy fines or jail term attached as well as come up with ideal methods of disposing wastes arising from this spare parts sourcing process so as to reduce or eliminate incessant environmental contamination occasioned by this process through dismantling of unserviceable automobiles. Also, materials which can help to immobilize the heavy metals as well as adsorb the hydrocarbon waste should be developed to help fight the already contaminated environment.

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