The Impact of Discharged Automotive Oil on Heavy Metal Concentrations on Soil Around Mechanic Workshops in Nasarawa West Senatorial District, Nasarawa State Nigeria.

[1]U. Yahaya; [2]P.C. Madu; [2]B.W Tukura and [3]Gav B.L

[1]Department of Science Laboratory Technology, Federal Polytechnic Nasarawa,NIGERIA.
[2]Department of Chemistry, Nasarawa State University, Keffi, NIGERIA
[3]Department of Chemistry, Federal University of Agriculture P.M.B 2373, Makurdi, NIGERIA

Abstract: The concentrations of some heavy metals in soil of Nasarawa West Senatorial District were analyzed using a standard method. Composite soil samples were drawn from depths of 0-15cm in three different locations for each local government in the Senatorial District and analyzed using Atomic Absorption Spectrophotometer (AAS). The results of the heavy metal concentrations (Cobalt, Zinc, Cadmium, Copper, Nickel, Manganese, Chromium, and Lead) as presented in tables, generally showed elevation in metal ion concentrations around automobile workshops investigated vis-a-vis the impact of the automobile workshops in metal ion concentrations. The values obtained from the analysis showed that most of the values of metal concentrations are higher than the recommended WHO standard. This may be as a result of percolation, dissolution or diffusion which may likely occur.

KEYWORDS: Automotive Oil; Mechanic Workshop; Heavy Metals and Soil.

DOI of the Article: https://doi.org/10.46501/IJMTST0708029

Available online at: http://www.ijmtst.com/vol7issue08.html

As per UGC guidelines an electronic bar code is provided to seure your paper

To Cite this Article: U. Yahaya; P.C. Madu; B.W Tukura and Gav B.L. The Impact of Discharged Automotive Oil on Heavy Metal Concentrations on Soil Around Mechanic Workshops in Nasarawa West Senatorial District, Nasarawa State Nigeria.. *International Journal for Modern Trends in Science and Technology* 2021, *7*, 0705090, pp. 169-176. https://doi.org/10.46501/IJMTST0708029

Article Info. Received: 09 July 2021; Accepted: 07 August 2021; Published: 17 August 2021

INTRODUCTION

The increase in population worldwide has led to a high level of industrialization and urbanization, which in turn have led to environmental pollution arising from the indiscriminate discharge of industrial effluents. These effluents may contain most common heavy metals, such as Hg, Zn, Cu, Co, Pb, Cr (Madu *et al.;* 2007). There is need for research and public information on these metals, otherwise unknown dangers may create irreparable environmental damage. (Olonisakin *et al.*;2005).

Heavy metals are natural components of the earth crusts. They are stable and persistent environmental contaminants of coastal waters and sediments. Since they cannot be degraded or destroyed, they enter our bodies via food chain, drinking water and air (Lawrence, 1990). Examples of heavy metals include mercury (Hg), cadmium (Cd) arsenic (Ar) chromium (Cr) lead (Pb) nickel (Ni) zinc (Zn), and selenium (Se). Interest in metals like Zinc, Copper, Iron and Selenium which are required for metabolic activity in organisms lies in the narrow path between their essentiality and toxicity. Other heavy metals like lead, cadmium and mercury may exhibit extreme toxicity even at low levels under certain conditions, thus necessitating regular study, monitoring and assessment of heavy metal pollution of sensitive aquatic environment (Nriagu, 1996).

Some heavy metals (e.g., Fe and Zn) are important elements needed by both plants and animals in small quantity for their normal body development and physiological functions including effective immune system. They play regulatory function in the body tissues and are then discharged out of the body. Hence, their regular supply in the body is essential (Aremu *et al.;* 2008). However, the dietary concentration of one heavy metal can affect the availability of other heavy metals. (Aremu *et al.*;2006).

MATERIALS AND METHODS

2.1 MATERIALS

Soil sample, nitric acid,sulphuric acid, hydrofluoric acid, hydrogen peroxide, potassium chloride, sallicyclic acid, Barrium chloride, potassium chromate, silver nitrate, potassium dichromate, manganese sulphate, magnesium sulphate, ferric chloride, phosphate buffer, Sodium hydroxide, deionized water, atomic absorption spectrophotometer, spectrophotometer, UV-visible spectrometer, microwave digestion system, weighing balance, measuring cylinder, sample bottle, hydrochloride Beaker, evaporated dish, hot plate, Oven, Crucible, Agate Mortar, Nylon sieve.

2.2 METHODS

Soil samples (10g) collected during the dry and Rainy season were weighed and air dried in the laboratory. The weighed sample was pulverized with an agate mortar and then sieved through a nylon sieve with a pore diameter of $\leq$ 0.149mm. The sieved sample (2g) was weighed into a tetrafluoroethylene beaker and mixed with 6cm^3 of concentrated nitric acid (HNO_3), concentrated hydrochloric acid 3 cm^3 and 25 cm^3 of concentrated hydrogen peroxide and then heated in microwave digestion system (GEM mass) for 3hr until a clear colourless solution was obtained. The digested solution was then diluted to 500cm^{3}with deionized water and filtered through a 0.45µm micro-porous membrane. The filtered solution 1 cm^3 was measured and diluted to 10cm^3 and stored in bottles prior tometal analysis using Inductively Coupled Atomic Absorption Spectrophotometer (AA-6800 SHIMADZU) as described by Udousoro*et al.;* 2010. The whole experimental procedure was repeated using soil sample from wet season.

Heavy metal content determinations

The level of heavy metals cobalt, zinc, cadmium, copper, manganese, chromium and lead in the filtrates of the digested samples were determined using Atomic Absorption Spectrophotometer (SHIMAZU) by aspirating sample solution into the machine. Three (3) replicate determination of each sample were carried out for each of heavy metals etc.

RESULTSAND DISCUSSION

3.1 RESULTS.

Table 1: Seasonal Concentration (mg/L) of heavy metals in soil from TOTO L.G.A.

Rainy Season

	Gadabuke		Toto		Tudu-Uku	
Element	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
Co	79.72 ± 7.25	9.09	53.13 ± 4.29	8.07	33.82 ± 2.78	8.22
Zn	5.11 ±0.45	8.81	6.72 ± 0.68	10.12	4.47 ± 0.42	9.40
Cd	2.12 ± 0.24	11.32	2.91 ± 0.38	13.06	1.12 ± 0.11	9.82
Cu	1.62 ± 0.19	11.73	2.93 ± 0.37	12.63	2.62 ± 0.25	9.54
Ni	15.61 ± 1.43	9.16	0	ND	8.48 ± 0.72	8.49
Mn	32.17 ± 2.63	8.18	12.73 ± 1.02	8.01	15.68 ± 4.62	29.46
Cr	2.06 ± 0.27	13.11	11.15 ± 1.02	9.15	5.22 ± 0.46	8.81
Pb	35.47 ± 2.88	8.12	32.37 ± 2.62	8.09	0	ND

Table 2: Seasonal Concentration (mg/L) of heavy metals in soil from TOTO L.G.A.

Dry Season

	Gadabuke		Toto		Tudu-Uku	
Element	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
Co	82.24 ± 7.39	8.99	65.52 ± 4.35	6.64	35.42 ± 3.07	8.67
Zn	7.31 ± 0.69	9.44	7.17 ± 0.71	9.90	4.83 ± 0.48	9.94
Cd	0	ND	0	ND	2.17 ± 0.32	14.75
Cu	2.72 ± 0.39	14.34	4.51 ± 0.35	7.76	4.26 ± 0.44	10.33
Ni	18.43 ± 1.78	9.66	166.53 ± 15.07	9.05	10.22 ± 0.95	9.39
Mn	34.51 ± 2.73	7.91	14.31 ± 1.56	10.90	16.33 ± 4.66	28.54
Cr	0	ND	15.53 ± 1.68	10.82	6.81 ± 0.75	11.01
Pb	38.23 ± 3.05	7.98	39.44 ± 2.7	6.85	42.23 ± 3.37	7.98

Table 3: Seasonal Concentration (mg/L) of Heavy Metals in soil from Nasarawa L.G.A.

Rainy Season

	Mararaba		Nasarawa		Shamagye	
Element	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
Co	0	ND	0	ND	26.67 ± 2.26	8.47
Zn	20.07 ± 1.63	8.12	48.42 ± 3.91	8.08	2.77 ± 0.22	7.94
Cd	1.61 ± 0.16	9.94	2.82 ± 0.25	8.87	1.93 ± 025	12.95
Cu	1.63 ± 0.16	9.82	1.68 ± 0.13	7.74	2.45 ± 0.26	10.61
Ni	50.37 ± 4.17	8.28	0	ND	14.19 ± 1.15	8.10
Mn	140.26 ± 9.81	6.99	224.55 ± 18.05	8.04	142.53 ± 11.47	8.05
Cr	11.83 ± 0.92	7.78	14.47 ± 1.26	8.71	7.23 ± 0.67	9.27
Pb	5.22 ± 0.43	8.24	68.81 ± 4.86	7.06	53.21 ± 4.37	8.21

Table 4: Seasonal Concentration (mg/L) of Heavy Metals in soil from Nasarawa L.G.A.

Dry Season

	Mararaba		Nasarawa		Shamagye	
Element	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
Co	26.42 ± 2.84	10.75	26.91 ± 2.98	11.07	28.21 ± 3.23	11.45
Zn	25.43 ± 2.38	9.36	55.37 ± 4.23	7.64	0	ND
Cd	3.13 ± 0.37	11.82	4.32 ± 0.36	8.33	2.98 ± 0.23	7.72
Cu	3.37 ± 0.38	11.28	2.77 ± 0.27	9.75	3.27 ± 0.34	10.40
Ni	66.87 ± 5.24	7.84	33.81 ± 2.65	7.84	17.62 ± 2.17	12.32
Mn	188.33 ± 8.72	4.63	264.52 ± 2.91	3.67	185.61 ± 12.13	6.54
Cr	166.24 ± 7.47	4.49	173.44 ± 7.65	4.41	9.15 ± 2.32	25.36
Pb	13.48 ± 0.02	0.15	72.22 ± 5.17	7.16	64.42 ± 4.84	7.51

Table 5: Seasonal Concentration (mg/L) of Heavy Metals in soil from Kokona L.G.A.

Rainy Season

	Agwada		Garaku		Kufan-Gwari	
Element	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
Co	0	ND	0	ND	71.23 ± 6.41	9.00
Zn	122.43 ± 11.04	9.02	46.24 ± 3.72	8.04	8.36 ± 0.82	9.81
Cd	31.12 ± 3.18	10.22	2.26 ± 028	12.39	2.38 ± 0.23	9.66
Cu	1.24 ± 0.19	15.32	2.06 ± 0.27	13.11	2.02 ± 0.28	13.86
Ni	37.02 ± 3.38	9.13	24.09 ± 1.19	4.94	11.18 ± 0.19	1.70
Mn	359.21 ± 28.78	8.01	70.91 ± 5.08	7.16	141.28 ± 9.91	7.01
Cr	20.38 ± 1.62	7.95	8.52 ± 0.51	5.99	0.75 ± 0.13	17.33
Pb	24.03 ± 2.26	9.40	13.51 ± 1.27	9.40	62.52 ± 5.05	8.08

Table 6: Seasonal Concentration (mg/L) of Heavy Metals in soil from Kokona L.G.A.

Dry Season

	Agwada		Garaku		Kufan-Gwari	
Element	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
Co	75.03 ± 6.64	8.85	69.91 ± 6.57	9.40	78.82 ± 6.71	8.51
Zn	148.185 ± 12.81	8.64	48.61 ± 4.07	8.37	12.62 ± 2.07	16.40
Cd	4.63 ± 0.48	10.37	3.62 ± 0.38	10.50	3.22 ± 2.3	71.43
Cu	0	ND	4.34 ± 0.49	11.29	0	ND
Ni	39.88 ± 3.46	8.68	32.52 ± 3.57	10.98	16.37 ± 2.91	17.78
Mn	361.53 ± 29.18	8.07	76.33 ± 5.49	7.19	146.72 ± 10.37	7.07
Cr	25.43 ± 2.64	10.38	9.62 ± 1.29	13.41	2.32 ± 0.28	12.07
Pb	27.33 ± 275	10.06	18.51 ± 3.22	17.40	66.22 ± 5.64	8.52

Table 7: Seasonal Concentration (mg/L) of Heavy Metals in soil from Keffi L.G.A.

Rainy Season

	Keffi-Nasarawa Junction			Keffi-Main Garage			S/G keffi (NYSC)		
Element	**Mean**	**SD**	**CV**	**Mean**	**SD**	**CV**	**Mean**	**SD**	**CV**
Co	0	0	ND	20.52	1.85	9.02	0	0	ND
Zn	5.14	0.52	10.12	83.63	5.95	7.11	3.54	0.37	10.45
Cd	1.53	0.17	11.11	1.16	0.17	14.66	2.12	0.27	12.74
Cu	0.81	0.18	22.22	2.03	0.26	12.81	2.45	0.26	10.61
Ni	1.15	0.18	15.65	6.91	0.67	9.70	17.63	1.46	8.28
Mn	14.91	1.27	8.52	92.91	6.55	7.05	15.91	1.17	7.35
Cr	24.81	2.08	8.38	3.36	0.38	11.31	15.71	1.37	8.72
Pb	3.12	0.28	8.97	3.12	0	ND	31.33	2.58	8.23

Table 8: Seasonal Concentration (mg/L) of Heavy Metals in soil from Keffi L.G.A.

Dry Season

	Keffi-Nasarawa Junction			Keffi-Main Garage			S/G keffi (NYSC)		
Element	**Mean**	**SD**	**CV**	**Mean**	**SD**	**CV**	**Mean**	**SD**	**CV**
Co	32.61	2.85	8.74	24.48	2.04	8.33	28.08	2.62	9.33
Zn	8.46	0.98	11.58	88.61	6.08	6.86	5.42	0.81	14.94
Cd	3.21	0.37	11.53	0	0	ND	4.15	0.36	8.67
Cu	0	0	ND	2.91	0.28	9.62	3.52	0.37	10.51
Ni	0	0	ND	8.42	0.97	11.52	18.23	2.62	14.37
Mn	17.54	2.17	12.37	144.81	6.64	4.59	16.31	1.38	8.46
Cr	25.21	2.37	9.40	4.81	0.78	16.22	18.22	1.66	9.11
Pb	9.43	2.08	22.06	12.43	2.08	16.73	36.61	2.85	7.78

Table 9: Seasonal Concentration (mg/L) of Heavy Metals in soil from Karu L.G.A.

Rainy Season

	Karu		Nyanya		karshi	
Element	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
Co	26.6 ± 1.92	7.22	0	ND	20.51 ± 1.26	6.14
Zn	1.72 ± 0.16	9.30	40.61 ± 2.48	6.11	0	ND
Cd	0.81 ± 0.18	22.22	2.21 ± 0.26	11.76	1.91 ± 0.17	8.90
Cu	2.42 ± 0.29	11.98	2.91 ± 0.28	9.62	1.82 ± 0.11	6.04
Ni	18.33 ± 1.15	6.27	11.49 ± 0.28	7.14	53.81 ± 4.39	8.16
Mn	13.71 ± 1.14	8.32	30.92 ± 2.51	8.12	29.17 ± 2.64	9.05
Cr	9.21 ± 0.66	7.17	14.41 ± 1.35	9.37	11.19 ± 0.75	6.70
Pb	37.54 ± 3.07	8.18	2.16 ± 0.12	5.56	13.51 ± 1.18	8.73

Table 10: Seasonal Concentration (mg/L) of Heavy Metals in soil from Karu L.G.A.

Dry Season

	Karu		Nyanya		Karshi	
Element	**Mean**	**CV**	**Mean**	**CV**	**Mean**	**CV**
Co	42.22 ± 2.76	6.54	41.52 ± 2.68	6.45	26.32 ± 2.57	9.76
Zn	0	ND	45.53 ± 2.87	6.30	52.34 ± 2.91	5.56
Cd	0	ND	4.62 ± 0.77	16.67	3.04 ± 0.36	11.84
Cu	3.35 ± 0.37	11.04	4.82 ± 0.48	9.96	3.41 ± 0.33	9.68
Ni	22.13 ± 2.47	11.16	14.23 ± 1.26	8.85	56.42 ± 4.58	8.12
Mn	16.81 ± 1.87	11.12	36.52 ± 1.91	5.23	34.22 ± 2.91	8.50
Cr	13.21 ± 1.76	13.32	15.71 ± 2.67	17.00	14.22 ± 1.46	10.27
Pb	40.23 ± 3.87	9.62	11.62 ± 2.17	18.67	16.63 ± 1.58	9.50

DISCUSSION

The analysis of heavy metals in soil sample are summarized in table 1-10 cobalt in soil throughout the world result from a concentration of natural and man's activities. The highest concentration of cobalt is recorded at Gadabuke 82.24mg/L (dry season) and lowest is record at Karshi 20.51mg/L. cobalt was not detected at Mararaba, Nasarawa, Agwada. Garaku, Keffi Nasarawa junction and Nyanya.

The concentration of cobalt from the result obtained is greater than the WHO standard in soil sample (WHO= 5.0mg/L) (1998) the higher concentration of this metal could be as result of natural deposit.

The zinc content in all the soil has a highest mean concentration of 148.19mg/L (dry season) in Agwada and the lowest mean concentration of zinc is 1.72mg/L (rain season) Karu. Their value is higher than that of the control and suggests that, there is anthropogenic contribution. Since no industry exists in the vanities of their area, it is assume the elevation of zinc level to be from the ant mechanic clusters since this element is found as part of many additives to lubricating oils (Abenchi et al. 2010). However, the concentration of zinc in this investigation is higher compared with many other researchers (Nwanchukwu*et al.*; 2010, Nwanchukwu*et al.*; 2011 and that of Shinggu *et al.*; 2007), although it is comparable in that of soil analyzed in Yawiri, North western Nigeria (Yahaya*et al.*; 2010). The value of zinc obtained from this investigation control to be above maximum allowable limits (Lacatusu, 2000).

The mean concentration of cadmium examined at various location shows that the metal has highest concentration in Agwada 31.12mg/L (rainy season) and lowest in Karu 0.81mg/L (rainy season). The metal not detected at Gadabuke, Keffi-main garage and Karu (dry season). The result obtained was within the range as obtained by the relatively relaxed criteria acceptable in Germany (Lacatusu 2000). The value obtained for the elevated cadmium concentration is consistent with that of Ghosh M & Singh SP. (2005) that investigated heavy metal in soil of auto-mechanic workshop and referee dump soil in other parts of Makurdi, control Nigeria. The value was also in the same range as throe reported by other researchers in other part of Nigeria such as (Abauchi *et al.*; 2010 Adelekan and Alawode 2011). The accumulation of cadmium in this study area is likely to come from lubricating oils, vehicle wheels and metal allow used for hardening of engine parts (Dabkowska-Naskret, 2004). There is a wide spread of copper in almost all the location except in Agwada, keffi-Nasarawa junction and Kufan Gwari (Dry season) where the metal was not detected. The highest concentration of copper is in Nyanya 4.82mg/L (dry season). And lowest in Keffi-Nasarawa. Junction 0.81mg/L (rainy season) the values obtained for copper concentration is within the maximum allowable limit of WHO (WHO 5.0mg/L, 2007). There values were below the maximum allowable limit if Australia Canada, Poland, and Great Britain (10.0mg/L) (Lacatusu, 2000). The distribution of capper in the location is ascribed to automobile warless cantering electrical and electronic

parts such as copper, wires, electronic and copper pipes and allows from corroding vehicle scraps which have littered the vicinity of their workshop for a long time with metal released from the corrosion gradually leaching in to the concentration of nickel in the soils investigated shows highest concentration of the metal is recorded in Total 166.53mg/L and lowest in Keffi-main garage is recorded 6.91mg/L. that metal was not detected at Toto and Nasarawa junction in the rainy season and also not detected in keffi Nasarawa junction in the dry season. The value obtained from the investigation is relatively higher then values of 11. 5 mg/L in Ipeaiyeda*et al.;*(2007) and 17.38mg/L recorded by Iwegbue *et al.;* (2006). Although the result were higher than that reported by Lutre *et al.*; (2011)(48.6mg/L). They are also higher than that in India as reported Krishna and Govil (2007). Like other metal the distribution of nickel in their location could be attributed to the disposal of sprat automobile batteries from the nearby auto-battery charges which could have contributed to the contamination of the soil sample (Udousoro *et al.;* 2010). In most cases, however, the concentration of Nickel was above the maximum allowable limits for heavy metals in soil regulated by various countries, which suggests that, for there is little anthropogenic contribution.

Manganese (Mn) is among the more abundant element in the earths cannot and is widely distribution in soil, sediment, rocks, and water (Shrivastra and Mishra, 2011). The highest concentration of manganese is reported in Agwada 361.53mg/L and the lowest is reported in Toto 12.73mg/L there is a very wide distribution of the metal in allocation. The concentration of the shied areas is above the WHO maximum allowable limit. Kimberly and Williams, 1999, Karen, 2005 reports that there is no soil quality criteria established for manganese in the investigation, it would appear that the level of manganese in the soil studied is building up substantially, especially in Agwada, keffi-main garaged and Kufan Gwari , and the need to be monitored to present any further increase becomes necessary.

Chromium is one of those heavy metal the environment concentration of which is steadily increasing due to industrial growth, especially the development of metal, chemical and tanning industrial (Adepoju *et al,;* 2012). The highest concentration of chromium is recorded in Nasarawa 173.44mg/L (dry season) and lowest is in Kufan Gwari 0.75mg/L. the metal was not detected Gadabuke (dry season). Result obtained in the lowest investigation showed that the concentration of chromium in some of the location is above the maximum allowable limit of WHO (WHO 0.50mg/L, 2008). Ghosh and Finch (2005) Observed that non-biodegradability of chromium is responsible for it, persistence in the environment, once mixed in soil it undergone transformation into various mobile before ending into the environmental sink (Onder *et al,;* 2007). The result of the analysis of lead concentration showed that the highest value is recorded in Nasarawa 72.22mg/L and the lowest is in Nyanya 2.16mg/L. lead was not detected at Tudu-Uku and Keffi main garage. Just like other metal analyzed, the concentration of the metal was above the recommended limit while in some location the metal is with the maximum allowable limit (WHO 2.0mg/L, 2008). The value obtained in this study was lower than 19.62mg/L reported by Nwachnkwu *et al.;* (2011) for auto-mechanic workshop area in Oweri, south-East Nigeria. However, the level are in line with throe reported by Udousoro *et al.;* (2010) in South-South Nigeria and throe in industrial area in North-west Nigeria, but above that reported by *Pam et al.;* (2013) in central Nigeria. Allowable limit of lead concentration varies widely with countries (Lacatusu, 2000). Virtually all the level of lead obtained in this study are above the acceptable limit for soil in several countries. It in reported that lead has the composition of heavy metal in waste oils (Oguntimehin *et al.;* 2008).

CONCLUSION

There are many different chemicals, substances and process used in auto-mechanic workshops, which are potentially dangerous, both to the environment and to health of human beings and also affect the plants around. This is very clear from the results of the analytical investigation of the heavy metals analysis of soil from the sample sites of Nasarawa West Senatorial district that there is high degree of contamination and pollution. It was observed that the various pollutants (heavy metals) build up to very high concentration in the soils, and thereby percolate into the wells around the auto-mechanic workshop thereby posing great threat to the people that consume the water and eat from the plant grown around the auto-mechanic

workshop and also great hazards to the soil. The soil quality becomes compromised. Most of the heavy metals analyzed and the level of their presence can hardly support soil animal life.

REFERENCES

[1] Abenchi ES, Okunola OJ, Zubariu SMJ, Usman A.A &Apene E, (2010). Evaluation of Heavy metals in road side soils of major streets in Jos Metropolis, *Nig. J. Environ. Chem. Ecotoxicol.***2 (6): 98-102**

[2] Adelekan BA &Alawode AO (2011).Concentrations of Municipal Refuse Dumps to Heavy Metals Concentrations in Soils Profile and Ground Water in Ibadan, *Nigeria J. of Appl. Biology.40:2727-2737.*

[3] Adepoju – Bielle A.A, Issa O.A, Oguntibejuin O.O, Ayoola G.A Adejumo O.O (2012) Analysis of some selected toxic metals in registered herbal products manufactured in Nigeria. Afri J. Biotech 11:6918-6922.

[4] Anoliefo, G O; Vwioko, D E (2001). Tolerance of Chromolaena odorata (L)K. and R. grown in soil contamination with spent lubrication oil. Journal of Tropical Biosciences, 1:20-24.

[5] Aremu, M.O; Sagari D.U.; Musa B.Z. &Chanda M.S. (2008).Assessment of Ground Water and Stream Quality for Heavy Metals and Physico-chemical Contamination in Toto local Government Area, Nasarawa State. *International Journal of Chemical Science*. 2(1): 8 -11.Ipeayeda AR, Dawodu M, Akand T. (2007), Heavy Metals concentration of topsoil and dispersion in the vicinities of reclaimed auto-repair workshops in Iwo, Nigeria. Research J. Appl. Sci. 2(11): 1106-115.

[6] Iwegbue CMA, Isirimah NO, Igwe C, Williams ES, (2006). Characteristics level of heavy metals in soil profiles in automobile mechanic waste dumps in Nigeria. Environmenalist, 26:123-128. 17.

[7] Lacatusu R. (2000). Appraising levels of soil contamination and pollution with heavy metals. In: H.j Heineke W, Eckelmann A.J, Thommason RJ, Jones A, Montanarella L, Buckley B(Eds.). European soil Bureau – Research Report No. 4 Section 5(7): 393-403. The European Soil Bereau Joint Research Centre 1 – 201020 ISPRA – Italy.

[8] Lawrence, W. (1990) Vitamin – Mineral therapy, Reviewed from http:/w.w.w. any vitamins. com/copper.htm. *J. Science* .272: 223-224.

[9] Levy D.V, Barbarick KA, Siemer E.G, and Sommers L.E. (1992) "Distribution and partitioning of trace metals in contaminated soils near Leadville, Colorado," Journal of Environmental Quality, vol. 21, no. 2, pp. 185–195. View at Google Scholar · View at Scopus

[10] Luter L, Akaahan T.J, Attah S. (2011) Heavy metals in soils of auto mechanic shops and refuse dumpsite in Makurdi, Nigeria. J. Appl. Sci. Environ. Mange. 15(1): 207-210.

[11] Madu, P.C; Adoda R.A. Ehitonihu C.A. &Moumouni A. (2007). Analysis of some heavy metals in selected soil in Keffi town, Nasarawa state Nigeria. *Indiana journal of multidisciplinary research Res. Vol. 3.*

[12] Nriagu, J.O; (1996). History of global metal pollution science *J. Science.272: 223-224.*

[13] Nwachukwu MA, Feng H &Alinor J (2011). Trace metal Deposition in soil from Auto-mechanic village to urban residential areas in Owerri, Nigeria.Proc. Environ. Sci. 4:310-322.

[14] Nwachukwu M.A, Feng H, Achilike K(2010). Intergated study for automobile waste and environmentally ffriendly mechanic village in the Imo river Basin Nigeria Afr. J Environ. Sci, Technol., 4(4): 234-249 Available onlune at www.academicjournals.org/AJEST.

[15] Oguntimehin I & Ipinmoroti KO (2008). Profile of heavy metals from automobile workshops in Akure, Nigeria. *J Eviron.Sci Technol*. 1 (7):19-26.

[16] Onder S, Dursun S. Demirbas A. (2007). Determination of heavy metal pollution in Grass and soil of City Centre Green Area (Konya, Turkey.) Polish J. of Environ. 16(1): 145-154.

[17] Pam A.A, Sha;ato R, Offem JO. (2013). Contributions of automobile mechanic sites of heavy metals in soil: A case study of North Bank Mechanic Village Makurdi, Benue State, central Nigeria J. Chem. Biol. Physical Sci. 3(3): 2337-2347.

[18] Shrivastava KBL & Mishra SP (2011). Studies of various Heavy Metal in Surface and Ground water of Birsinghpur town and its surrounding rural area district Satna (M.P). Curr world Environ.6:271-274.

[19] Udousoro II, Umoren IU &Asuquo EO (2010).Survey of some heavy metal concentrations in selected soil in South Eastern parts of Nigeria.*World J. Appl. Sci. Technol.2(2):139-144.*

[20] USEPA (1996) Report: recent Developments for In Situ Treatment of Metals contaminated Soils, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response.

[21] World Health Organization (WHO),(2006).Guidelines for drinking-water quality criteria.3rd edition incorporating 1st& 2nd addenda, 1: 13-33

[22] World Health Organization, WHO (1996).World Health Organization .guidelines for drinking-water quality. 2ndEdn., vol. 2, Health criteria and supporting information, WHO, Geneva.

[23] World Health Organization, WHO (2004). The Guidelines for Drinking water quality, third edition.www.who.int/water-sanitation-health/dwq/gdwq 3rev.

[24] World Health Organization, WHO (2014). The Guidelines for Drinking water quality, third edition.www.who.int/water-sanitation-health/dwq/gdwq 3rev

[25] Yahaya MI, Ezeh GC, Musa YF, Mohammed SY (2010), Analysis of heavy metals concentration in road side soil in Yauri, Nigeria. Afri .J. Pure Apple. Chem. 4(3): 22-30.