HEAVY METALS FOUND IN THE SOILS AT AUTOMOBILE MECHANIC WORKSHOPS IN OBOSI, IDEMILI NORTH L.G.A OF ANAMBRA STATE.

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ABSTRACT: The concentration of Cu, Cd, Cr, Hg and Pb in automobile mechanic workshops in Obosi, Idemili North Local Government Area of Anambra State Nigeria, have been determined to ascertain the exert level of these heavy metals in the soils within the study area. Six soil samples were collected from six different mechanic workshops. The samples were prepared,digested and analyzed using Atomic Absorption Spectrophotometer (AAS) machine. The soil samples contain mean values of 2.403ppm of Pb, 0.6385ppm of Cd, 5.8223ppm of Cu and 0.000ppm of Hg. The heavy metals were found to be higher in concentration levels for Cu, Cr, Cd and Pb compared to the Minimum Concentration Level (MCL). The result obtained indicates that the soils in the automobile mechanic workshops have been impacted highly with Cu, Cd, Cr and Pb.

Keywords: Soil, Heavy Metals, Automobile Mechanic workshop, Obosi, Anambra state.

INTRODUCTION:

Heavy metals are natural components of the earth's crust with a large variation in concentration. They are referred to as heavy metals because their densities are five times heavier than water. Heavy metals are among the most notorious contaminants of soil, food crops and ground water because of their abundant biochemical and physiological effects despite their low concentrations. (Ogbuagu et al, 2008).

Heavy metals may have toxic effects on plants, animals and humans and their toxicity is linked to their mobility in soil. The greater the mobility of the heavy metals the higher the toxicity risk. Heavy metal mobility depends mainly on soil properties. Accordingly, one important process affecting heavy metal mobility in soil is sorption: sorption is the phenomenon in which metal ions which typically bear a positive charge are attracted to solid particles in the soil such as organic matter which mostly bear a net negative charge. This binding is often reversible and metals bound unto the solids are in equilibrium with metals in the soil water. This means that strongly retained metal ions are removed from the soil water and becomes less mobile than weakly retained ions. (Abodunde et al, 2009).

The activities in Obosi automobile mechanic workshops ranges from dismantling of vehicles, disposal of petrol, washing of engine and other automobile parts, combustion, fluid leakage, component wear and corrosion of batteries and metallic parts such as radiators represents important sources of heavy metal accumulation and contamination of the environment in Obosi.

Most metals with important commercial uses are toxic and hence undesirablefor indiscriminate release into the environment. Such metals includes zinc (Zn), copper (Cu), lead (Pb), chromium (Cr), mercury (Hg) and cadmium (Cd).

Heavy metals are metals that their atomic masses are heavier than 50.0 with the exception of the halogens and the noble gasses. Most of these heavy metals are transition elements because they have an incomplete d-sub shell in at least one of their compounds. (Wilson et al, 2005).

A metal is regarded as heavy metal when its density is $5gcm^{-3}$ or more and such metals are lethal when consumed above the allowed concentration level. This is because the solubility of these discharges renders the metals easily introduced into the food chain and hence accumulates in the human body after injection which results in serious disorders. (Babel and Kurniawan, 2004).

Examples of these heavy metals include, vanadium, chromium, cobalt, copper, cadmium, mercury, nickel lanthanide and actinide series.

These heavy metals are required in varying amounts by living organisms. Humans require them as food supplement, for plants they serve as micro-nutrients essential for growth. Examples include iron, cobalt, lead, manganese, zinc e.t.c.

Metals like mercury and plutonium are toxic to human health and have no beneficial effect on organisms; their accumulation overtime in the bodies of animals can cause severe illness. Some elements at certain condition which are normally toxic for certain organisms, under certain conditions are beneficial to others. Examples vanadium, cadmium and tungsten. (Lane and Morel, 2010).

Environmental pollution is the introduction of waste matter into the environment by man and this causes damage or deterioration to the living organisms and environment.

Heavy metals can persist for a long time within different organic and inorganic colloids before becoming available to living organisms. They are non-biodegradable and therefore endanger human beings and wildlife. (Adedekan and Abegunde, 2011).

These metals accumulate the soils, plants and aquatic body. Soil chemistry distinguishes heavy metals as a special group of elements because of their toxic effects on plants.

Sometimes, we assume that heavy metal pollution is always associated with intensive industrial nearness, most often this is not the case. Roadways and automobiles are the largest sources of heavy metals, metals released from road travel accounting for greater percentage of the total metals in road run-off.

With the substitution of leaded gasoline, lead concentration is decreasing whereas the brakes releases copper,tyres releases zinc, and motor oil accumulates metal as the engine runs. So, discarded oil becomes another source of heavy metal into the environment. (Fairfax, 2013).

Most metals in the environment are cations and some soil particles carry negative charges at the various sites of the organic matter, if the metal is attached to the negative site, the metal is trapped in the soil.

However, if the metal becomes soluble it becomes more dangerous because it can be easily transported and made available to plants and animal. In this case, there is heavy metal bioaccumulation. (Ezenweke L.O, 2017).

In aquatic environment, streambeds exhibit similar charge characteristics that heavy metals tend to be sequestered at the bottom of water bodies. Some of the dissolved metals become more susceptible to the harmful effects of heavy metal pollution to the aquatic environment because of prolonged contact with the soluble metals. Most common heavy metal pollutants in our fresh water are As, Cd, Cu, Ni, Pb and Hg. On reaching the fresh water with low pH, metal solubility increases and the metal particles become more mobile and more toxic. (Ezenweke L.O, 2017).

The symptoms of heavy metal poisoning include nausea, vomiting, profuse sweating diarrhea and metallic taste in the mouth, based on the metal; there may be blue-black line in the gums. In severe cases, patient exhibit obvious impairment of cognitive, motor and language skills. (Michael, 2010).

BACKGROUND OF STUDY:

Living organisms require varying amounts of heavy metals such as lead, iron, cobalt, manganese and zinc. Humans also require these elements as food supplements in varying amounts. Excessive levels can be damaging to the organism and even cause death. Heavy metals like mercury and plutonium are toxic metals that have no beneficial effects on organisms and their accumulation overtime in the bodies of man and animal can cause severe illness. Certain elements which are normally toxic for certain organism under certain conditions are beneficial to others. Examples includes cadmium, tungsten and vanadium. (Lane and Morel, 2010).

MATERIALS AND METHODS

SAMPLE COLLECTION

Soil samples were collected from automobile mechanic workshops at Obosi, Idemili North Local Government Area of Anambra state, Nigeria on the 24th of April, 2017.
They were collected by using hand trowel to dig 3cm deep into the soil and obtain six soil samples from six different mechanic workshops in Obosi which werecollected using hand gloves and plastic containers with lids which was labeled as samples A, B, C, D, E and F.

SAMPLE PREPARATION:

In the laboratory, samples A, B, C, D, E and F was prepared for digestion by thus:
Six filter papers was weighed empty using the analytical weighing balance calibrated to 0.00. 10grams each of the soil samples A, B, C, D, E and F was weighed using the analytical weighing balance and wrapped in a foil paper, this foil paper was labeled A, B, C, D. E and F according to the soil sample it contains.

ASHING: This is the process of heating the soil samples in a laboratory oven for 3 hours at 6080C, this helps to release the mineral contents in the soil samples. After 3 hours of ashing,

the samples were unwrapped and the soil sample poured into beakers labeled A, B, C, D, E and F according to the soil sample it contains. 20% of tetraoxosulphate(vi)acid was prepared by adding 20ml of tetraoxosulphate(vi)acid to 80ml of water and stirred vigorously. 20ml of 20% of tetraoxosulphate(vi)acid was added to beakers A, B, C, D, E and F. Containing samples A, B, C, D, E and F. These beakers were covered tightly with foil paper before heating on the heating mantle to avoid splashing.
After heating there was reduction, so distilled water was added to these beakers to 50ml/mg and filtered using filter paper. The filtrate was collected in sterile plastic bottles.

The six digested soil samples from automobile workshops in Obosi were analyzed for heavy metals namely; copper, chromium, lead, mercury and cadmium using Varian AA240 Atomic Absorption Spectrophotometer equipment at Spring Board Research Laboratories Awka according to APHA 1995, American Public Health Association.

WORKING PRINCIPLE OF ATOMIC ABSORPTION SPECTROPHOTOMETER (AAS):

The principle of the AAS machine lies on the Beer-Lambert's law, which states that the quantity of light absorbed by a substance dissolved in a fully transmitting solvent is directly proportional to the concentration of the substance and the path length of the light through the solution.
Mathematical representation of Beer-Lambert's law:

$$A = \text{Log}10\ (IO/I) = \epsilon lc$$

Where the constant ϵ= molar absorptivity.

PREPARATION OF REFERENCE SOLUTION:

This was carried out by using the standard method for the analysis. A series of standard metal solutions in the optimum concentration range was prepared, the reference solutions were prepared by diluting the single stock element solutions with water containing 1.5 ml of conc. HNO_3 acid/liter. A calibration blank was prepared by plotting the absorbance of standard versus their concentrations.

RESULTS AND DISCUSSION

The results of the analysis conducted are presented in the tables below.
TABLE 1: Table 1 contains the results of lead (Pb) in samples A, B, C, D, E and F.

Element (ppm)	Sample A	Sample B	Sample C	Sample D	Sample E	Sample F
Lead (Pb)	3.634	1.600	1.581	1.526	4.094	1.985

Mean $\overline{x} = \Sigma x / n$

$$= \frac{3.634 + 1.600 + 1.581 + 1.526 + 4.094 + 1.985}{6}$$

$$= 2.403\text{ppm}$$

Standard deviation $S.D = \sqrt{\Sigma (x - \overline{x})^2 / N}$

TABLE 2: table2: shows the standard deviation for lead (ppm).

Samples	X	x- $\bar{x}$	(x- $\bar{x}$)^2
A	2.403	1.231	1.5154
B	2.403	-0.803	0.6448
C	2.403	-0.822	0.6756
D	2.403	-0.877	0.7691
E	2.403	1.691	2.8595
F	2.403	-0.418	0.1747

$\Sigma(x- \bar{x})^2 = 6.6391$

S.D $=\sqrt{\Sigma(x- \bar{x})^2/N}$

S.D for lead (ppm) = 1.0519

TABLE 3: shows the results of mercury (Hg), in samples A, B, C, D, E and F.

Element (ppm)	Sample A	Sample B	Sample C	Sample D	Sample E	Sample F
Mercury	0.00	0.00	0.00	0.00	0.00	0.00

Mean $\bar{x} = \Sigma x/n = 0.00$ppm

Standard deviation $=\sqrt{\Sigma(x- \bar{x})^2/N} = 0.00$

TABLE 4: shows the results of cadmium (ppm) in samples A, B, C, D, E and F

Element (ppm)	Sample A	Sample B	Sample C	Sample D	Sample E	Sample F
Cadmium	0.75	0.050	0.166	0.508	0.088	2.269

Mean $\bar{x} = \Sigma x/n = \frac{0.75 + 0.050 + 0.166 + 0.508 + 0.088 + 2.269}{6}$

$= 0.6385$

Standard deviation $=\sqrt{\Sigma(x- \bar{x})^2/N}$

TABLE 5: shows the standard deviation for cadmium (ppm) in samples A, B, C, D, E and F.

Samples	X	$x-\bar{x}$	$(x-\bar{x})^2$
A	0.75	0.1115	0.0124
B	0.050	-0.5885	0.3463
C	0.166	-0.4725	0.2233
D	0.508	-0.1305	0.0170
E	0.088	-0.5505	0.3031
F	2.269	1.6305	2.6585

Standard deviation $=\sqrt{\Sigma(x-\bar{x})^2/N}$

S.D for cadmium (ppm) = 0.7703

TABLE 6: shows the results of copper (ppm) in samples A, B, C, D, E and F.

Element	Sample A	Sample B	Sample C	Sample D	Sample E	Sample F
Copper (ppm)	5.827	4.049	8.184	4.984	3.839	8.051

$$\text{Mean } \bar{x} = \Sigma x/n = \frac{5.827 + 4.049 + 8.184 + 4.984 + 3.839 + 8.051}{6}$$

$$=5.8223$$

TABLE 7: shows the standard deviation for copper (ppm) in samples A, B, C, D, E and F.

Samples	X	$x-\bar{x}$	$(x-\bar{x})^2$
A	5.827	0.0047	0.00002209
B	4.049	-1.7733	3.1446
C	8.184	2.3617	5.5776
D	4.984	-0.8383	0.7027
E	3.839	-1.9833	3.9335
F	8.051	2.2287	4.9671

Standard deviation $=\sqrt{\Sigma(x-\bar{x})^2/N}$

S.D for copper (ppm) = 1.7477

TABLE 8: shows the results of chromium (ppm) in samples A, B, C, D, E and F

Elements	Sample A	Sample B	Sample C	Sample D	Sample E	Sample F
Chromium (ppm)	3.046	2.868	3.242	1.705	2.163	2.114

Mean $\overline{x} = \Sigma x/n = \dfrac{3.046 + 2.868 + 3.242 + 1.705 + 2.163 + 2.114}{6}$

= 2.523ppm

Standard deviation $=\sqrt{\Sigma(x-\overline{x})^2/N}$

TABLE 9: shows the standard deviation values for chromium (ppm)

Samples	X	$x-\overline{x}$	$x-\overline{x})^2$
A	3.046	0.523	0.2735
B	2.868	0.345	0.1190
C	3.242	0.719	0.5170
D	1.705	-0.818	0.669
E	2.163	-0.36	0.1296
F	2.114	-0.409	0.1673

Standard deviation $=\sqrt{\Sigma(x-\overline{x})^2/N}$

S.D for chromium (ppm) = 0.2135

TABLE 10: shows the mean and standard deviation values for elements in samples A, B, C, D, E and F.

Elements	Symbols	Standard deviation values	Mean values
Lead	Pb	1.0519	2.403
Mercury	Hg	0.000	0.000
Cadmium	Cd	0.7703	0.6385
Copper	Cu	1.7477	5.8223
Chromium	Cr	0.2135	2.523

TABLE 11: shows the mean values of the heavy metals in samples A, B, C, D, E and F and the Minimum Concentration Level (MCL) of these elements according to Barakat, 2011.

Elements	Symbols	Mean values (ppm)	MCL (ppm)
Lead	Pb	2.403	0.006
Mercury	Hg	0.00	0.0003
Cadmium	Cd	0.6385	0.010
Copper	Cu	5.8223	0.250
Chromium	Cr	2.523	0.050

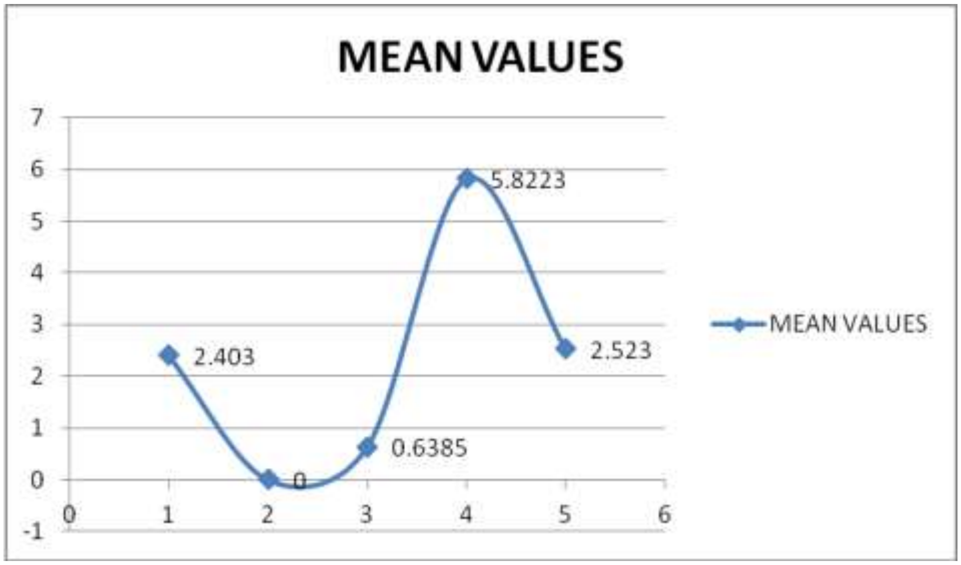

FIGURE 1: A graph showing the values for mean of heavy metals found in samples A, B, C, D, E and F.

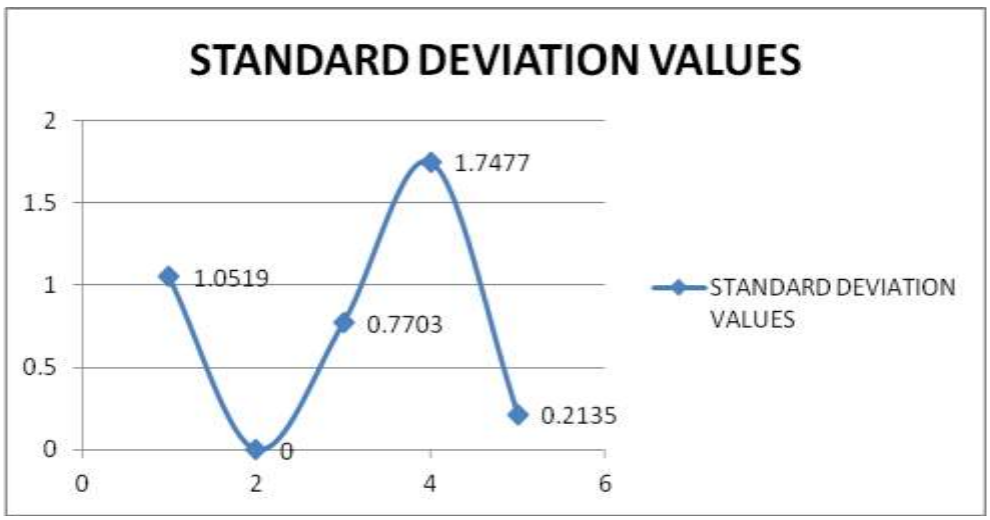

FIGURE 2: A graph showing the values for the standard deviation of elements in samples A, B, C, D, E and F.

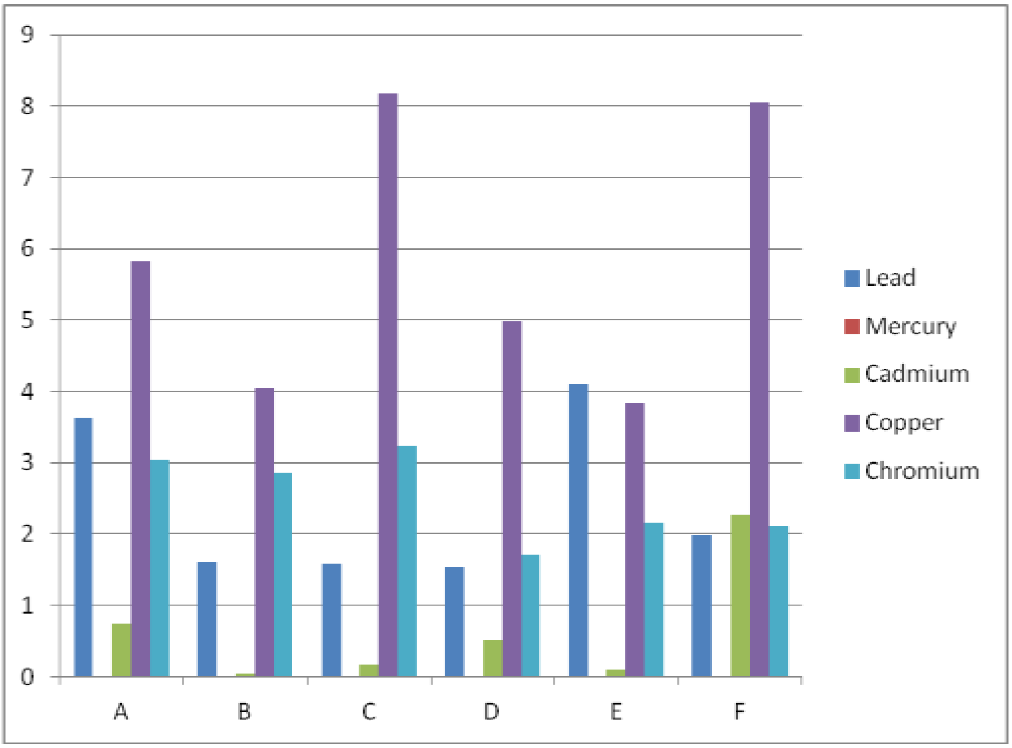

FIGURE 3: A bar chart showing the individual elements and their values in samples A, B, C, D, E and F.

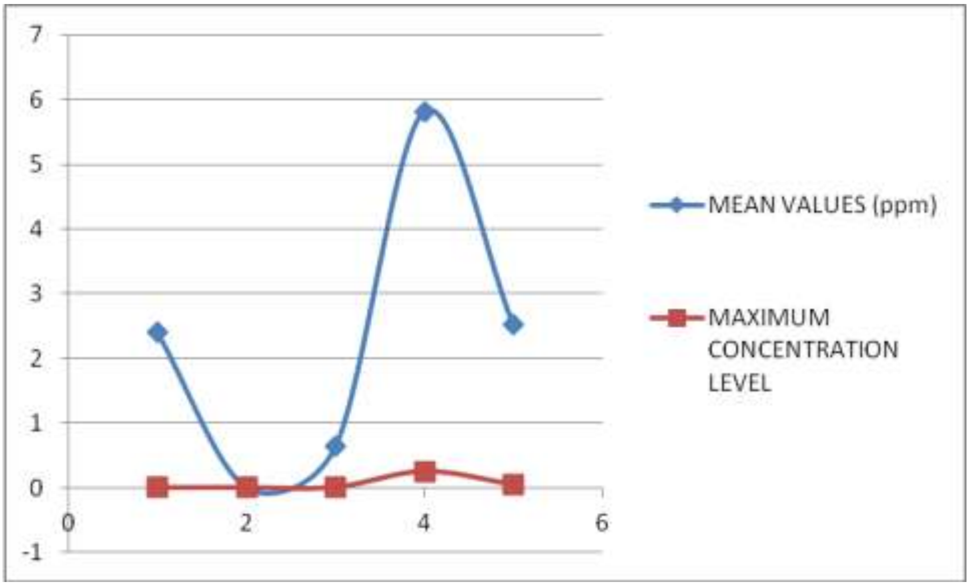

FIGURE 4: shows the mean values of heavy metals and the toxicity Minimum Concentrated Values. (MCL).

TABLE 12: The results obtained from the soil analysis of six samples collected from six different mechanic workshops in Obosi are shown below:

Parameters	A	B	C	D	E	F
Lead ppm	3.634	1.600	1.581	1.526	4.094	1.985
Mercury ppm	0.00	0.00	0.00	0.00	0.00	0.00
Cadmium ppm	0.75	0.050	0.166	0.508	0.088	2.269
Copper ppm	5.827	4.049	8.184	4.984	3.839	8.051
Chromium ppm	3.046	2.868	3.242	1.705	2.163	2.114

DISCUSSION

The heavy metals found in these soil samples are influenced by emissions from the automobiles such as lubricating oil, brake emissions, grease, tetraethyl lead (TEL) which is added as an anti-knock in gasoline, and wastes from engine oil. The distribution of individual elements reflects the concentration in the automobile mechanic workshop where the samples were collected.
For sample A, there are total values of;3.634 Pb, 0.00 Hg, 0.75 Cd,5.827 Cu and 3.046 Cr, comparing the concentrations of the elements in sample A and the toxicity minimum concentration level according to Barakat, I observed that only Hg fell within the permissible limit, whereas Pb, Cd, Cu and Cr were higher in concentration above the permissible limit.
For sample B, there are total values of;1.600 Pb, 0.00 Hg,0.050 Cd, 4.049 Cu and 2.868 Cr, comparing the concentrations of the elements in sample A and the toxicity minimum

concentration level according to Barakat, I observed that only Hg fell within the permissible limit, whereas Pb, Cd, Cu and Cr were higher in concentration above the permissible limit.
For sample C, there are total values of;1.581 Pb,0.00 Hg, 0.166 Cd,8.184 Cu and 3.242 Cr, comparing the concentrations of the elements in sample A and the toxicity minimum concentration level according to Barakat, I observed that only Hg fell within the permissible limit, whereas Pb, Cd, Cu and Cr were higher in concentration above the permissible limit.
For sample D, there are total values of;1.526 Pb,0.00 Hg,0.508 Cd, 4.984 Cu and 1.705 Cr, comparing the concentrations of the elements in sample A and the toxicity minimum concentration level according to Barakat, I observed that only Hg fell within the permissible limit, whereas Pb, Cd, Cu and Cr were higher in concentration above the permissible limit.
For sample E, there are total values of; 4.094 Pb, 0.00 Hg, 0.088 Cd, 3.839 Cu and Cr 2.163,comparing the concentrations of the elements in sample A and the toxicity minimum concentration level according to Barakat, I observed that only Hg fell within the permissible limit, whereas Pb, Cd, Cu and Cr were higher in concentration above the permissible limit.
For sample F, there are total values of; 1.985 Pb, 0.00 Hg, 2.269 Cd, 8.051 Cu and 2.114 Cr,comparing the concentrations of the elements in sample A and the toxicity minimum concentration level according to Barakat, I observed that only Hg fell within the permissible limit, whereas Pb, Cd, Cu and Cr were higher in concentration above the permissible limit.
Comparing these results, I observed that mercury was not found at all in all the samples, therefore Obosi automobile mechanic workshops where I collected the samples from are free from mercury poisoning, the other four heavy metals; chromium (Cr), lead (Pb), copper (Cu) and cadmium (Cd) were observed to be above the Minimum Concentration Level (MCL).
This result shows that the people who live and work around and within Obosi where the samples were collected are at a great risk of heavy metal poisoning.

CONCLUSION:

In conclusion, using the AAS machine, I analyzed six soil samples from six different workshops in Obosi for five heavy metals, copper, chromium, lead, mercury and cadmium shows that possible health implications like, kidney damage, renal disorder, human carcinogen, nausea, diarrhea, vomiting, liver diseases, Wilson disease, insomnia, damage of foetal brain , circulatory and nervous systems damages. Also persistence of these metals in the soil of automobile mechanic workshops in Obosi may lead to increased uptake of these metals by plants and can also contaminate ground water.

RECOMMENDATION:

- Phytoremediation and stabilization should be tried in Obosi and any other areas where there is high concentration level of heavy metals in the soil.
- Regular survey of these heavy metals should be carried in Anambra State and other parts of Nigeria for environmental pollution monitoring of these heavy metals in our environment.
- The production and importation of leaded gasoline in Nigeria should be discouraged by the federal government.

- Environmental active groups, e.g. Environmental Protection Agency (EPA), non-governmental organization and communities' needs to be encouraged financially by the federal government towards education and awareness on the use and discarding of the offending items (gasoline, metal scraps, lubricating oil e.t.c.).

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