Heavy Metals And Microbial Load Of Soil Contaminated With Calcium Carbide Waste From Panel-Beater's Workshop In Five Communities In Delta State, Nigeria

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Abstract: This study was carried out to investigate heavy metals and microbial load of soil contaminated with calcium carbide waste from panel-beater's workshop in five communities in Delta State, Nigeria. The soil samples used for this study were collected from five calcium carbide waste dumpsite (contaminated) and five non calcium carbide waste dumpsite (non-contaminated). The contaminated soil samples were collected from panel beaters workshops in Eku, Ekpan-Effurun, Obiarukwu, Abraka and Japka-Effurun, while the non-contaminated soil samples were collected across the road in opposite directions from the contaminated sites along the same route, all in Delta State. The samples obtained were analysed for microbial load using standard pour plate techniques and heavy metal concentration using Atomic Absorption Spectrophotometer. The results obtained shows that the difference observed in the heavy metal contents between contaminated and non-contaminated soil samples in Eku, Ekpan-Effurun, Obiarukwu, Abraka and Jakpa- Effurun, was not significant ($P > 0.05$). A significant difference was however observed in the heavy metal contents for all the locations put together ($P<0.05$). it also shows that, the difference in microbial count between contaminated and non-contaminated samples was not significant for Eku, Ekpan-Effurun, Obiarukwu, and Jakpa-Effurun ($P > 0.05$), but was significant between contaminated and non-contaminated samples in Abraka ($P < 0.05$). Calcium carbide contaminated soil had higher microbial load and higher heavy metal concentration than non-contaminated soil. Therefore, building pit systems, where these calcium carbide waste will be collected and properly treated before releasing them into the soil, to eliminate the hazards of such contaminations is highly recommended.
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Introduction

Soils are the major deposit point for heavy metals released into the environment by these anthropogenic activities. Unlike organic contaminants which are oxidized to Carbon (IV) Oxide by microbial actions, most metals do not undergo microbial or chemical degradation (Kirpichtchikova *et al.,* 2006), and their total concentration in soils persists for a long time after their introduction (Adriano, 2003). Maslin and Maier (2000) opined that the presence of toxic metals in soils can severely inhibit the biodegradation of organic contaminants. Heavy metal contamination of soil may pose risks and hazards to humans and the ecosystem through direct ingestion or contact with contaminated soil (Adriano, 2003).

Heavy metals have been variously defined as those metals with higher atomic number and weight. It may also be defined as large group of elements with an atomic density of greater than 6gcm-3, which are both biologically and industrially important or any metallic chemical element that has a relatively high density and is toxic or poisonous at low concentration (Ezejiofor *et al.,* 2013). They are trace metals that are at least five times denser than water, and as such, they cannot be metabolized by the body (stable elements) and are passed up the food chain to humans (bio-accumulative).

Over 20 different heavy metals are known, and they include aluminium, antimony, arsenic, cadmium, chromium, cobalt, lead, manganese, mercury, nickel, selenium, tin, vanadium, zinc, platinum, and copper (metallic form versus ionic form) (Ezejiofor *et al.,* 2013). Some of these heavy metals alongside microorganisms are found in soils. Pelczar *et al.* (2003) and Prescott *et al.* (2003) define the soil as a complex mixture of several types of organic and inorganic materials including various living micro and macro organisms. Soils may become contaminated by the accumulation of heavy metals and metalloids as a result of emission from the rapidly expanding industrial sectors, mine tailings, disposal of high metal wastes, leaded gasoline and paints, land application fertilizers, animal manures, sewage sludge, pesticides, waste water irrigation, coal combustion residues, spillage of petrochemicals, and atmospheric depositions (Patnik *et al.,* 2003).

Calcium carbide is a chemical compound mainly used industrially in the production of acetylene and calcium cyanamide. Calcium carbide is produced industrially in an electric arc furnace from a mixture of lime and coke at approximately 2000^0C. In a panel beaters workshop, calcium carbide is used on the surrounding soil, gives the characteristics or the physical properties white colour of the panel beater's workshop soil where it is dumped and used. The contamination of the soil by calcium carbide waste leads some physical and chemical process in that particular soil and then, biodegradative activities by microorganisms (Voroney, 2006).

This work is therefore aimed at investigating the oils of panel beaters workshops for the presence of heavy metals and obtain microbial load of such soils. This study provides information on how to better appreciate the pollution status of the affected area as regarding calcium carbide wastes that are copiously dumped in the area by panel beaters.

Materials And Methods

Samples and preparation

The soil samples used for this study were collected from five calcium carbide waste dumpsite (contaminated) and five non calcium carbide waste dumpsite (non-contaminated). The contaminated soil samples were collected from panel beaters workshops in Eku, Ekpan-Effurun, Obiarukwu, Abraka and Japka-Effurun, while the non-contaminated soil samples were collected across the road in opposite directions from the contaminated sites along the same route, all in Delta State. Soil samples were obtained with a hand auger from top soils within the study location.

Determination of Heavy Metals

Atomic absorption Spectrophotometer (Perkin Elma Analyst 100, U.K.) for each of the metals. 1g of the soil sample was mixed with 7ml of concentrated HNO_3 and 3ml of HCL and left to standardized overnight. 10ml of the de-ionized water was added to the overnight sample and heated for 3hours. The digest was filtered through the Whatman No. 1filter paper and made up to 25mL mark with de-ionized water. The digest was then analyzed for heavy metals using a spectrophotometer. Quality assurance was guaranteed through double determination use of blanks for correction of background and other sources of error.

Total Viable Counts

Using standard pour plate techniques, the microbial load of the isolates were obtained and recorded in CFU/mL.

Results

The results presented in Table 1 shows that the difference observed in the heavy metal contents between contaminated and non contaminated soil samples in Eku, Ekpan-Effurun, Obiarukwu, Abraka and Jakpa- Effurun, was not significant (P > 0.05). A significant difference was however observed in the heavy metal contents for all the locations put together (P<0.05). With respect to microbial count, the result presented in Table 2, shows that, the difference in microbial count between contaminated and non-contaminated samples was not significant for Eku, Ekpan-Effurun, Obiarukwu, Jakpa-Effurun and the combination of all the locations (P > 0.05). a significant difference was however reported between contaminated and non-contaminated samples in Abraka.

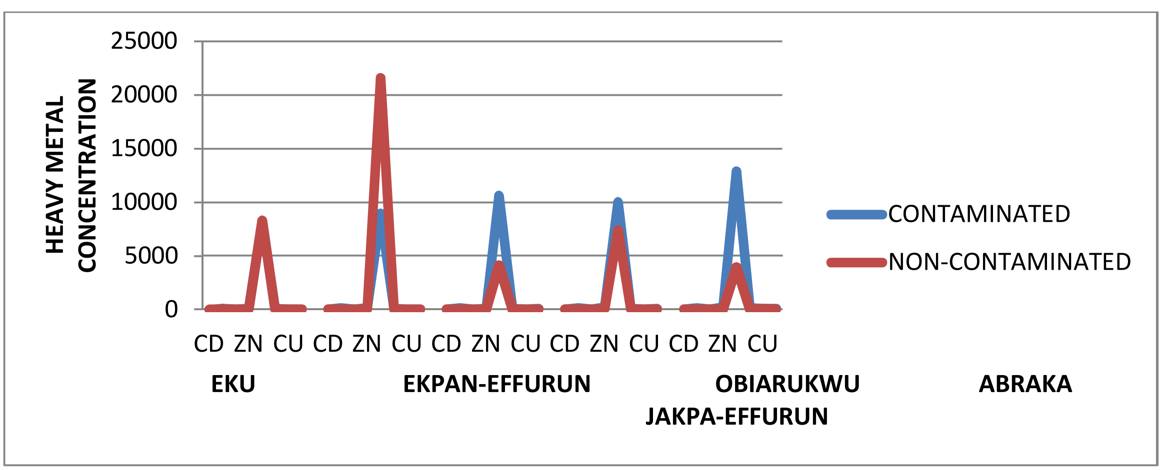

Figure 1: Heavy metal contents of five locations in Delta State

Table 1: Difference in Heavy metal contents between Contaminated and uncontaminated soil

Variable	F	P
Eku	0.00	0.96
Ekpan-Effurun	0.51	0.48
Obiarukwu	1.74	0.19
Abraka	0.27	0.60
Jakpa-Effurun	2.47	0.12
All locations	**35.44**	**0.00***

* Significant at 0.05

Table 2: Difference in Microbial Count between Contaminated and uncontaminated soil

Variable	F	P
Eku	0.00	0.99
Ekpan-Effurun	2.62	0.12
Obiarukwu	0.79	0.39
Abraka	**9.13**	**0.01***
Jakpa-Effurun	0.39	0.54
All locations	2.32	0.06

* Significant at 0.05

Discussion

In this study, the heavy metals identified include: cadmium (Cd), lead (Pb), Chromium (Cr), Zinc (Zn), Iron (Fe), Manganese (Mn), Copper (Cu) and Nickel (Ni).

The results presented in Table 1 and 2, shows the heavy metals concentrations and microbial counts of five panel beater locations in Delta State. The results in Table 1 shows that the difference in heavy metal concentrations between contaminated and non-contaminated soils, for the five locations (Eku, Ekpan-Effurun, Obiarukwu, Abraka and Jakpa-Effurun are not statistically different ($P > 0.05$) (Figure 1). This implies that, although there are variability in concentration, but the variability are not statistically meaningful, hence, the calcium carbide did not significantly influence the type and concentration of heavy metals present in the soil. Generally however, there is a statistically significant difference in heavy metal concentration between contaminated and non-contaminated soils among the five locations ($P < 0.05$). This report agrees with the work of Bamgbose *et al.,* (2000), who reported that a high concentration of heavy metals in the contaminated site compared to the controlled site.

The difference between the concentrations of the heavy metals of contaminated and uncontaminated soil can be hazardous to the environment and human. Like other urban centers where the demand for suitable land for development exceed the availability, such contaminated sites may be used in the future for either residential or industrial, or construction for children play grounds, school, which may not be ideal for human inhabitation, more also the underground water might become contaminated. In developing nations such as Nigeria, the government in most cases clears these sites and goes ahead with redevelopment projects without any form of assessment. People using such land may be faced with great environmental hazards.

The microbial counts obtained showed that the difference in microbial load between contaminated and non-contaminated soil is not significant in all the locations studied except for Abraka ($P < 0.05$). This probably implies that the presence of the calcium carbide in the soil samples did not significantly influence the type of microbes found in the soil, although the contaminated soils have more microbial load than the non contaminated soil.

Conclusion

Calcium carbide contaminated soil had higher microbial load and higher heavy metal concentration than non-contaminated soil. Studies of community dynamics related to calcium carbide degrading microbes have the potentials to enhance natural genesis of long-term effect of calcium carbide waste product pollution and to determine new remediation. Therefore, building pit systems, where these calcium carbide waste will be collected and properly treated before releasing them into the soil, to eliminate the hazards of such contaminations is highly recommended.

References

1. Adriano, D.C. (2003). *Trace elements in terrestrial environment; Biogeochemistry, Bioavailability and risks of metals.* Springer publishers, 2nd Edition. 43pp.
2. Bamgbose, O., Odukoya, O.O. and Arowolo, T.O.A. (2000). Earthworms Bioindicators of metal pollutions in Dumpsite of Abeokuta city, Nigeria. *Rev. Biol. Trop.* 48: 1- 13.
3. Ezejiofor, T.I.N., Ezejiofor, A.N., Udebuani, A.C., Ezeji, E.U., Ayalogbu, E.A., Azuwuike, C.O., Adjero, L.A., Ihejirika, C.E., Ujowundu, C.O., Nwaogu, L.A. and Ngwogu, K.O. (2013). Environmental metals pollutants load of a densely populated and heavily industrialized commercial city of Aba, Nigeria. *Journal of Toxicology and Environmental Health Sciences.* 5(1):1-11.
4. Kirpichtchikova, A, Manceau, A, Spandini, F. and Jacquent, T. (2006). Speciation and Solubility of Heavy metals in Contaminated soil using X- ray, microflourescence, EXAFS spectroscopy, chemical extraction and

thermodynamic medelling. *Geochemica.* 70(9): 2163- 2190.
5. Nwachukwu, M.A., Feng, H. and Alinnor, J. (2010). Assessment of heavy metal pollution in soil and their implications within and around mechanic villages. *Int. J. Environ. Sci. Tech.* 7(2): 347-358.
6. Patnik, T.B. (1993). Spatial variability of microbial processes in soil- A review. *Journal of Environmental Quality.* 22: 409- 417.
7. Pelczer, M.J., Chan, E.C.S. and Krieg, N.R. (2003). *Microbiology*, Fifth Edition. McGraw Hill Publishers. New York. pp 412- 478.
8. Prescott, L.M., Harley, J.P. and Klein, D.A. (2003). *Microbiology*, 6th Edition. McGraw Hill, USA. pp 669- 676.
9. Voroney, R.P. (2006). *The soil Habitat in soil Microbiology, Ecology and Biochemistry*. Eldor A. Paul ed.

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