International Journal of Research in Science and Engineering Technology
Vol. 1 No. 1 December, 2016
ISSN 2141 825X
www.oasisinternationaljournal.org

SOIL CONTAMINATION DUE TO HEAVY METALS WITHIN AUTO-MOBILE WORKSHOP CLUSTERS ALONG MARIERE BY T-JUNCTION (∝) AND ORUBOR BY PROF. EBIE (β) AGBOR, DELTA STATE-NIGERIA

by

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Abstract

The concentration levels of heavy metals within two automobile clusters coded Alpha (∝) and Beta (β) respectively in Agbor metropolis are presented. Heavy metal analysis of the soils in the two clusters showed the presence of cu, mn, Ni, Zn, cd, Pb, and Fe in abundance trend of Fe > Zn > Mn > Pb > cd > Ni > cu. Also, the concentration levels of the soils were above the control values except for cd at β cluster. Cadium at β cluster represented a contamination hazards which requires some remedial action.

Keywords: *Heavy metals, soil concentration, automobile workshop, Agbor.*

1.0 Introduction

Heavy metal is a general term used to describe a group of metals and metalloids with an atomic density greater than 5.0g/cm^3 (Duffus, 2002). There is increase in automobile repairs/workshop activities in most cities in Delta state as a result of the seemingly increase in the importation of used automobiles. The waste –oil used in the maintenance and repairs of these automobiles contain oxidation products, and in most cases metallic particles and sediment water resulting from organic and inorganic chemicals used in oil additives including metals and indeed from machinery wears during repair works which are then transferred to the housing compartment of a crankshalf during combustion. These workshops lack or do not adequately comply with waste management and waste disposal practices and regulations.

Automobile mechanic works has been implicated for elevated concentration of heavy metals (cu, cd, Pb, Ni, Zn, Fe, and Mn) in soil profile in the vicinity of automobile mechanic waste dumps (Iwegbue et al, 2006). Assessing the concentrations of heavy metals in these sites provides information on guidance for redevelopment, extents of contamination and choice of possible remediation or clean up techniques.

One of the major sources of increase in heavy metal concentration of the ecosystems in Nigeria is auto mechanic activities (Adewole and Uchegbu, 2010). These auto mechanic workshops are found in clusters of open plots of land in the vicinity of urban towns and cities (Nwachukwu et al, 2010), Nwachukwu et al, 2011.

The primary objective of this study is to investigate the concentration levels of heavy metals in soils within automobile workshops in the city of Agbor.

2.0. The study Area

The study was carried out at Agbor, Delta State. Agbor town has between latitude 6^0 16^1 0^{11} North and Longitude 6^0 9^1 0^{11} East. The town drains into the Asimiri. The area lies within the subequatorial climate with wet season of about 96 weeks and annual rainfall of over 2000mm. The area is also humid with average temperature of between 24^0c – 27^0c, (Ikoeje, 1981), which adequately supports rainforest, kind of vegetation. The major industrial activities in this town are medium scale industries, steel and automobile mechanic works.

2.1 Study Area ALPHA (∝) : T- Junction Cluster

This automobile workshop cluster, ∝, is well known for repairing and maintaining automobiles with a large clientele. It is located along Marierie a major busy area in the city. This site has been in existence for over 10years. Behind this workshop is located a virgin land about 500m away. The land was used as a control site for this cluster.

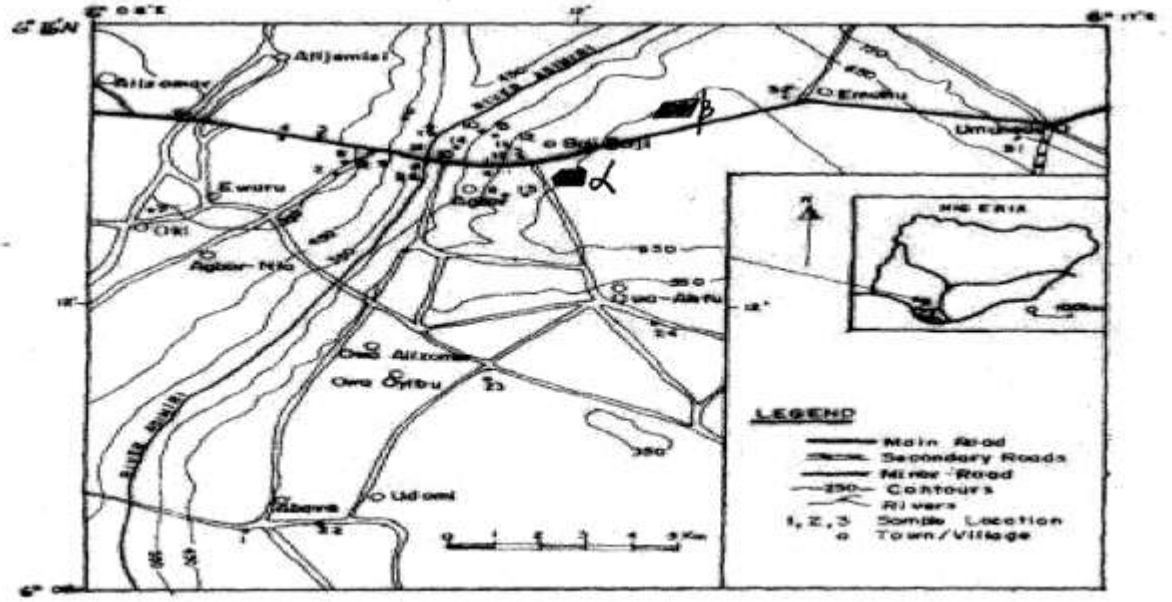

Fig 1: Topography of Study Area

2.2 Study Area Beta (β): Orubor by Prof. Ebie Cluster

This is one of the oldest auto mechanic workshop clusters in the city of Agbor. It is highly patronized mostly in the area of spray painting automobile body works and engine fitting. This site is surrounded by residential and commercial premises. Opposite this site is an annex of the state ministry of Agriculture and Natural resources, which was used as a control site for this sampling cluster.

It is important to note that all the sites have the usual outlook of an automobile workshop, characterized by the presence of patches of waste engine oil and grease on the ground, scrap metal objects, discarded paint cans and engine oil containers and so on.

2.3 Sample Collection and Preservation

Nine surface soil samples were randomly collected from each of the two study auto mechanic workshop clusters ∝, and β at a depth of 0.03m. A study by (Abenchi et al, 2010 and Krishna and Gravil, 2007) indicates that soil pollutants normally contaminate the upper layer of the soil at a depth of (0-40) cm. Hence the choice of this studies depth. One control sample was also collected for each cluster site. A total of 20 soil samples were randomly collected from the two study areas. Samples were collected with the aid of a soil auger, spool, hammer and hand gloves. After each sampling, the soil auger was cleaned and washed with clean distilled water and air-dried to constant weight to avoid microbial degradation (Kakulu, 1993). Each soil sample was immediately emptied into a carefully labeled plastic bag and stored in iced chest coolers for onward transportation to the laboratory for analysis.

2.4 Method of Analysis

The soil samples were digested using a mixture of $2cm^2$ of 60% perchloric acid, $15cm^3$ of concentrated nitric acid and $1cm^3$ of concentrated sulphuric acid (Burrell, 1974). The digested samples were analysed for the metals using Atomic Absorption Spectrophotometer. (Perkin Eloner Model A. Analyst 2002 fitted with deuterium lamp for background correction).

3.0 Results and discussion

Table 1: Concentrations of heavy metals (mg/kg) in the sampled soils within the two auto-mobile workshop clusters, ∝ and β respectively.

Elements	∝ Cluster mean ± SD	B, Cluster mean ± SD	Control mean ± SD
Copper, cu	0.30 ± 0.03	0.36 ± 0.06	0.1 ± 0.01
Manganese, Mn	30.52± 8.20	54.20 ± 11.2	15.2 ± 0.01
Nickel, Ni	2. 25 ± 2.3	1.19 ± 1.32	0.19 ± 0.02
Zinc, Zn	60.3 ± 3.12	70.25 ± 2.14	12.8 ± 0.06
Cadmium, Cd	8.45 ± 1.01	1.60 ± 1.40	1.78 ± 0.15
Lead, Pb	9.78 ± 2.00	7.12 ± 1.14	45.0 ± 0.07
Iron, Fe	64.45± 2.61	92.11 ± 4.78	4.00 ± 0.16

Table 1 above presents the concentrations of heavy metals in the soils within the automobile workshop clusters ∝ (T-junction) and β (Orubor by Prof. Ebie) clusters in Agbor metropolis. The mean + SD is also indicated together with the mean control values from the control sites.

Heavy metal analysis of the soils in the two automobile workshop clusters ∝, and β respectively showed the presence of Cu, Mn, Ni, Zn, Cd, Pb and Fe in the following order. Fe > Zn > Mn > Pb > Cd > Ni > Cu

The concentrations in the soils from the β cluster are higher than those from the ∝ cluster with the exceptions of Nickel, Cadmium and Lead which were higher in samples from ∝ cluster than β cluster.

3.1 Discussion of results

Low copper (Cu) concentrations were recorded for the two automobile clusters under study with mean values of 0.30mg/kg at ∝ and 0.36mg/kg at β. Though, these values are slightly higher than the mean control value. This level of concentration of copper may have resulted from electrical components such as wires in addition to waste oil, and alloys from corroding vehicle scraps which have littered the vicinity of these clusters for a long time, with metals released from the corrosion gradually leaching into the soil (Nwacukwu, et al 2011).

The manganese level in this study has mean values of 30.52mg/kg at ∝ cluster and 54.20mg/kg at β cluster respectively. These are much higher than the control value. The high manganese levels could be attributed to the fact that manganese in the form of oxide is a component of subsoil material (levy et al 1992). In addition, the levels of manganese could be from used batteries, discarded metal rails, machinery parts and wastes from welding works and spray paintings of vehicles. High concentration of manganese results in kidney failure, liver and pancreas malfunctioning but its optimum concentration is very essential for respiratory enzymes and connective tissues development (Underwood, 1977).

Exposure to abnormally high concentration of manganese particularly informs of dust and fumes are known to have resulted to adverse effects on humans (Waldboh, 1978). In this study Nickel (Ni) has the second lowest concentration levels of the soils at both clusters ∝, and β respectively. Its value was 2.25 mg/kg at ∝ and 1.19mg/kg at β clusters. These values are lower than the mean control value of 0.19 mg/kg. These results are relatively lower than values of 11.5mg/kg in Ipeaiyeda et al (2007) and 17.38 – 16.52 mg/kg recorded by Iwegbue et al (2006).

The low level of Nickel in this study areas suggest for now that there is little anthripogenic contribution. The Zinc (Zn) levels in the soils had mean value of 60.3mg/kg at ∝ clusters and 70.25 mg/kg at β cluster. These values are higher than the control value and are indicative that, there is anthropogenic contribution to the soil samples. The high concentration of Zinc from the automobile clusters is that this element is found as part of many additives of lubricating oils (Abenchi et al, 2010). However, the concentration of zin in this study is small compared with many other studies (Nwachukwu et al 2010, Nwachukwu et al , 2011 and Shinggu et al, 2007), although it is comparable to that of soils in Cameroon, and that of Yauri, North –West Nigeria (Yahaya et al, 2010).

Cadmium, cd, was detected in the two cluster areas of study. The concentration levels are 8.45mg/kg at ∝ and 1.60mg/kg at β clusters respectively. This is higher than the control value of 1.78mg/kg. According to (Jarup, 2003, Ebong et al, 2008), the presence of cadmium could be due to nickel – cadmium batteries, motor oil and disposal sludge in the automobile clusters. This was also collaborated by Dabkowska – Naskret, 2004), that the presence of cd is likely to come from lubricating oils, vehicle wheels and metal alloys used for hardening of engine parts.

The mean values of Pb in soils obtained in this study were 9.78mg/kg at ∝ and 7.12mg/kg at β clusters respectively. These values were significantly very low compared to the mean control value of 45.0mg/kg. Lead occurs naturally in all soils in concentrations ranging from 1 to 200mg/kg with a mean value of 15mg/kg (Chirenje et al, 2004). The lead concentration in this study was lower than those reported in other studies by

Adelekan and Abegunde (2011), from some mechanic villages in Ibadan. This may be as a result of lower amount of used automobile batteries –which are indeed a ready source of lead.

The Iron levels in the studied clusters had mean values of 64.45 mg/kg at ∝, and 92.11mg/kg at β respectively. High levels of iron obtained in this study can be rationalized from the fact that natural soils contain significant concentrations of iron. (Aluko, and Oluwande, 2003). The presence of Iron obtained in this study can be attributed to automobile crankshafts wear and vehicle body damage.

This levels of iron are in agreement with those reported by Eddy, et al (2003), Oguntimehin and Ipinmoreti (2008), Osakwe, 2010) and Abidemi (2011). Acute exposure of iron in humans leads to vomiting, cardiac depression and metabolic acidosis (Soghoian, 2011).

4.0 Conclusion

The accumulation pattern of the heavy metals in the soil followed the order Fe > Zn > Mn > Pb > Cd > Ni > Cu. This order is justified by the fact that iron constitutes about 80% of total content of the scraps dumped on the soil. The study revealed that the activities in the automobile clusters ∝ (T-junction) and β (Orubor by Prof. Ebie) contributed to the contamination of the soils. The higher concentrations of heavy metals at β cluster in camparison to ∝ cluster may be attributed to the relative porosity of the soils or difference in ability to retain heavy metals at the soil particle surface (Lenntech, 2009).

The concentrations of heavy metals from this study were within concentrations found in normal agricultural soil and below the interdepartmental committee on the Redevelopment of contaminated land (ICRCL) threshold values except for cadmium Cd at β cluster, which shows that the soil in β cluster requires some remedial action for Cd before such land can be used for any form of choosen development.

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