Assessment of the Level of Some Heavy Metals in Roadside Dust in Jos Metropolis Plateau State.

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Abstract- This study was carried out to assess the effect of some heavy metal concentration (Cr, Fe, Ni and Pb) in roadside dust using atomic absorption spectrophotometer (AAS) in three study sites sites (Farin-Gada, Terminus Roundabout and British America Junction) .The dust samples were digested using Aqua regia. All the selected heavy metals were detected in the roadside dust samples. In British America Junction the concentration of the metals ranged from 5.30ppm to 364.19ppm with Cd recording the least value and while Fe recorded the highest value. In Terminus Roundabout, the concentration of the heavy metals ranged from 0.77ppm to 371.97ppm with Cd recording the least and Fe the highest value. In Farin-Gada, the metals concentration ranged from 5.51ppm to 375.14 Cd recording the least and the Fe the highest value. However the selected heavy metals exceeded the WHO standard for heavy metals in dust indicating that vehicular emissions also contributed to the high concentration of these heavy metals in the dust samples.

Index Terms- Heavy metal, AAS, Dust, Concentration, Roadside

I. Introduction

Heavy metal effects are increasingly becoming of health concern, as they are found in plants, soil, water and in the atmosphere. In recent years, public and scientific attention has increasingly focused in its contamination, pollution and its effects on humans and other living creatures (Nwadiogbu, 2013). Heavy metals are naturally occurring metals having atomic number (Z) greater than 20 and an elemental density greater than $5g/cm^3$ (Ali & Khan, 2017). Heavy metals are found naturally in the earth, and become concentrated as a result of human activities, and can enter plants through the soil, animals and human tissues through inhalation. These metals have low excretion rates through the kidney which result in damaging effect on humans, even at very low concentration (Jimoda, 2012). Heavy metals may come from many different sources in urban areas. Atmospheric pollution is a major contributor to heavy metals contamination in top soils (Kelly et al., 2010).

One of the most important sources of air pollution is vehicle emission. Metals such as Fe, Cu and Zn are essential components of many alloy, pipes, wires and tires in motor vehicles and are released into the roadsides environment as a result of mechanical abrasion (Vijeta and Neelam, 2014). The metallic pollutants in the air eventually fall on the ground surface depending on wind flow patterns and increased their concentration in adjacent areas (Vallero, 2007).The presence of heavy metals is one of the significant environmental problems caused by anthropogenic activities which include human activities such as urban road construction, waste incinerations, sewage disposal, bush burning, vehicle exhaust, industrial discharges, oil lubricants (Ho and Tai, 1988) .Deposited dust on impervious surface is one of the most important issues in urban environmental management (Ma and Singhinnuson, 2012). Air pollution is a major problem for modern societies and is a potential lethal form of pollution. Therefore, urban air pollution studies focused on street dust in recent years (Addo, 2013).The urban area is consisting of varying concentrations of trace elements from anthropogenic and natural sources (Nwadiogbu, 2013). The deposited dusts on roads do not remain for long, they are quickly and easily re-suspended back into the atmosphere, and contain an important amount of trace elements. (Addo, 2013).

The aim of this work is to assess the concentration of some heavy metals The aim of this work is to assess the concentration of some heavy metals (Ni, Fe, Cd, and Pb) using Atomic Absorption Spectrophotometer (AAS) in roadside dust.

II. MATERIALS AND METHOD

SAMPLING

About 50g of roadside dust was collected by spreading polythene within an area of approximately 2m x 2m from the edge of the roadside for about 3 – 4 hours after which the dust sample was collected using a plastic packer and brush. This was done twice a week for two months after which these samples were stored in well labeled polythene bags, transported to the laboratory where it was sieved with a sieve of diameter 0.5mm.

DIGESTION OF THE DUST SAMPLE

1.0g of the dust sample from each site was digested with 10ml of aqua-regia (HNO_3: HCl) in the ratio of 3:1 in a Pyrex beaker and heated on a pot plate at a temperature 110 for 3 hours and was evaporated to dryness. The digested sample was further diluted with 40ml of 2% HNO_3, and was filtered using watchman filter paper No.42 and transferred into a 50ml volumetric flask, then distilled water was added to make up to the mark and analyzed using Atomic Absorption Spectrophotometer (AAS) (Vanda, 2016).

III. RESULTS AND DISCUSSION

RESULTS

The result of the chemical analysis of road side dust of some selected heavy metals from the three study sites are shown in Table 1

Table 1: Heavy metal concentration in roadside dust.

Heavy metal	Terminus Roundabout	British America Junction	Farin-Gada	WHO(2012)Limit of dust in air (ppm)
Fe (ppm)	371.97	364.19	375.14	300
Ni (ppm)	3.61	3.07	6.20	2.0
Pb (ppm)	49.22	16.29	65.74	7.0
Cd (ppm)	0.77	5.30	5.51	0.7

IV. DISCUSSION

From the result of the chemical analysis in Table 1, the concentration of iron from the three study location ranges from 370-375ppm with Farin-Gada recording the highest value of 375.14ppm followed by Terminus Roundabout with a value of 371.97 and British America Junction with the least value of 364.19ppm. This study shows that the concentration of Fe is higher compare to the value of 320ppm reported in other studies (Lee, 2016). The WHO permissible limit of 300ppm for Fe in roadside was however lower than the values recorded in this work from the three study sites. It is known that adequate Fe is in a diet is very important for decreasing anemia (Seaword et al., 2015). However when the metal is much in the body it becomes a challenge as it increases the risk for liner disease (curtiosis, cancer) heart attack or heart failure, diabetes mellitus, osteoarthritis, osteoporosis, metabolic syndrome, hypogonadism, and numerous symptom and in some cases premature, death (Yuan et al., 2017). However the high concentration of iron in this study sites might be attributed to some of the activities carried out in some of these sites. In Farin-Gada site, a lot of activities like welding, car fabrication and repairs take place which may contribute to the high concentration of this metal in this study site.

The concentration of Ni from the three study sites ranges from 3.06ppm-6.20 ppm with Farin-Gada recording the highest value of 6.20ppm, followed by Terminus Roundabout with the value of 3.61ppm and British America Junction with the least value of 3.06ppm. The concentration of Ni reported in this study is higher compared to the value of 2.0ppm reported in other studies (Fujiwara et al., 2013).The concentration of Ni in this study however exceeded the WHO permissible limit of 2.0ppm (WHO, 2012). Nickel causes dermatitis (a type of skin rash) and eczema when it comes in contact with the skin, nickel causes asthma when inhaled into the body. The most serious harmful health effects from exposure to nickel, such as chronic bronchitis, reduces lung function and cancer of the lung and nasal sinus (Lee Yung et al., 2016).However the high concentration of Nickel in Farin-Gada than the other sites could be as a result of traffic congestion, resulting in emissions from vehicle engines, that uses gasoline which contains the metal and also by the abrasion and corrosion of vehicle parts. The burning of fossils fuels as well as the refining of metals such as copper (Cu) introduced considerable amounts of Ni into the atmosphere (Lui et al., 2016).

Lead (Pb) from the three study sites ranges from 16.29 - 65.74 ppm with Farin-Gada recording the highest value of 65.74 ppm followed by Terminus Roundabout with a value of 49.219ppm and British America Junction with the least value of 16.29ppm. The result shows that the concentrations of Pb in the dust samples are higher when compared to the value of 39.0ppm reported in other studies (Alkhashman et al., 2017). The concentration of Pb in this study however exceeded the WHO permissible limit of 7.0ppm recorded in this work from the three study site (WHO 2012The high concentration of Pb in Farin-Gada when compared with other study sites like Terminus Roundabout and British America Junction might be due to the differences in traffic density, metal construction work, iron bending and welding of metals which is a common practice along the streets where the samples was collected.

The concentration of Cd from the study sites ranges from 0.767-5.51ppm with Farin-Gada recording the highest value of 5.651ppm followed by British America Junction with a value of 5.302 ppm and Terminus Roundabout with the least value of 0.767ppm. The result shows that the concentration of Cd in the dust sample is higher in Farin-Gada compare to the value of 3.4ppm reported in other study (Wong., 2013). The concentration of Cd in this study however exceeded the WHO permissible limit of 2.0ppm (WHO, 2012). The concentration of these metal in these study area is higher compared to the WHO permissible limit .Cadmium when inhaled into the body can cause a severe toxicity in humans. Prolonged exposure too can affect the variety of organs with the kidney being the principal target (Chung et al., 2016). Much accumulation of Cadmium in the body can cause spinal /joints degeneration, depressed immune system and lymphatic swelling (Wei et al., 2010). However the high concentration of cadmium in Farin-Gada site than Terminus Roundabout and British America Junction might be as a result of automobile fuel and burning of tyres, lubricating oils and also vulcanization processes carried out in Farin-Gada.

V. CONCLUSION

All the selected heavy metals were detected in all the study sites. The results also indicated that the concentration of these heavy metals in the roadside dust from the three study sites exceeded the WHO (2012) permissible limit for dust in air with Farin-Gada recording the highest concentration of all the selected metals followed by Terminus Roundabout and British America Junction. This could be attributed to the intensity of vehicular traffic emissions most especially in Farin-Gada coupled with some activities like welding, car fabrication, and repairs, burning of fossils, vulcanization processes, iron bending, and metal construction work indicating that prolong stay in these areas can result in serious health problems.Therefore consistent exposure to the dust pose health hazard to both human, plants and the atmosphere, since none of the metals were within the WHO permissible limit. Carrying out activities regularly within these study areas may result in the accumulation of these metals in the body which may lead to serious health problem as these metals bio-accumulate in the body tissues.

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