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Analysis of Suspended Air Particulates Along Four Sawmills in Nigeria During the Wet and Dry Seasons

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Abstract: Sawdust particulate matter collected from different parts of Akure metropolis, Nigeria were analyzed for heavy metals using flame atomic absorption spectrophotometry. Particulate samples were collected between May and December 2004 gravimetrically. Total Suspended Particulate (TSP) concentrations were between 2.28-11.74g/m^3 (dry season) and 1.66-9.10g/m^3 (wet season). During both seasons, Pb, Mn and Zn were enriched in the samples. Pb/Zn ratio was generally highest in the highways it varied thus: 1.92-2.48 (wet season) and 1.96-2.27 (dry season). There were significant variations and correlations for interaction of seasons and distance for all the locations. From the results there is a great need to discourage the citing of residential areas near sawmills, this is just to minimize the hazardous effects on public health.

Key words: Suspended air particulate, sawmill, wet and dry seasons, trace heavy metals, public health

INTRODUCTION

It has been well established that the greatest air pollution in Nigeria environ is atmospheric dust[1-3]. This has required attention and leading to the establishment of agency charged with setting guidelines and enforcing environmental quality standards along the lines of the US EPA.

Recently, there has been high increase in the establishment of sawmills located in different areas in Nigeria. There has also been a subject of tree felling without planting new ones to replace them. Presently there are plans to educate the populace on the disadvantages of tree felling without planting new ones.

Many researchers have reported on the suspended air particulates along motorways, cement factories and other areas[2,4-6]. Its consequences on human health, soils and vegetation have been enumerated. The study been reported here is part of a comprehensive work to investigate the likely impact of sawmill operations on the surrounding areas. In this study, the results of the analyses of dust particulates and heavy metal characterization in Akure Local Government Area (LGA) of Nigeria during the wet and dry seasons of year 2004 were reported

Experimental

Sampling: The air particulate sampling was conducted between May and December 2004 in sawmills located in Akure LGA (Expressway, Ondo road, Oba-Ile road and Owode). The sites of collection were between 0 and 100 m using air samplers with whatman grade 41 filter paper as the collecting media for a period of 10h. Sampling locations were based on traffic volume, road conditions and work volume.

Analysis: The Total Solid Particulates (TSP) weights were determined by using an analytical balance. The differences between the initial and final weights were noted. For the flame atomic absorption spectrophotometric analysis, 0.5 g of the dust particulate samples were digested by adding 10 cm^3 of 65% HNO_3 and 2 cm^3 of conc. HF. This was heated to dryness on a water bath. Then 10 cm^3 of 1% HNO_3 was added and heated to boiling and the solution allowed to cool to room temperature and finally made up to 50 cm^3. The digested sample solutions were analyzed using an SP 1900 Pye Unicam, flameless atomic absorption spectrophotometer for the determination of the heavy metals

Statistical analysis: All determinations were in duplicate. The mean, ANOVA and correlation coefficient were determined using SPSS for windows 10. Pb/Zn ratio was also computed.

RESULTS AND DISCUSSION

Tables 1 and 2 depict the average rate of dustfall varying from 2.28 g/m^3 (Owode) to 11.74g/m^3 (Oba-Ile) for the dry season, while during the wet season, 1.10 to 9.10g/m3 are recorded for Owode and express way respectively. These size distributions are high as they imply that most of the sawdust particulates are deposited closer to the source and it is mainly fine particles that reach 100 m away from the source. From the results it is observed that results obtained for wet season is lower

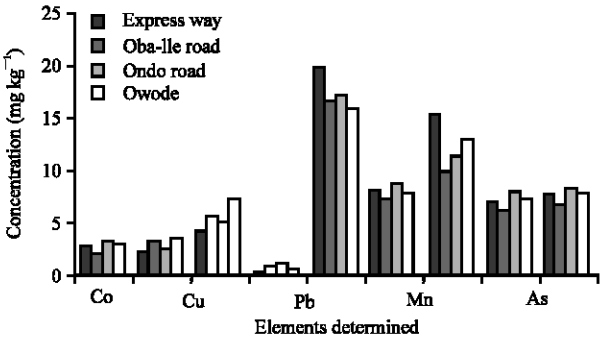

Fig. 1: Elemental concentration of sawdust particulates during the wet season

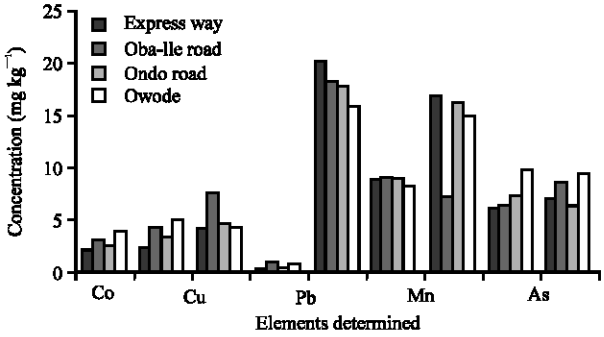

Fig. 2: Elemental concentration of sawdust particulates during the dry season

than what obtained for the dry period. This could be attributed to relative humidity of the environ. During the dry period relative humidity is generally low and so air borne particulates are generally high. This is reasonably in good agreement with the results of[2] for dusts collected in harmattan period of 1989. The high concentration of the dusts recoded from 0 to 75 meters in the respirable fraction range makes then potentially dangerous from the health point of view. The high level of dustfalls can also be associated with dust generated by traffic mobility. In express way, Oba-Ile and Ondo roads heavy loads of traffic supplemented with traffic jams are observed very often. Climatic variables influence the severity of air pollution in general and dust fall in particular. These vary tremendously from day, from season to season and from location to location[6]. High rate of saw milling would add more and more to the atmospheric dustfall pollution.

In order to establish inter TSP relationship in the samples the correlation coefficient of the TSP at the sampling points was calculated. A vary high correlation was found between 1 to 75 meters indicating that most of the coarse components of the sawdust are deposited closer to the source and it is mainly the fine particulars that reach 100meters away from the source.

Table 1: Particle size (g/m^3) distribution during dry season

	0	1	25	50	75	100
Expressway	10.0	9.72	9.00	7.25	6.22	4.10
Oba-Ile Road	11.74	10.15	8.25	6.44	5.22	3.25
Ondo Road	9.25	7.25	6.40	4.35	4.22	3.25
Owode	8.66	6.22	5.77	4.20	4.00	2.28

Table 2: Particle size (g/m^3) distribution during wet season

	0	1	25	50	75	100
Expressway	9.10	9.00	8.24	7.29	6.44	4.25
Oba-Ile road	9.00	8.42	7.77	7.00	6.25	3.00
Ondo road	7.25	6.87	6.00	5.12	3.72	2.98
Owode road	6.24	5.28	3.25	3.00	2.54	1.66

Table 3: P-value of elements in all locations during the wet and dry seasons

Elements	P-value	Error
Pb	0.02**	0.2
Mn	0.006*	0.3
Zn	0.006*	0.3
As	0.001***	0.3
Ni	0.001***	0.5
Cu	0.001***	0.3
Cr	0.02**	0.3
Co	0.006	0.5
Cd	0.02**	0.5

* Significant at 10.0% level, ** Significant at 5.0% level, *** Significant at 1.0% level

Table 4: Mean values of Pb/Zn concentration for the locations (wet season)

Locations	Mean
Expressway	2.48
Oba-Ile road	2.32
Ondo road	1.92
Owode	2.04

Table 5: Mean values of Pb/Zn concentrate for the locations (Dry season)

Location	Mean
Expressway	2.27
Oba-Ile road	2.03
Ondo road	1.98
Owode road	1.96

Figures 1 and 2 depict the particular size distribution of the elements. For most of the elements, the shapes of the plots are similar for both cases. Although the peaks obtained for the wet season are less pronounced. These distributions are slightly different from the distribution of the same elements in Russian soils[7]. The high concentrations of Pb, Mn, Zn and other elements in the wet and dry seasons may have been as a result of more contributions of TSP from sources other than automotive emission such as fugitive dust from unpaved and poorly maintained roads, fertilizers and pesticides from agricultural activities. There are significant variations (Table 3) for interaction of season and distance for the four locations, for all the locations during both seasons the general trend in element concentrations is in the order: Pb>Mn>Zn>As>Ni>Cu>Cr>Co>Cd.

Pb/Zn ratio was calculated for all the dust falls and the means of the results are presented in Table 4 and 5.

Table 6: Comparison of Pb/Zn results of this study with others

Locations	Values	Reference
Russia		
Soils	0.5-1.56	Drechsel and Wilcke[7]
Iran		
Tea		Ebadi *et al.*[9]
Nigeria		
Road side dust	2.21-5.62	Ogunsola *et al.*[3]
Air particulates	0.57-1.31	Ogunsola *et al.*[2]
Soils		Abulude[10]
Pakistan		
Vegetables	0.02-0.05	Naeem *et al.*, 1995
Sawdust	1.92-2.48	This study

The ratio is generally highest in the major highway areas and the least, on average an order of magnitude below those from urban areas[8]. This confirms that Pb enrichment of the dust fall is mainly due to automotive emissions. A comparison of the Pb to Zn ratio found in this study with those other studies as shown in Table 6 establishes the fact that the ambient Pb emanates primarily from vehicle exhaust emissions.

CONCLUSIONS

The results of the study showed that coarse components of the sawdust were deposited close to the source (0-75 m). Pb, Mn and Zn produced the highest values in all the samples, beside, it was established in this study that Pb/Zn ratio was generally highest in the major highway areas. From the present observation, it is highly recommended that sawmills should be cited 100 m away from residential areas.

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