QUANTITATIVE ASSESSMENT OF SOME HEAVY METAL CONTENT IN SUSPENDED DUST OF SELECTED LABORATIES IN USMANU DANFODIYO UNIVERSITY, SOKOTO, NIGERIA

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ABSTRACT

The suspended dust in selected laboratory (Agric. Chemical, biochemistry, chemistry, microbiology and physics) of the faculty of sciences, Usmanu Danfodiyo University were collected, digested and analysed for both physico-chemical (Mg, Ca, CEC and OM) and heavy metals (Fe, Cr, Cd, Cu and Pb) using Atomic Absorption Spectrophotometer. The Ca content was below 2mg/kg in all the samples except physics laboratory with 2.8mg/kg, while Mg was ranges between 0.68 – 4.94mg/kg. The organic matter (OM) was higher in Biochemistry laboratory compared to Agric. chemical laboratory. Cation Exchange Capacity (CEC) also showed significant decrease from Agric. Chemical to Physics laboratory. The results showed that Fe ranges between (237.00 – 448.81 mg/kg), Cr (8.60 – 35.20 mg/kg), Cd (0.38 – 7.2 mg/kg), Cu (100.90 – 219.60 mg/kg) and Pb (6.0 – 139.80 mg/kg). The results indicated that Cr was not detected in biochemistry and physics laboratories. Cadmium was also not detected in chemistry laboratory. The amounts of the heavy metals detected in the suspended laboratory dust though lower than some reported values for street dust, but, could still have a long term effects in human particularly students since the laboratory is an immediate environment to them. Hence, constant monitoring should be encouraged.

Key word: Atomic Absorption Spectroscopy, Heavy metal, Laboratories, Suspended dust

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INTRODUCTION

Heavy metals are loosely-defined subset of elements that exhibit metallic properties. It mainly includes the transition metals, some metalloids, lanthanides and actinides. Many definitions have been proposed some based on density, some on atomic number, some on chemical properties or toxicity [1].

Dust can be seen as a fine powder made up of very small pieces of sand or particulate substances [2]. It is usually originated from longer masses of the same material through a mechanical breakdown process such as grinding, cutting, and explosion between materials e.g. rocks [3]. Dust particles are usually in size range from 1-100µm in diameter and they settle slowly under the influence of gravity[4].

The likely pathways of exposure to metal-contaminated dust by human through skin contact [5].
Heavy metals may come from many different sources to the urbanized area. One of the most important heavy metals source is vehicle emission. Three main factors known to influence the levels of heavy metals in dust samples which have been reported are traffic, industry and weathered materials, particularly house and street dust [6]
It has been reported that "elemental concentrations of suspended dust were determined simultaneously by filter-sampling and inductively coupled plasma mass spectrometry (ICP-MS) at a coastal urban background site and an island site [7]. At the coastal site, the concentrations of Cr, Co, Ni, and as were in the range of 1-10µg m^{-3} while those of V, Cu, Zn and Pb are in the range of ten to several hundreds of μgm^{-3}.

Lead exposure can occur through drinking water, food, air, soil and dust from old paint containing lead, soil/dust are the major potential exposure pathways for infants and young children [8]. One of the effects of lead to human is loss of hearing and developmental delays [9].

However, little or no attention has been given to the problem of heavy metal contamination in our laboratories despite the fact that they serves as testing ground for most of the chemicals usage globally. Consequently; there are no regulations or guidelines for heavy metal contamination in our laboratories. This lack of information on the level of heavy metals in our laboratories dust necessitated for the assessment of such in selected science laboratories of Usmanu Danfodiyo University, Sokoto.

MATERIALS AND METHODS

REAGENTS

All reagents used in this work were of analytical grade quality.

SAMPLING

The dust samples were collected from five different laboratories in faculty of science of Usmanu Danfodiyo University Sokoto (UDUS) by the use of small piece of cotton as describe in Radojevic and Bashkin, [10]. The cotton was used to sweep the dust suspended on the wall lockers and windows in the laboratories in to a white paper. The dust was then mixed and homogenized, transferred to the sample bottles for analysis. Thus, the samples were labeled as follows;

A = Chemistry laboratory

B = Physics laboratory

C = Agric chemical laboratory

D = Biochemistry laboratory

E = Microbiology laboratory

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SAMPLE DIGESTION

1g of each samples was weighed and put separately in an empty Kjeldhal flask, 10ml of nitric acid (HNO_3), 2 ml of 60% perchloric acid ($HClO_4$) and 5ml of concentrated sulphuric acid (H_2SO_4) were added to each sample in a micro Kjeldhal flask. The samples were placed on a digester and heated for 15minutes, allowed to cooled at room temperature and filtered into a standard 50ml samples bottle and were made up to the mark with distilled water. The filtrate was subsequently analysed for heavy metals using atomic absorption spectrophotometer (UNICAM, 969) at National Research Institute for Chemical Technology (NARICT) Zaria [11]. Blank was also prepared in similar manner and analysed for the same metals.

STATISTICAL ANALYSIS

Data obtained were statistically analyzed using SPSS version 10.0 statistical packages and reported as mean ± standard error of mean of triplicate values.

RESULTS AND DISCUSSION

Table1 and 2 shows the results of the physicochemical parameters and heavy metals content in the suspended dust analysed in this work. From the table1 it shown that all the samples analysed contain detectable amount of all the metals with exception of B and D which indicated that Cr were not detected. Similarly, Cd is either absent of beyond the detection limit of the machine in C.

Various physico-chemical and biological factors control the mobility of metals in soils [6]. The physicochemical parameter of the dust (table 1) indicated that magnesium and calcium content ranges from 0.68 to 4.94mg/kg and 1.11 to 2.0 mg/kg of the dust respectively. The cation exchange capacity (CEC) has been reported to influence the heavy metals' mobility and solubility. The CEC value in this work is low in all the samples. While the percentage organic matter (OM) is higher when compared with CEC.

Table 1: Physicochemical Parameters of the Suspended Laboratory Dust

Samples	Mg(mg/kg)	Ca(mg/kg)	CEC (%)	O.M (%)
A	4.3±0.01	1.9±0.10	5.42±0.06	9.3±2.00
B	4.9±0.04	1.4±0.02	3.02±0.03	35.5±0.90
C	3.3±0.09	1.8±0.06	3.72±0.36	27.5±1.98
D	1.3±0.10	1.2±0.09	2.42±0.46	6.51±0.70
E	0.7±0.02	2.8±0.03	2.46±0.50	21.1±1.88

- Values are reported as mean ± standard error of mean of triplicate analysis

Table 2: Heavy Metals Concentrations (mg/kg) of the Suspended Laboratory Dust

	Metals concentration (mg/kg)				
Samples	Fe	Cr	Cd	Cu	Pb
A	427.8±21.01	8.9±0.3	7.1±0.10	102.1±1.20	88.3±9.0
B	36.9±33.20	ND	0.6±0.0.1	182.3±3.10	105.8±8.5
C	255.5±18.50	13.4±0.90	ND	214±5.60	130.3±9.5
D	301.6±25.10	34.8±0.40	0.4±0.021	130.6±4.80	68.3±2.00
E	410±17.18	ND	4.7±0.10	123.7±8.90	6.5±0.5

- Values are reported as mean ± standard error of mean of triplicate analysis

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ND=Not detected

The concentrations of heavy meals in some selected laboratories dust samples from faculty of science of the Usmanu Danfodiyo University, Sokoto are presented in Table1. The result of the study shows Fe, Cu, and Pb were detected in all the laboratories suspended dust samples investigated, meanwhile Cr and Cd were not detected in Physics and microbiology laboratories, Cd was also not found in the dust sample of Agric chemical laboratory. Fe has the highest concentration almost all the samples; this could be attributed to the facts that it is the most abundance metal in the earth crust [12].

Furthermore, the concentration of Fe in this study is higher than the one obtained in some motorways in the city of Sokoto, Nigeria [13]. The Concentration of Cd in samples A and E are higher than the values recommended by International Atomic Energy Agency, IEAE [14]. The cadmium content reported here is greater than the values obtained by Popoola *et. al.*, [15] in similar works

The Pb concentrations in all the samples are higher compared to the finding of Popoola *et. al.*, [15], with the exception of E, but below the maximum value of 294 mg/kg reported by Xiaoyan *et* al [5] in residential area in china. This high concentration of Pb may be due to the chipping of paints on the wall. It has been reported that emulsions and gloss types of paint contained substantial levels of Pb [16].

The concentration of Cr is lower than 103.0mg/kg reported in dust of Newzealand [17] Nbut little above the value obtained in classroom dust in Lagos [15].

Cadmium contents in all the samples are above 0.43 mg/kg recommended by New York State Department of Environmental Conservation [18]. The higher concentration was observed in A, this could be to the excessive use of cadmium containing compound in the laboratory compared to the other laboratories.

Cu is also detected in higher concentration in all the samples under investigation. The Cu contents follows the C > B > A > D >E. The higher value in C and B could be as results of the use of fertilizer and copper wire in the area respectively. comparing heavy metals concentration in street dust from some popular cities of the world like Islamabad, Pb has 104.0 mg/kg and in Hongkong has 120.0 *m*g/kg [19] while that of chromium in Newzealand has the concentration of 103.0 mg/kg respectively [17]. This indicates that the heavy metals concentration in street dust from some popular cities in the world have higher concentration than the metal concentration in this work

CONCLUSION

The result of this study show the presence of Fe, Cr, Cd, Cu and pb in all the laboratories dust samples investigated, the only exception is that Cr and Cd were not detected in B, E and C respectively. The amounts of metals detected in laboratory dust are lower than some reported values for street dust in some popular cities in the world. Results indicated that the metal pollutant in laboratory dust could significantly contribute to the heavy metal burden in human beings especially in the University since the laboratory is an immediate environment of students where they spent appreciable amount of time. However despite the low levels of the metals

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in this work compared to that of some popular cities they could still lead to serious health hazard considering their cumulative effects in the environment.

REFERENCES

1. Henry I.F, Dowdy R.H., Multiple Metal Accumulations as Factor in Learning Achievement within Various New-Orleans elementary School Commodities, 2008

2. Charya, S. and Komarnicki, G.J.K.., Lead and Cadmium in Indoor Air and Urban Environment. *Environmental pollution*, 2008, volume 136 pp 47-61.

3. Bensiali, A. Both, R. and Glendon, A., Models for problem- solving, *Health and safetyscience***,** 1992, volume15 **pp** 183-205.

4. IUPAC. Glossary of Atmospheric Chemistry Terms. International Union of Pure and Applied Chemistry, Applied chemistry division, *Commission on Atmospheric Chemistry. 1990, Volume* 62 Issue 11 pp 2167-2219.

5. Xiaoyan, L., Shuting, Z. and Mei, Y. Accumulation and Risk Assessment of Heavy Metals in Dust in Main Living Areas of Guiyang City,Southwest China. .J.*Geochem*. 2014, Volume 33 pp 272–276. DOI: 10.1007/s11631-014-0687-x

6. Al-Khashman, O. A. Heavy metal distribution in street dust and soils from the work place in Karak Industrial Estate,Jordan, *Atmospheric Environment, 2004, Volume* 38 pp 6803–6812

7. Cerhard L. and Aissa, M. S. Global fate and Distribution of polycyclic aromatic Hydrocarbons Emitted from Europe and Russia, *Atmospheric Environment*, 2006, Volume 41 pp 8301-8315.

8. George, W. Chemistry of Metal Retention by Soil. *Environmental Science and Technology*. 2011 Volume 23 pp 1046-1056.

9. Karri, I., Dowdy, R. H. and Volk, V. Movement of Heavy Metals in Soils. Chemical Mobility and Reactivity in Soil System. 2008, Pp.229-240.

10. Radojevic, M. and Bashkin, V. N. Practical Environmental Analysis, 2nd Edition, Rsc Publishing, 2006, Cambridge, Uk.

11. Radojevic, M. and Bashkin V.N. Practical Environmental Analysis. Royal Society of Chemistry. 1999, Cambridge. UK.

12. Okoye, B.C.O. (2008). Nutrients and selected Chemical analyse in Lagos Lagoon Surface Water, *International Journal of Environmental Studies,* **38**:131-135.

13. Malami, D.I., Tsafe, A.I., Tijjani N., Mathalo, A., Dioho, I.J., Eleri, A. I., Lawal, A.M. and Soba N.I. Determination of Elemental Composition of Total Suspended Particles along Some Motor Ways in Sokoto, Nigeria. *International Journal of scientific and Engineering* Research, 2012, Volume **3** Issue 8

14. Arslan, H. and Gizir, A.M., "Heavy-metal content of roadside soil in Mersin, Turkey", *Fresenius Environmental Bullettin*, 2006 Volume 15 Issue 1 pp 15-20

15. Popoola O.E, Bangbase O, Okonkwo O.J., Awofolu O.R. Heavy Metals Content in Classroom Dust of Some Public Primary Schools in Metropolitan Lagos, Nigeria *Research Journal of Environmental and*

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Earth Science. 2012, Volume 4 Issue 4 pp 460-465 ISSN:2041-04012.

16. Adebamowo, E.O, Agbede, O.A and debamowo, C.A, An evaluation of Lead levels in residential points sold in Nigeria market, *Indoor Built Environment*, 2006, Volume 15 pp 551-554.

17. Faiz, Y, M., Tufail, M.T., Jawad, M. M., and Chaudhry, S. Road Dust Pollution of Cd, Cu, Ni, pb and zn along Islambad Expressway, Pakistani. *Microchemical* J, 2009, Volume 92 pp 18-192.

18. NYS DEC, New York State Brownfield Cleanup Program Development of Soil Cleanup Objectives Technical Support Document. New York State Department of Environmental Conservation and New York State Department of Health, Albany, NY. 2006. Access on 16th august 2011. Available @ http://www.dec.ny.gov/chemical/34189.html

19. Yeung, Z. L. L., Kwok, R.C.W. and YU, K.N. Determination of multi-element profiles of street dust using energy dispersive X-ray fluorescence (EDXRF). *Applied Radiation and Isotopes*, 2003, Volume 58 pp 339–346

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