

Determination of Lead in Hair and Nails of Electrical Generators Workers in Hilla City

A.A.Al-Kuramy
Univ. of Babylon.
College of Science

M.M.Al-rufae
Univ. of Kufa
College of Science

L.I.Al-Mosawy

H.E.Al-Harby

Univ. of Al-Qadisiya

Univ. of Al-Qadisiya

College of Science

College of Science

Abstract

Lead is one of the most important and widely distributed pollutants in the environment, the major sources of lead is bathtubs (cast iron, porcelain, steel), batteries, dust, paints, pesticide industry and tetraethyl lead $Pb (C_2H_5)_4$ as an antiknocking in petrol.

Lead concentration was determined in (30) samples collected from hair and nails of electric generators workers, and (10)

samples as a control by using atomic absorption spectrophotometry.

The average of lead concentration was found to be (2.43×10^{-2} ppm) in hear and (2.02×10^{-2} ppm) in nails, the correlation factor between period time (year) and lead concentration was ($r = 0.8131$), ($r = 0.0578$) in hair and nails respectively and the period time was between (1 – 9) years at (8) hours (day).

الخلاصة

يعد الرصاص من العناصر الاساسية السامة في تلوث البيئة، كونه يأتي من مصادر عدة اذ يستعمل في صناعة أنابيب مياه الشرب (الأنابيب المغلونه) وفي صناعة مركبات مبيدات الحشرات وصناعة الأصباغ وصناعة البطاريات ويمكن عد اكثر مصدر للتلوث بالرصاص هو رباي اثيل الرصاص المستخدم كمادة ضد القرقة في وقود السيارات.

تم تقدير تركيز الرصاص في (30) عينه جمعت من شعر واطافر عمال المولدات الكهربائية الأهلية التي تعمل بالبنزين مع (10) عينات سيطرة باستخدام تقنية الامتصاص الذري .

وجد أن معدل تركيز الرصاص في الشعر (2.43×10^{-2} ppm)، أما في الأظافر كان (2.02×10^{-2} ppm)، وان معامل الارتباط بين مدة العمل (السنة) وتركيز الرصاص في الشعر كان ($r = 0.8131$) ، أما في الأظافر كان ($r = 0.0578$) حيث تراوحت مدة العمل بين (1 – 9) سنوات وبمعدل (8) ساعات في اليوم .

Introduction

Heavy metals are elements with density more than 5g/cm^3 , positioned at lower right corner of periodic table, high affinity towards S, atomic number of 22-92, and periodicity of 4-7. High metal affinity towards (S) atom causes spontaneous bonding with (S) atom⁽¹⁾.

Elements of heavy metals are distributed on our earth's surface, soil, water, and air, the heavy metals are in the form of organic compounds, inorganic, and bond to other metals which are hazardous compared to its free state, mercury, lead, and arsenic with the assistance of bacteria containing methyl cobalamine coenzymes alters heavy metals into methyl compounds of heavy metal that are hazardous in the form of gas or fluids⁽²⁾.

Heavy metals are causing mineral imbalance which can lead to many of diseases in human and animals such as hyperglycemia, hyperactivity, headaches, hypertension, cancer and arthritis⁽³⁾.

The levels of trace elements in the human body are often evaluated by determining their concentration in blood, urine, hair, and some tissues^(4,5).

Hair can provide a more permanent record of trace elements associated with normal and abnormal metabolism as well as trace elements assimilated from the environment^(6,7).

A hair samples are easily collected, conveniently stored, and can be easily treated, therefor the analysis of human hair has becomes an important way to understand any quantitative change in certain elements inside the body⁽⁸⁾.

Like hair, nails have many superficial advantages as a biomarker for Pb exposure, especially because specimen collection is noninvasive and simple and because nail specimens are very stable after collection, not requiring special storage conditions, Nail-Pb is considered to reflect long-term exposure because this compartment remains isolated from other metabolic activities in the body⁽⁹⁾.

Lead is mostly used in battery, cable, coloring and pesticide industry, and as an antiknocking in petrol, lead is added in petroleum as tetraethyl lead $Pb (C_2H_5)_4$ or tetra methyl lead $Pb (CH_3)_4$, the compound is mixed with ethylene dichloride $(C_2H_4Cl_2)$ and ethylene dibromide $(C_2H_4Br_2)$ to increase octane of petroleum, so that lead does not precipitate in the cylinder or spark plug, thus engine use and efficiency is increased⁽¹⁰⁾.

This work aimed to determination of Pb concentration in hair and nails of electrical generators workers in Hilla city.

Experimental

A- Instrumentals:

1- Pye Unicam Flame Atomic Absorption Spectrophotometer.

2- Digital Balance (Startorius, Bp-3015, Germany).

B- Reagents:

Standard stock solution of lead (II) (20 ppm) was prepared by dissolving (0.0031 gm) in 100 ml distilled water of Pb (NO₃)₂ (Analar – Riedel – Dehean) .

Concentrated nitric acid and perchloric acid (Analar – Merck).

C-Sample preparation:

A (0.04) gm hair and (0.03) gm nails was collected from electric generators worker, samples were washed twice ,

first with acetone and then with double distal water and dried

After heating for 30 min. at a temperature of 50-80 c°, samples was digested with (3:1) perchloric acid to nitric acid mixture⁽¹¹⁾.

Samples were measured by using atomic absorption spectrophotometer, standard curve was obtained during the measuring.

Results & Discussion

To determine lead concentration in samples calibration curve should be obtained, figure (1) shown the calibration curve of lead.

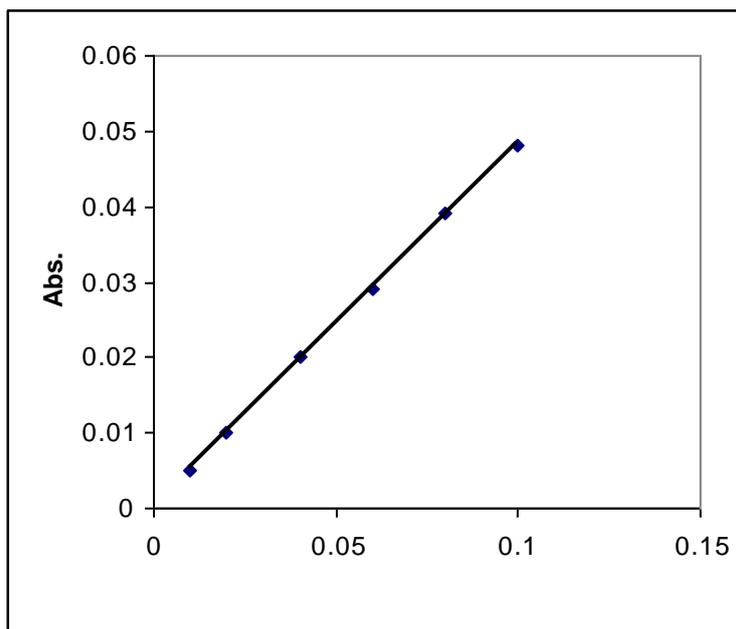


Fig.(1) Calibration curve of Pb⁺²

From fig.(1) many parameters are obtained, like linearity ($R^2 = 0.9997$)

and the average concentration of lead in hair and nails are (2.43×10^{-2} ppm) and (2.02×10^{-2} ppm) respectively in Pb conc.(ppm $\times 10^{-2}$) samples, but in controls it was found (3.26×10^{-3} ppm) in hair and (0.83×10^{-3} ppm).

The relation ship between lead conc. in hair and nails with period time of work/ year was shown in fig. (2 & 3).

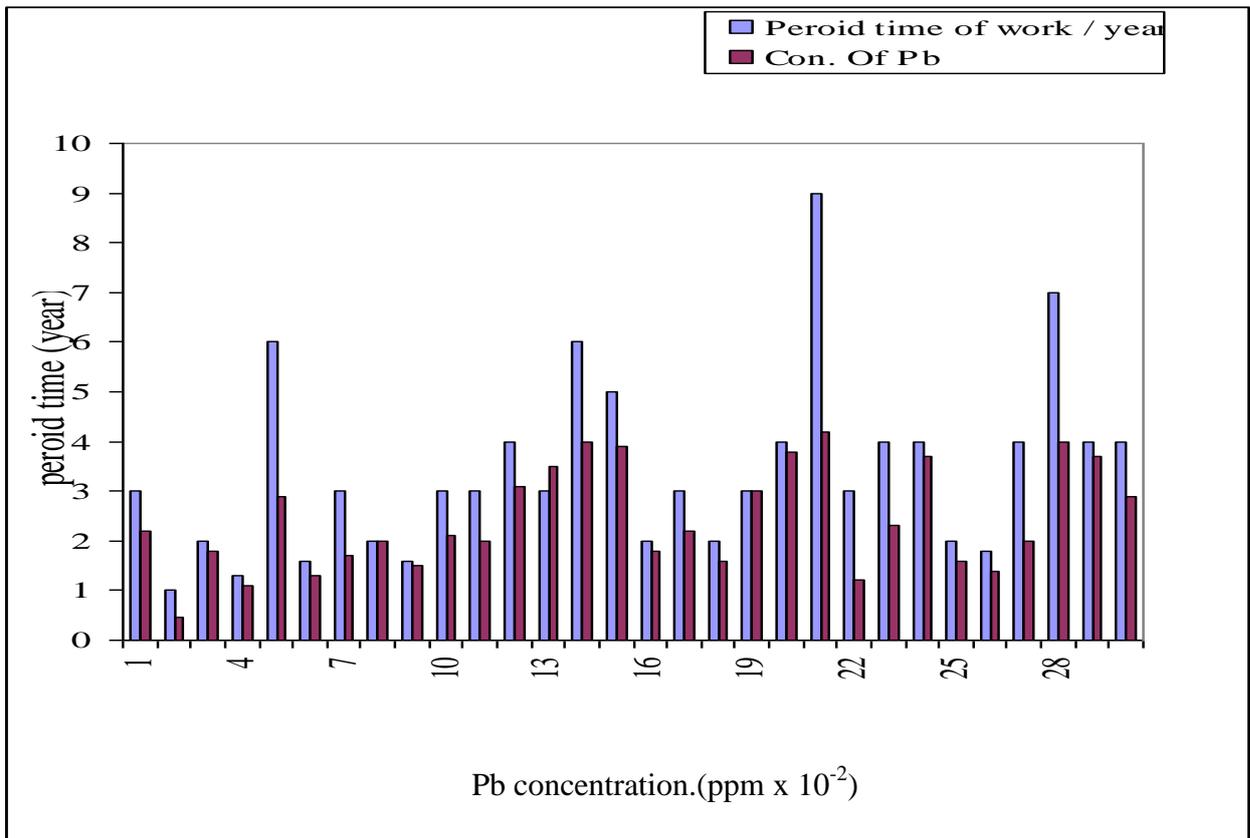


Fig.(2) The relation ship between Pb concentration in hair with period time (year).

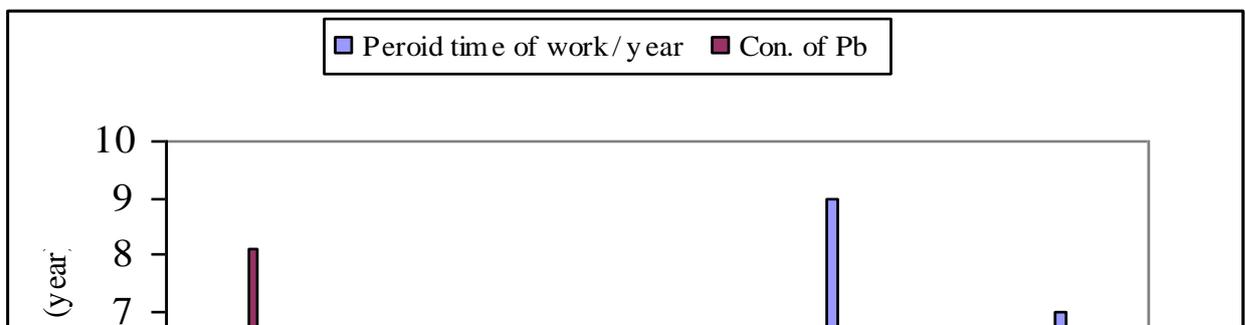


Fig.(3) The relation ship between Pb concentration in nails with
period time (year).

Figure (2) show the increase in lead concentration in hair with
increase in period time of work/ year and the correlation factor
is ($r = 0.8131$).

Figure (3) show the concentration of lead in nails is increase non linearity with increase in period time of work/ year and the correlation factor is (r = 0.0578).

These figures (2&3) explain the hair is more pollution than nails.

The effect of smoking on the concentration of lead in hair and nails was also studied, it was found that the lead concentration increases in smoking workers compared with nonsmoking, Table (1) shows the effect of smoking on the lead concentration.

Table (1) Effect of smoking on the lead concentration in hear and nails.

	Smoking worker		Nonsmoking worker	
	Pb con.(ppm) in hair	Pb con.(ppm) in nails	Pb con.(ppm) in hair	Pb con.(ppm) in nails
Sample	2.50×10^{-2}	2.32×10^{-2}	2.33×10^{-2}	1.63×10^{-2}

s				
Control	3.2×10^{-3}	1.5×10^{-3}	1.10×10^{-3}	0.17×10^{-3}
s				

The table and figures refers to increase lead concentration in samples compared with controls (ten times), this values of (Pb) lead to many hazardous like lead intoxication vary from nausea, anemia, stomachache to paralysis⁽¹²⁾, lead can affect the nervous system, intelligence, and child growth because lead may replace calcium in bones causing paralysis it is also stated that anemia is due to lead in blood influencing **ALAD** (delta amino levulonate dehydratase) activity in hemoglobin formation of red blood cells. Ca, Fe, Zn, Cu, and phosphate deficiency will increase lead absorption in body tissue⁽¹³⁾, kidney is the main target organ of heavy metal intoxication, the mechanism of kidney intoxication is presumably through heavy metal effect on-SH bonds of dehydrogenase enzymes. In acute intoxication, heavy

Besides its hematological effects, lead also is known to delay birth, cause sterility, miscarriage, and fetal death, the general toxic capacity of lead in human causes severe damage in kidney, reproductive system, liver, brain, central nervous system, and eventually death^(15,16).

The influence of lead contained in wallpaper or paint is believed to cause mental retardation in children, schizophrenia and mania especially those living in old houses that do not meet healthy living standard^(1,17).

Conclusions

This work reflects the amount of pollution in electric generators workers due to the direct contact with fuel that contains high amounts of $\text{Pb}(\text{C}_2\text{H}_5)_4$ compound.

The concentration of lead in electric generator workers is higher than control, it is about (ten times).

The worker should be carry by safety conditions like gloves and caps to minimize the hazardous of pollution.

The smoking effect is show very clear on the smoking worker compared with non smoking workers because this staff (smoking) has a high concentration of lead.

The pollution by lead in hair is higher than in nails, because lead is still in hear root, but nails are cat off in every time,

References

- 1- M.S.Seani, The electronic Journal of the Indonesian Medical Association, (2000),1(6),212.
- 2- J.Sneddon and K.S.Farah, Spectrosc. Lett., (1994), 4, 401.
- 3- B.Wnidhan, Effect of toxic metals on learning ability and behavior, www.drmatzen.com/windham/windham.
- 4- K.Bencze, Fresenius, J.Anal. Chem., (1990), 337, 867.
- 5- S.A.Katz, Am. Lab., (1979), 11, 44.
- 6- P.Bermejo-Barrera, G. Horsley, L. Pritchard, K. David, B. Leadbetter and R. Seager, Talenta, (1996), 43, 1099.

- 7- J.E.Tahan, V.A.Granadillo and R.A.Romero, Anal. Chem. Acta, (1994), 123,271.
- 8- X.Dong, Y.Nakaguchi and K.Hiraki, Anal. Scin., (1998), 14, 785.
- 9- F.Barbosa, F. Marcelo, S. Sandrim, and C. Valeria, Environmental Health Perspectives, (2005), 113, 12.
- 10-M.S.Seani, The correlation between the concentration of heavy metals (Pb, Cu, and Hg) in the environmental and human hair. Buletin Kimia, (1995), 9, 147.
- 11-L.M.Klevay, B.R.Bistrain, C.R.Fleming, and C.G.Newmann, Am.J.Clin.Nutr., (1987), 46, 233.
- 12-J.K.Piotrowski and D.O.Coleman. Environmental hazard of heavy metal, Summary evaluation of lead, cadmium and mercury. WHO, Geneva (1980).
- 13-R.Cohen, Review of lead toxicology relevant to the safety assessment of lead acetate as a hair coloring. Fd Chem Toxic. Pergamon Press Plc (1991), 29, 485.

- 14- L.J. Caserett and J. Doull, Toxicology the basic science of poisons. New York, Mc Millan Publishing Co. Inc. (1975).
- 15- G.L. Waldbott, Health effect of environmental pollutants, 2nd edition, Saint Louis: The CV Mosby Company (1978).
- 16- F.A.Jabir, J.Babylon, Pure and Applied Scineces, (2000), 10, 560.
- 17- M.Bekaroglu, Y. Aslan, O. Deger, H. Mocan and E.Evdaran J. Child Psychol. Psychiatry, (1996), 37, 225.