

Assessment of Lead Concentration in the Surface and Profile Soil

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ABSTRACT

There is a lead in the earth of the crust, among other. Lead is widely used in industry for building construction, lead-acid batteries, bullets, shot, etc. Lead poisoning is an important environmental pollutant that can have life-long adverse health effects. Lead causes symptoms ranging from the loss of neurological function to death depending upon the extent and duration of exposure. The current study reports the determination of lead concentration in soil samples, distribution of lead on the surface and its penetration in the profile of soils. We have selected 21 sampling point at a distance 80-600 m around Former Factory Production of Batteries to Berat, Albania. We have collected a total of 28 soil samples (surface and profile). All the representative soil samples were analyzed using Atomic Absorption Spectrometry for their lead content. The concentration ranges of lead in soil samples collected at different points are compared with the Maximum Contaminant Levels (MCL) specified by the Directive 86/278/EEC. From results obtained the fraction of lead in surface soil samples was in range: 126 mg/kg-24207 mg/kg. We have calculated Hazardous Quoted (HQ) for each point sampling. The level of lead in the profile of worked soil samples, in the depth 20-30 cm has decreased compared to the concentration of lead concentration in surface soil samples. Analysis of this study was performed in the Institute of Applied Nuclear Physics, University of Tirana, Albania.

Key words: lead, surface and profile soil samples, Atomic Absorption Spectrometry (AAS).

INTRODUCTION

Lead is one of the trace elements composing the earth's crust (EPA 1980). Lead is not essential element beneficial to humans, animals and plants also it was known as one of the most toxic heavy metals in the environment (Demayo et al. 1982). The particles of lead deposited in soils from several sources. While soils, are the largest accumulators of lead (Alushllari 2015). Lead tends to accumulate in the environment: in soil, seawater, fresh water and in sediments (Zayed et al., 1998). Lead continuously transferred between air, water and soil by natural processes, physico-chemical such as erosion, precipitation, dry deposition of dust etc.

Its exposure in the environment results in a wide range of negative effects, depending from the level of lead and time of extended.

Since lead is mostly used for the production of batteries, the major pollution comes exactly from this industry. In general, areas close to Factory of Battery Production are presented with environmental problems, due to increased production and consumption of lead from vegetation and livestock.

As a result, the contamination of soils has influence on the increase of the level of lead in vegetation (Zakrzewski 2002). The high levels of exposure to lead result in biochemical and toxic effects on the people, causing problems on acute or chronic damage and physical and psychological in capabilities on people (Aigbedion 2005).

The purpose of this study is: define of lead concentration in surface and profile soil and distribution of lead in surface and profile soils around the former Factory of Battery

Production- Berat. The complex of Factory for the production of batteries in Berat, Albania has begun its activity in 1970. It was designed not only to produce batteries for passengers' cars and trucks, but also other military and technical equipment. This factory operated at full capacity until 1997. The Battery Factory conducted its activity as a state-run factory for about 20 years.

environmental concentrations is Atomic Absorption Spectroscopy (AAS). In this paper we present determination of lead in soil by AAS method. The level of Pb in soil samples was compared to the values recommended by the European Community according to Directive 86/278 EEC (EEC 2006) and was calculated the potential of risk Hazardous Quoted (HQ) by USEPA (US EPA 2006).

One of the methods for determination of the total contents of heavy metals of their

Table 1. Concentration of lead, both area and depth in soil samples.

Nr	Sampling stations	Code	Nord	East	Pb (mg/kg)	SD	RSD %
1	S_1	P1_T1	40°42'27.26'	19°58'59.67'	24207	11	18
2	S_1	P1_T2	40°42'27.26'	19°58'59.67'	26142	0.06	11
3	S_1	P1_T3	40°42'27.26'	19°58'59.67'	52982	9.9	3.8
4	S_2	P2_T1	40°42'33.45'	19°58'57.86'	350	3	5.6
5	S_2	P2_T2	40°42'33.45'	19°58'57.86'	125	14	11.2
6	S_3	P3_T1	40°42'34.04'	19°58'53.05'	342	12	9.3
7	S_4	P4_T1	40°42'35.44'	19°58'56.36'	244	0.2	0.8
8	S_5	P5_T1	40°42'31.29'	19°58'58.87'	951	28	1.1
9	S_6	P6_T1	40°42'31.81'	19°58'9.00'	1203	22	1.83
10	S_7	P7_T1	40°42'31.33'	19°58'58.80'	236	9.7	2.2
11	S_8	P8_T1	40°42'31.03'	19°58'59.08'	228	12	5.26
12	S_9	P9_T1	40°42'39.38'	19°59'05.72'	243	9.4	12.7
13	S_10	P10_T1	40°42'28.41'	19°59'02.91'	126	1	0.6
14	S_11	P11_T1	40°42'23.70'	19°59'02.70'	460	0.3	0.1
15	S_12	P12_T1	40°42'24.25'	19°59'00.87'	742	22	0.2
16	S_13	P13_T1	40°42'22.67'	19°58'59.83'	384	0.4	4.9
17	S_14	P14_T1	40°42'24.45'	19°59'00.96'	78	0.2	0.1
18	S_14	P14_T2	40°42'26.21'	19°59'01.29'	10614	3	0.6
19	S_15	S15_T1	40°42'04.97'	19°58'42.21'	341	1.11	0.33
20	S_16	S16_T1	40°42'06.07'	19°58'43.86'	185	2.7	1.46
21	S_16	S16_T2	40°42'06.07'	19°58'43.86'	218	13.5	6.19
22	S_17	S17_T1	40°42'08.00'	19°58'52.31'	1503	3.21	0.21
23	S_17	S17_T2	40°42'08.00''	19°58'52.31'	718	6.43	0.9

24	S_18	S18_T1	40°42'08.13"	19°58'53.46'	149	0.78	0.52
25	S_19	S19_T1	40°42'08.20"	19°58'53.33'	163	0.94	0.58
26	S_20	S20_T1	40°42'07.25"	15°58'52.39'	662	0.13	0.02
27	S_21	S21_T1	40°42'05.09"	15°58'59.73'	187	16.3	8.72
28	S_21	S21_T2	40°42'05.09"	15°58'59.73'	193	8.9	4.61

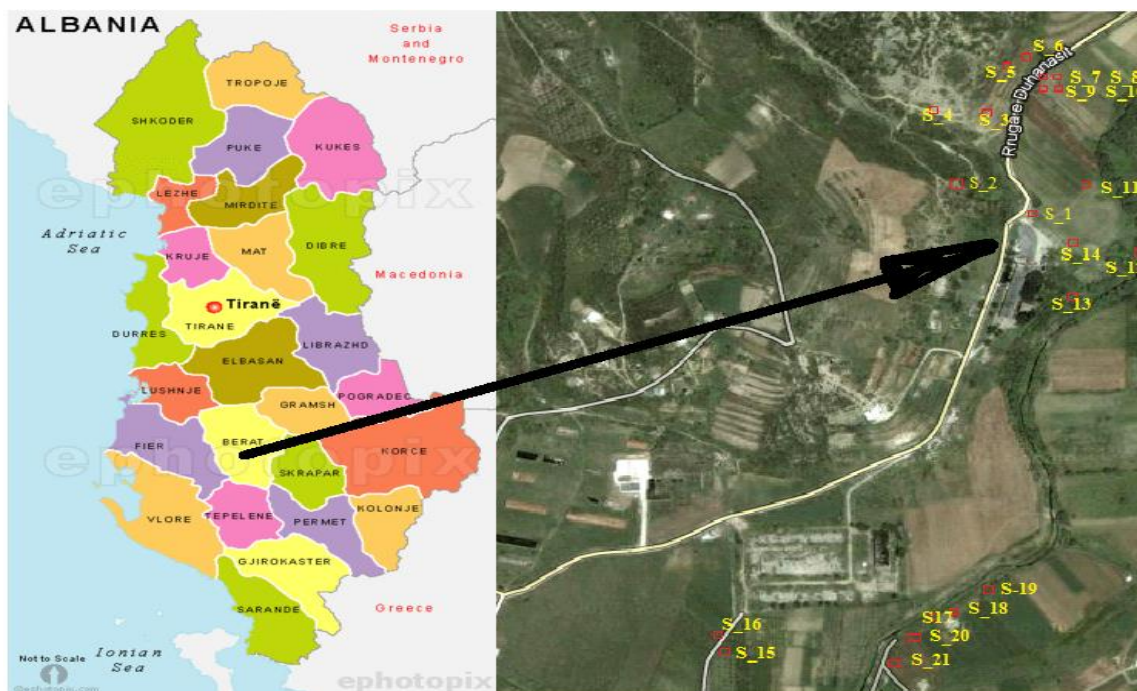


Fig. 1: Map of sampling stations of soil.

MATERIALS AND METHODS

Both representative soil samples depth and area were collected around the street ex-Battery Production Factory-Berat. This Factory is located in the northeastern city of Berat, with respective coordinate: 40° 42' 24.82'' N and 19° 58' 59.42'' E.

During the sampling we have chosen 21 stations and we have collected a total 28 surface and profile soil samples in this area. 21 samples representing are collected at the surface soil (0-5cm) for each sampling point, while 7 samples representing at the three sampling points are taken in the depth 15-120 cm. These sampling stations are marked in map 1, while their coordinates are presented respectively in table 1 with results. Represented soil samples analyzed using Atomic Absorption Spectrometer,

Aanalyst 800 Perkin Elmer with Atomic Absorption Spectrometry, Flame method. Hollow cathode lamp (HCL), used as radiation source for the determination of lead according recommended conditions. Acids used for the digestion of samples, stock solutions of lead have high grade purity.

Glass and Teflon vessels used were treated with solution 10% v/v nitric acid, for 24 hours and then washed with water bidistilled.

Both depth and area soil samples are digested according Analytic Method Atomic Absorption Spectrometry. Instrumental conditions for lead are based on Analytical Methods of Atomic Absorption Spectrometry, from Perkin Elmer (Perkin-Elmer Corp. 1991-1999). Digestion soil samples are prepared using a procedure recommended by Environmental Protection Agency (EPA, Method 3050B)

was used as the conventional acid extraction method. Three applications were carried out for the measurement of calibration standards and measurement of samples. For each element calibration curve equation is linear and passing through point zero. A quality control material IAEA-Soil_7 was analyzed in parallel with the soil samples. To check the instrumental drift, an aqueous standard solution was analyzed after every three samples.

RESULTS AND DISCUSSION

the table 1 is presented results for analyzed samples, (sampling points, code in AAS, coordinates, mean concentration of lead as well as Relative Standard Deviation percentage (% RSD) and Standard Deviation (SD) in representative soil samples. In addition, from results obtained we have calculated Hazardous Quoted (US EPA 2006) for representative surface soil samples. From results obtained is observed the lead concentration there is not unique distribution. The fraction of lead in surface soil samples was found in the order 126 mg/kg-24207 mg/kg (figure 2). The highest concentration of lead was found in samples collected in S_1 and S_14 points.

In this territory were throwing wastes in uncontrollable way and is thought to be mixed solid waste of factory with soil. Areas where samples are collected is not used to plant crops but livestock feed. By analyzing profile samples in these points the lead concentration was higher than surface. By analyzing profile soil samples that are collected at cultivated soils is observed in general the concentration of lead has a trend to go down depending on the depth (figure 3).

The mean concentrations of lead in soil samples that are collected at different points during the street from Factory to Berat, are compared with the Maximum Contaminant Levels (MCL) specified by the Directive 86/278/EEC. Maximal concentration of

lead in soil recommended by the Directive 86/278/EEC is 300 (mg/kg).

We have calculated Hazardous Quoted for surface soil samples. Graphs in figure 2 & 3 are presented the dependence of the content of lead respectively at area and depth of representative soil samples.

Graph in figure 4 is presented Counter plot of Pb in soil samples, in figure 5 is presented Probability plot of Pb soil samples, in figure 6 is presented Dependence of lead from distance and in figure 7 show the variation of HQ in surface soil samples.

The factor of calculated Hazardous Quoted, HQ in representative soil samples was found in the order 0.4-80. From 21 surface sampling points 12 of them were found calculated Hazardous Quoted higher than normal. Hazardous Quoted for surface soil samples is higher than 1, which means this territory is contaminated and this pollution is associated with the high negative ecological and human effects.

Lists of figures

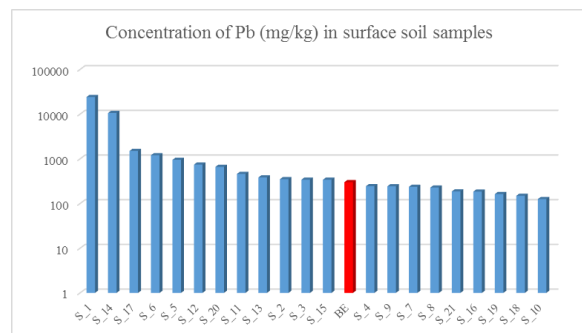


Fig. 2: Variation of Pb in surface soil samples

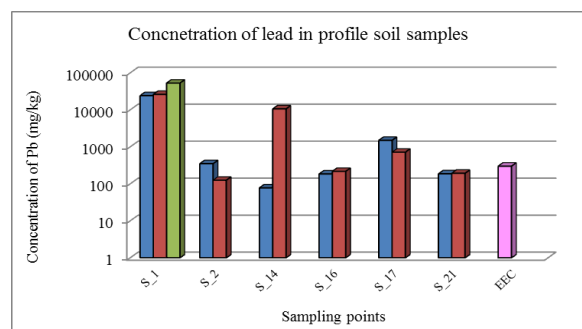


Fig. 3: Variation of lead in profile soil samples

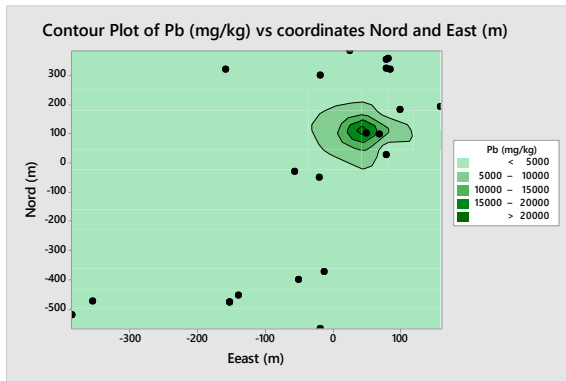


Fig. 4: Counter plot of Pb in soil samples.

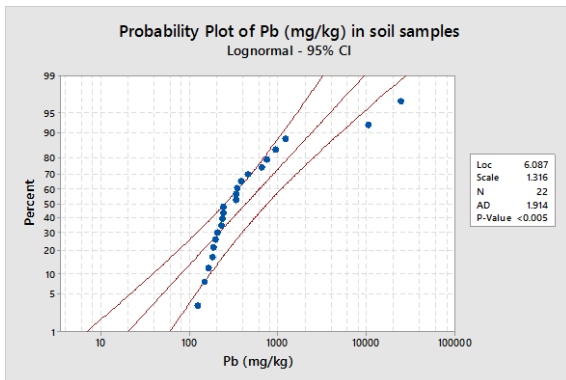


Fig. 5: Probability plot of Pb soil samples.

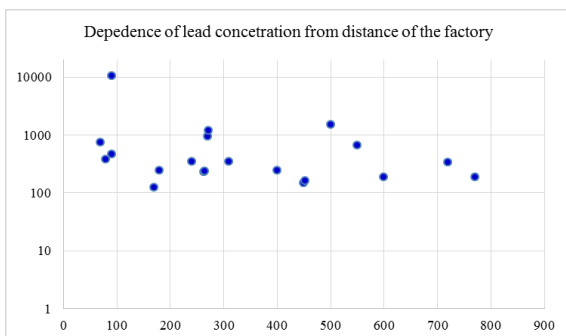


Fig. 6: Dependence of lead from distance.

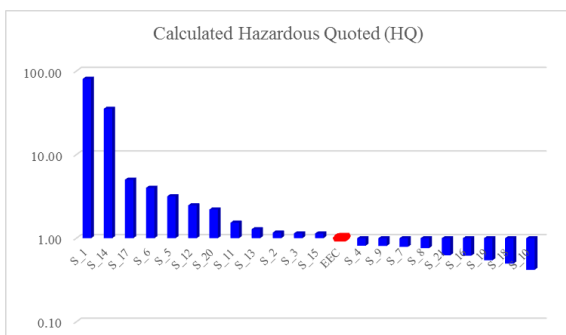


Fig. 7: Variation of HQ in surface soil.

CONCLUSION

During this investigation the level of fraction of lead was found to be present in all of the representative soils samples that analyzed. Also, lead was found present in to the profile of soil, (in the depth 20-120 cm). The level of lead in the profile soil samples, in the depth of 20-25cm collected in the cultivated soil has decreased compared to the concentration of lead in surface soil samples.

In uncultivated soils the concentration of lead in profile was higher than the surface soil (mixed waste from factory with soil). From the results obtained 12 soil samples contained lead concentration above the MCL, recommended by Directive 86/278/EEC for concentration of lead in soil.

In these points the calculated Hazardous Quoted was high. The main contribution of lead that is found in samples collected in this area comes as a result of anthropogenic processes.

Also, other sources of the contribution of lead in samples soils can mention agriculture, transport, construction and buildings, housing in these areas, etc.

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