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Lead Contamination in Soil and Vegetation Around Al Fossool Al arbaa Lead Plant in Tripoli District

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تركيز الرصاص في التربة وأوراق النباتات حول مصنع الفصول الأربعة لاستعادة الرصاص بمنطقة طرابلس

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تم قياس تركيز الرصاص في عينات من التربة والغطاء النباتي بالمنطقة المحيطة بمصنع الفصول الأربعة لاستعادة الرصاص حيث تم تحديد متوسط تركيز الرصاص في عينات تم تجميعها من أبعاد واتجاهات مختلفة من مكان المصنع. تبيّن من هذه الدراسة أن متوسط تركيز الرصاص في الكساء الخضري لعينات مغسولة بالماء يتراوح ما بين 541.3 و5.8 جزء لكل مليون، تم جمعها على بعد 100 و50 متر من المصنع على التوالي و1173.1 و8.7 جزء لكل مليون للعينات غير المغسولة والتي تم تجميعها على نفس الأبعاد السابقة وعلى التوالي أيضاً.

وبالمثل فإن متوسط تركيز الرصاص المقاس لعينات التربة المجمعة من نفس الأبعاد السابقة ذكرها تقع بين 5439.8 و12.0 جزأ لكل مليون على التوالي.

كما قورن تركيز الرصاص للمنطقة المحيطة بالمصنع مع تركيز الرصاص في مناطق القربولي والعزيزيّة وقصر بن غَشير حيث وجد أن تركيز الرصاص حول المصنع موضوع هذه الدراسة أعلى بكثير من تركيزه في المناطق الثلاثة المذكورة.

Abstract: *Lead contamination in soil and vegetation samples have been determined at different locations in Al Fossool Al arbaa lead plant (FALP) area. Average lead content was determined at different locations and directions from the plant in washed and unwashed vegetation samples, which ranged from 5.8 to 541.3 ppm and 8.7 to 1173.1 ppm respectively. Similarly, lead content in soil samples has also been determined at different locations and directions from the plant, which ranged from 12.0 to 5439.8 ppm. The observed lead content data were compared with newly obtained data from Al Aziziyah , Al Qarabulli and Ben Ghashir towns. The lead content in soil and vegetation of Al Fossool Al arbaa plant area was found to be much higher than that in the above mentioned locations.*

INTRODUCTION

Lead pollution and its effects on health are matters of general concern[1-3] . The potential danger to children is now receiving particular attention. Lead in various inorganic forms may be inhaled or ingested, and various sources of ingested lead are recognized and tolerable limits

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have been established[4–6]. One of the most important sources of lead contamination is the combustion of leaded gasoline by automobiles and the subsequent release of lead particles through exhaust. Lead contamination of soil appears to be virtually irreversible and lead finds access into plant and animals, and thus enters into the food web.

The small Al Fossool Al Arbaa Lead Plant (FALP), which recycled lead from used batteries, was in operation until early 1994. It was located at Bir Al-Usta Milad Area, about 15 kilometres east of Tripoli. The operation used to involve direct burning of lead-containing cores and the collection of molten lead manually. Combustion gases and particulate were directly released to the environment by means of an inadequate 15-metres-high chimney made of metal barrel.

The aim of this study is to determine the lead contents, in both, vegetation and soil, at various distances and directions from the plant

EXPERIMENTAL METHODS AND RESULTS

All glassware was leached in 50% nitric acid for 24 hrs. and washed in distilled water prior to use. Atomic absorption analyses were performed on a Varian Model 1475 instrument at 217 nm using an air-acetylene flame. Dilute standard solutions were prepared in the same acid matrix as the samples.

PREPARATION OF SAMPLES

a) ***Vegetation Samples:*** samples of plant leaves were collected in plastic bags from different locations and directions in Al Fossool Al arbaa lead plant area. These samples were prepared for analysis of lead content by atomic absorption spectrophotometer according to a standard procedure[7,8]. The samples were divided into two portions (i.e. washed and unwashed). Washing was carried out with about 20 litres of running water to remove the surface dust. Both samples (5–10 grams each) were oven dried at 105 °C for 2 hrs. and ashed by using a muffle furnace at 450 °C for 4 hrs. The samples were then cooled in a dessicator in the presence of anhydrous calcium chloride and were kept overnight. The dry weights of the samples were noted and the ash was dissolved in 2M HCl and filtered through Whatman No.50 filter paper and the volume was made up to 50 ml. These solutions were analyzed and the results are reported in Table 1.

b) ***Soil Samples:*** Ten soil samples were collected from different locations and directions in FALP area. The distance between one sample and another is about 10 metres. The soil samples collected were obtained from the surface to a depth of about 5 cm. These samples were prepared for analysis of lead content by atomic absorption according to the same standard procedure[7,8]. All samples were oven dried at 105 °C for 24 hrs. An accurately weighed (1–5 g) sample was taken into 250 ml beaker then 10 ml of 65% nitric acid was added and the mixture was evaporated to dryness by heating on a hot plate. After cooling this operation was repeated using a second aliquot of nitric acid. 10 ml of conc. HCl was added and the mixture was again evaporated to dryness. The residue was warmed to 40–50 °C with 75 ml of 1M HCl

Table 1. Lead levels in vegetation samples in ppm around Al Fossool Al arbaa lead plant. (Averages ± S.D.)

Location	Conc. of lead [wt. of dry ash]	
	washed sample	unwashed sample
South of plant		
100 – 150 m	290.2 ± 20.0	765.7 ± 51.3
400 m	94.1 ± 24.	103.2 ± 23.76
1000 m	11.86 ± 2.7	13.0 ± 2.5
North of plant		
20 m	489.4 ± 95.2	1158.0 ± 55.7
100 m	108.5 ± 21.4	113.5 ± 22.1
400 m	17.3 ± 2.3	21.1 ± 4.1
800 m	11.0 ± 1.3	13.4 ± 2.4
1000 m	5.8 ± 1.1	8.7 ± 2.1
West of plant		
20 m	413.2 ± 80.0	877.2 ± 46.2
100 m	105.0 ± 10.5	194.9 ± 12.1
1000 m	13.7 ± 2.0	20.6 ± 5.5
East of plant		
50 m	541.3 ± 32.4	1173.1 ± 111.9
150 m	480.0 ± 36.2	933.6 ± 28.9
500 m	15.7 ± 2.0	22.8 ± 4.0
1000 m	6.5 ± 2.2	16.0 ± 3.3

and the mixture was filtered through Whatman No.50 filter paper into 100 ml volumetric flask. The residue was washed with 1M HCl and the volume was made up to 100 ml by adding 1M HCl. This solution was analyzed by flame atomic absorption spectrophotometric method. The results are presented statistically in Table 2.

The wide deviation observed in the results of the measured soil samples (Tables 1 and 2), reflect the uneven spread of the lead deposit on the area surrounding the plant.

Table 2. Lead levels in soil samples in ppm around Al Fosool Al arbaa lead plant. (Averages ± S.D.)

Location	Average concentration of lead (Averages ± S.D.)
50 m away in all directions from FALP	5439.8 ± 181.6
West of plant	
100 m	813.1 ± 6.3
200 m	124.8 ± 7.7
500 m	21.9 ± 0.63
1000 m	21.6 ± 1.9
East of plant	
100 m	109.5 ± 25.5
1000 m	34.7 ± 8.5
South of plant	
150 m	172.3 ± 23.9
300m	34.6 ± 6.3
1000 m	19.4 ± 1.3
North of plant	
150 m	70.4 ± 3.6
300 m	30.9 ± 12.5
500 m	25.5 ± 1.7

Table 3. Comparative study between mean lead content in vegetation of Al Fossool Al arbaa lead plant area and other agricultural regions

Location	Overall average conc. of lead (in ppm of dry ash wt/wt)	
	washed sample	unwashed sample
(FALP) area	245.9*	501.9*
Al Aziziyah town	2.0	3.4
Al Qarabulli town	2.5	4.1
Ben Ghashir town	2.3	3.8

* Average of the averages at 100–150 meter distance from FALP in the four geographical directions.

Table 4. Comparative study between means of lead content in soil samples of Al Fossool Al arbaa lead plant area and other agricultural regions.

Location	Mean of lead concentration in ppm (wt/wt)
FALP area	291.3*
Al Aziziyah town	18.7
Al Qarabulli town	21.2
Qasar Ben Ghashir town	18.7

* Average of the average in the 100–150 metres distance from FALP in the four geographical directions.

DISCUSSION

The results reported in Table 1 show that the average level of lead in washed and unwashed vegetation samples increases as the distance from the FALP lessens, and that the east side of the plant (at 50 m) is more polluted with lead than in the other three directions. This may be due to the consistency of the west to east wind blow direction.

It is also observed from Table 1, that the average lead concentration in unwashed vegetation samples ranges (8.7 to 1173.1 ppm at distance of 1000 and 50 metres from FALP respectively) are higher than those of washed samples (5.8 to 541.3 ppm at the same above-mentioned distance). These differences, especially at 50 metres, reflect the amount of contaminating lead, which can be removed by washing. The results of the soil sample reported in Table 2 show a great similarity in the vegetation samples. However, the concentration of the lead at a 50 metres distance from FALP is about five times greater than that of the vegetation one. The results also show that the west side of the plant (at 100 m) has the highest concentration in comparison with the other directions.

This may be due to the fact that the waste disposal is situated on the west side of the plant. The comparative study of mean lead content in vegetation and soil of the FALP area and of other towns, namely, Al Aziziyah, Al Qarabulli and Ben Gashir[9] which are given in Tables 3 and 4 respectively, clearly indicates that the FALP area has much higher levels than those of the above-

mentioned towns. This reflects the extent of the lead pollution,(which exceeds the international permissible limit[5,6]), caused by the past operations of FALP in the studied area.

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[9] unpublished result.