



## **DISTRIBUTION PATTERN OF SOME HEAVY METALS IN SOIL AND PLANTS ALONG EL-MOUKATTAM HIGHWAY**

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### **Abstract**

Generally very wide variations are not noticed in the distribution of lead (Pb) between the different horizons of soil profiles. However, Pb contents vary more or less, in relation to humus and organic matter concentrations. Most of the time, an accumulation of Pb is observed in the upper soil horizons. The mobilization patterns of cadmium (Cd) indicate that ion exchange is an important factor in the retention of this element by the solid phase of the soil. Besides, the nature of the element, the physico-chemical properties of the soil may also affect the mobilization pattern. The levels of vehicular Pb and Cd in spontaneous plants and soils have been assessed by a national survey carried out on about 10 Km of El-Moukattam highway, according to a standardized project of samples collection. Evidence is reported for a typical distribution of both Pb and Cd, whose levels decrease as distances from the highway increase. Traffic volume, highways layout and green barriers influence proximal levels of both Pb and Cd. Relationships between Pb and Cd in spontaneous vegetation and in specific bioaccumulator plants (*Lolium multiflorum* L.) are also reported.

### **INTRODUCTION**

Vehicular traffic is the most widespread Pb sources, owing to the emissions from motor vehicle powered with leaded gasoline. Published results of several studies show Pb accumulation in crops, soils and spontaneous vegetation near the highways (ref. 1,2,3,4,5). Besides Cd emitted as particulate matter by tyres attrition (ref. 2) appears to be a good tracer of proximal vehicular induced pollution. Localized surveys carried out in El-Moukattam highway throughout 1998-1999 proved that a more detailed and wide research was needed over the period of one year in this area. A specific biomonitoring survey have been projected and developed as a part of wider investigation finalized to assess the possibility of vegetables (as components of the green barriers near the highways) to retain vehicular pollution such as Pb and Cd. Lead and some other heavy metals reached water, soil and plants as a direct result of the atmospheric pollution from automotive emissions (ref. 2). This Pb deposit is due to the addition of tetraethyl e lead or tetramethyl lead to the gasoline (ref 6, 7).

The aim of the present study is to investigate the effect of lead pollution on soil and spontaneous vegetation in El-Moukattam highway. The relationship between the Pb and Cd concentrations absorbed by plants are also investigated.

## **MATERIALS AND METHODS**

The investigation has been projected on the basis of the main El-Moukattam highway on about 10 Km of highway. Soil and plant samples were chosen for the present investigation according to the following procedure:

- (a) Selection of sampling sites: 13 sampling site have been selected in North (5), Middle (5) and South El-Moukattam highway (3) in order to give a sufficient representation to each sub-area whose average daily traffic (A.D.T.) are quite different. Besides, the type of highway layout has been taken into account for sampling site selection. The assessment of enrichment factors of both Pb and Cd considers as “a background level” the average level measured in leaves of 13 species at different distances from appreciable vehicular traffic.
- (b) Selection of sampling points: samples points have been selected for each sampling site at different lateral distances (0 to 200 m) from the edge of the highway.

Samples collection: samples of grass, leaves, twigs, and soil for 3 depth (0-5 cm; 5-10 cm; 10-15 cm) have been collected at each sampling point.

Samples were dried at 65 C (vegetable samples) or air dried (soils) and analyzed without any washing procedures, in order to assess the total amount of metals. Analyses were performed by using Prkin Elmer model 2380 atomic absorption spectrophotometer.

## **RESULTS AND DISCUSSION**

Figures (1 &2) show the relation between the average concentration of lead and cadmium in top-soil samples for each geographic area with distance from the edge of the highway.

These results show that the increase in the lead levels is associated with a similar increase in cadmium. This indicate that there is probably only one source of pollution responsible for the build up of these metals. These results are in agreement with those found by El-Gamal et al (ref.

8). Lead particularly produced from the vehicular exhaust emissions, whereas zinc is found in lubricating oils as additives (ref. 2, 8). The presence of these metals in the soil along this highway may well be attributed to the mechanical wear and tear which deposit these metals in the fine dust of this road. These metals eventually find their way to the adjacent water, soil and plants (ref. 9, 10). On the other hand a sharp decrease in the concentrations of both Pb and Cd is quite evident and well described (for  $P < 0.01$ ) by the equation:

$$y = a + b \ln x$$

where y is the unknown Pb or Cd concentration

x is the distance from the edge of the highway,

a is the concentration of Pb or Cd for  $x = 1$  m and

b is the edge slope of the relation

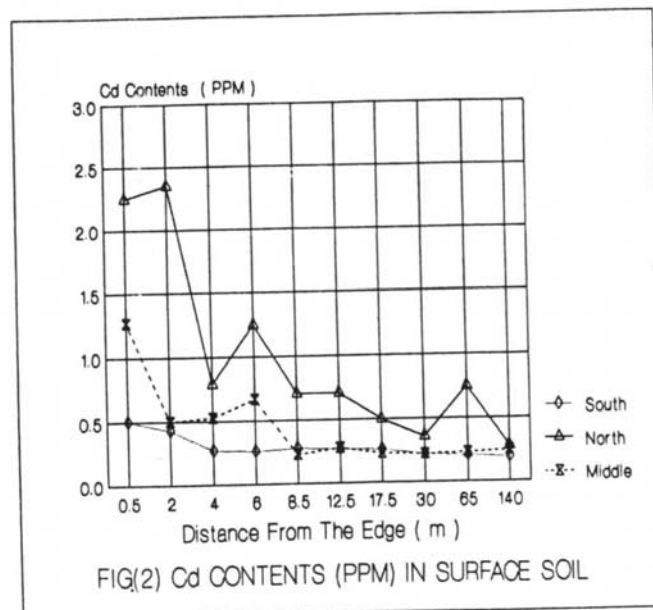
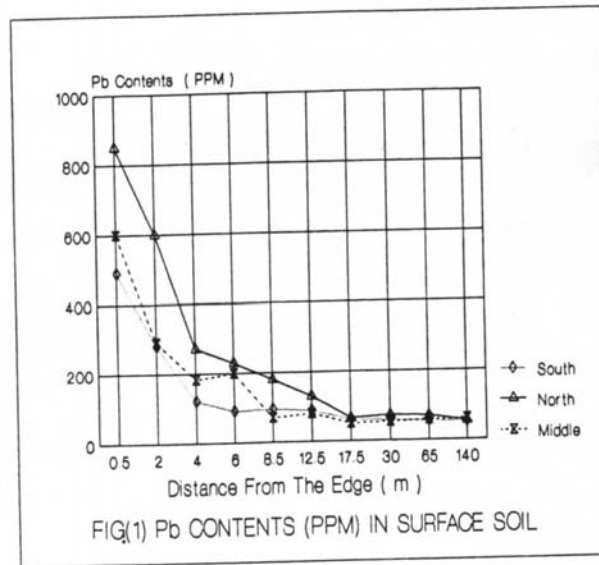
Lead appears to be the most specific tracer of vehicular pollutants. Comparison of concentrations in leaves at the edge of the highways with the concentration measured at the control site reveals a Pb-enrichment of 5-60 times, while for Cd the values are 2-5 times.

Lead and Cd concentration appear to be mainly due to different levels of traffic volume (Fig. 3) the geographic condition of average daily traffic (ADT) is reflected by foliage levels of Pb; Cd also shows the same pattern (ref. 11).

Further investigation included the level of metals in Egyptian green barriers. Values in table (1) reveal that green barriers permit to the reduction of the dispersion of heavy metals from the highway. This table also shows average Pb and Cd levels in soil and grass samples collected at various distance from the road before and behind the barrier. The data obtained from the spontaneous vegetation are confirmed by a seasonal survey (throughout 2000), carried out using a specific bioaccumulator *Lolium multiflorum* L.

$$r = \quad r =$$

There is a close correlation ( $r = 0.96$  and  $r = 0.98$ , for  $P < 0.05$ ) between Pb concentration in *Lolium*, and respectively in spontaneous grass (Graminaceae, Leguminosae and compositae) and leaves of spontaneous trees. These results are in agreement with those found by Ferretti et al (ref. 11).



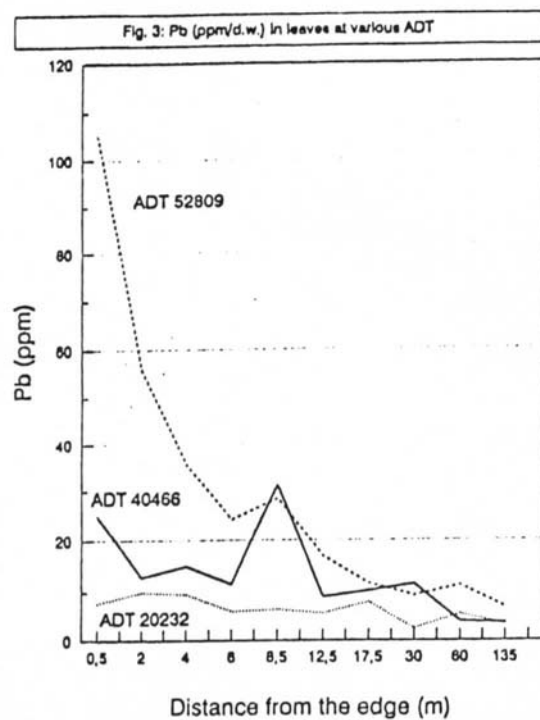


Table (1) Average Pb and Cd contents (ppm) before (BF) and behind (BH) the green barriers at various distances from the highway

Distance (m)	Metal	Soil		Plant	
		BF	BH	BF	BH
2	Pb	256.01	97.73	27.81	2.98
	Cd	0.83	0.33	0.30	0.02
4	Pb	160.02	63.50	35.71	8.05
	Cd	0.73	0.62	0.19	0.11
6	Pb	142.11	55.35	43.22	15.20
	Cd	0.58	0.15	0.13	0.09
8.5	Pb	89.03	61.88	30.98	7.17
	Cd	0.32	0.23	0.19	0.06

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## التوزيع النموذجي لبعض المعادن الثقيلة فى الارض والنبات بطريق المقطم السريع

ابراهيم الجمل – جامعة عين شمس – معهد البيئة

### الملخص العربى

من المعروف ان طبيعة العناصر والخواص الكيميائية والطبيعية للارض يؤثر فى حركية العناصر بها ولذلك فإنه يحدث تراكم بعض العناصر (الرصاص والكاديوم) الناتج من وسائل النقل والمواصلات فى النباتات التى تنمو تلقائيا حول الطريق لتتقى الجو من خطر التلوث بالمعادن الثقيلة . ولذلك اجريت الدراسة على الطريق السريع المقطم بطول حوالى 10 كيلو متر حيث اخذت عينات (نبات ، اراضى) لمسافات مختلفة من قمة الطريق ودرست بها بعض المعادن الثقيلة . ولقد لوحظ انخفاض تركيز الرصاص والكاديوم بوجه عام كلما ابتعدنا عن حافة الطريق كما وانه قد درست العلاقة بين عنصرى الكاديوم والرصاص خاصة فى النباتات النامية تلقائيا .