LEAD CONTAMINATION LEVELS IN ROADSIDE VEGETATION OF GHARIAN-TRIPOLI ROAD, LIBYA

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Abstract

This study was designed to determine the lead contamination in roadsides vegetation along 125 km of busy roads resulting from many sources such as the exhaust of cars that use gasoline. The area of this study was Gharian city center, and the sides of Gharian-Azizia, Azizia-Swani, Swani-Airport and Airport-Tripoli Roads. Samples were collected from the leaves of plants adjacent to public roads within the study area by distance of 2-5 km between samples within urban centers and 10-15 km within the roads, so as to give a true representation of the study area. Results of this study showed that the traffic volume caused a significant increase in Pb content in roadside vegetation. Higher Pb concentrations were found in sites with a higher traffic volume on main roads. Results showed that the rate of lead contamination varied within the study area, but generally less than 50.99 µg/100cm^2. It was found that the highest percentage of pollution within the city center of Azizia with 50.99 µg/100cm^2, followed by Gawasem center with 43.65 µg/100cm^2 while the lowest polluted area was Azizia-Swani road with 11.58 µg/100cm^2. The presence of elevated levels of lead on/in the plants closer to the roads with high traffic density caused by the use of alkyl lead compounds as antiknock and freezing additives in fuel needs more attention and some necessary steps should be adopted.

Keywords: lead, roadsides, Gharian, contamination

Introduction

Environmental pollution is a broad concept which includes pollution of various biological and physical components of the planet as a result of human activities, pollution occurs because of the unwanted changes in the physical properties, chemical or biological environmental media (air, water, soil), which may cause damage to human life or other living organisms or affect the balance of the natural environment. Pollution is the presence of a foreign substance in any component of the environment. Perhaps the most striking risk of pollution is air, water and soil pollution. Heavy metals may enter the food chain as a result of their uptake by edible plants, thus, the determination of heavy metals in environmental samples is very important [Alirzaveya et al. (2006); Kachenko et al. (2004)]. Contamination of roadside soils with heavy metals arises from a number of sources, such as vehicles, road wear, slipperiness control, buildings (heating and corrosion), local building activities, and pollution from local industries. Trace metal concentrations, such as Cd, Cu, Zn, and particularly Pb, in surface soils have been the focus of investigations (Baycu et al, 2006, Kaya, and Yaman, 2008; Yaman et al, 2005). The accumulation of these metals in topsoil is greatly influenced by traffic volume and motor vehicles, which introduce a number of toxic metals into the atmosphere

(Wixon and Davies, 1994). Pb, in particular, is an environmental pollutant in soils because of the use of alkyl lead compounds as antiknock and freezing additives in fuel (Ward, 1990; Choudhary *et al*., 1998; Carlosena *et al*., 1998). Pb is particularly toxic to the brain, kidneys, reproductive system, and cardiovascular system as a result of chronic and acute exposure and the repeated exposure of Pb buildup in the body (Bakirdere et al. 2008, Sutherland 2000). It was reported that children absorb Pb more readily in their gastrointestinal tracts than adults, and the developing nervous system is very susceptible to the deleterious effect of lead (Rossini and Mingorance, 2006; WHO, 1995 and Zu et al, 2005). During the last two decades, measures have been taken to reduce Pb emissions from motor vehicles. For example, in the UK the Pb content of leaded petrol was reduced from 0.3g Pb /L to 0.134 g Pb/L in January 1986 (Wang *et al*., 1998), and the complete removal of Pb from petrol in the UK was mandated by legislation that came into force in January 2000 (Massadeh and Snook, 2002).

Materials and Methods

Investigations were made along 100 km of roads from Gharian city to Tripoli including city centers. Samples of roadsides vegetation with distance 5m from the main roads (leaves from small bushes, gardens and grass) were collected from 7 different locations, covering main roadsides and some city centers. These study areas were the center of Gharian city center, Gharian-Azizia, Azizia-Swani, Swani-airport and Airport-Tripoli roads. The samples were collected at different distances; within the cities, it was between 2 and 5 km and in the roadsides was between 10 and 15 km. These samples were collected after a period of no rainfall and put in clean and dry plastic containers.

Washing was carried out using about 2 liters running water to remove the surface dust, then, addition of 20ml of hot (0.1M) nitric acid to each sample to dissolve the material deposited on the leaves of plants, and the solution was transferred to 100ml volumetric flask. To equivalent the acid, drops of concentrated ammonia were added and then, 60ml buffer solution (pH = 11.5) was added to the contents of the bottle. The buffer solution was prepared by mixing 350ml concentrated ammonia, 30ml of (10%) potassium cyanide, 1.5g potassium sulfate and the volume was completed to 1 liter with distilled water. The resulting solutions were collected and lead was determined using Portable Datalogging Spectro-photometer/HACGDR/2010.

Results and discussion

Table (1) shows the lead concentration of 24 collected samples, it shows that Gharian city samples had different values ranges between 14 and 46 µg/100cm^2

where the gharian city sample (4) had the highest concentration value 45.31 µg/100cm^2. Gawasem center, which is one of suburbs of Gharian, showed different values especially the sample (5) which had the highest concentration in this area with a value of 59.34 µg/100 cm^2. The contamination in Gawasem center ranges between 27 and 60 µg/100 cm^2. As shown also in Figure (1), sample (12) in the area of Gharian-Azizia road recorded the highest concentration between all areas with a value of 67.42 µg/100 cm^2 and the extent of contamination is ranged between 11 and 68 µg/100 cm^2. Sample (15) which is located within the city center of Azizia, recorded the highest rate of contamination in this area with 60.59 µg/100cm^2 a value of and the extent of contamination is ranged between 41 and 61 µg/100cm^2. Sample (18) which is in the area of Azizia-Swani has recorded the lowest a value for the concentration of lead of 11.06 µg/100 cm^2 and the extent of contamination within this area is located between 11and 13 µg/100 cm^2.

Table (1): Concentration of lead in different samples

No	Sampling areas	Lead (µg)	Area of sample (cm^2)	Lead conc. (µg/100 cm^2)
1	Gharian center	7.33	51.30	14.29
2	Gharian center	6.61	19.80	33.40
3	Gharian center	7.39	24.50	30.15
4	Gharian center	8.45	18.66	45.32
5	Gawasem center	7.61	12.83	59.34
6	Gawasem center	5.87	21.00	27.96
7	Gharian-Azizia road	2.48	16.33	15.21
8	Gharian-Azizia road	4.35	29.16	14.93
9	Gharian-Azizia road	3.65	14.00	26.04
10	Gharian-Azizia road	1.29	11.66	11.07
11	Gharian-Azizia road	8.06	14.00	57.60
12	Gharian-Azizia road	12.58	18.66	67.42
13	Gharian-Azizia road	3.54	5.83	60.86
14	Azizia center	6.48	10.70	60.59
15	Azizia center	6.39	15.37	41.49
16	Azizia center	8.90	17.50	50.88
17	Azizia-Swani road	4.52	37.33	12.10
18	Azizia-Swani road	3.87	3500	11.06
19	Swani-Airport road	7.58	26.83	28.25
20	Swani-Airport road	11.61	33.29	34.89
21	Swani-Airport road	9.35	31.85	29.37
22	Airport-Tripoli road	7.42	24.50	30.28
23	Airport-Tripoli road	9.26	20.94	44.21
24	Airport-Tripoli road	9.71	30.21	32.14

Sample (20) in the Swani -airport roadside has recorded the highest rate of contamination within this area with value of 34.89 µg/100 cm^2 and the extent of contamination in this region is ranged between 28 and 35 µg/100 cm^2. sample (23) showed the highest percentage of pollution within the Airport-Tripoli with value of 44.21 µg/100 cm^2 and the extent of concentration for this region is ranged between 30 and 45 µg/100 cm^2 as shown in Figure (1).

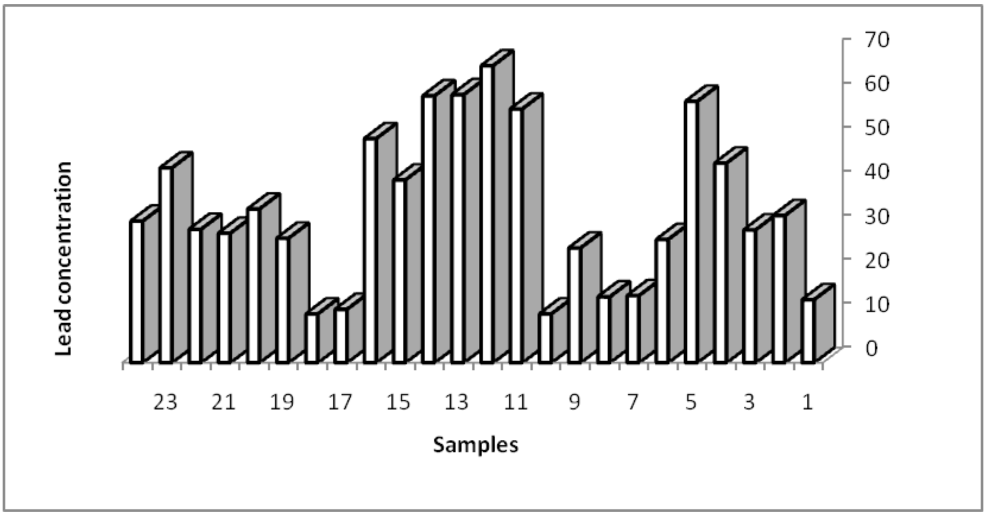

Figure (1): The concentrations of lead in the different samples

Discussion and Conclusions

Roadside vegetations along 100km between Gharian and Tripoli including the airport road are open to contaminations of diverse heavy metals and other gaseous pollutants, and to physical disturbances of being trampled by pedestrians and crushed by vehicles continuously. As shown in Figure (2) and table (2), lead concentration rate in the 7 areas differs from each other depending on the difference in traffic conditions, Maintenance and upgrading of roads and may be other weather conditions such as rain and wind, these results agreed with Massadeh et al (2004), ray and Georg (2009) and Kaya et al (2010).

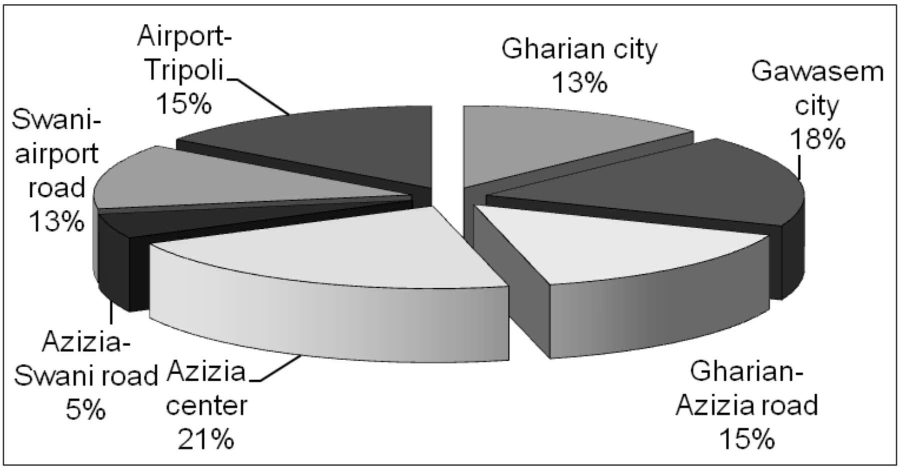

Figure (2): Concentration rate of lead contamination

Results showed that Azizia center is the most contaminated among the rest of the studied areas where the concentration of lead in Azizia was found to be 50.99 µg/100 cm^2 which could be due to the location of Azizia as an intermediate between other cities. Azizia-Swani road with 18km long was the lowest concentration with 11.58 µg/100 cm^2 which was considered as the less polluted area suggesting that a lower source of elevated lead contamination which is mainly derived from automotive emissions.

Table (2): Concentration rate of lead contamination

No	Sampling areas	Concentration rate for each area (µg/100 cm^2)	Overall rate of concentration (µg/100 cm^2)
1	Gharian center	30.79	34.22 µg/100 cm^2
2	Gawasem center	43.65	
3	Gharian-Azizia road	36.16	
4	Azizia center	50.99	
5	Azizia-Swani road	11.58	
6	Swani -Airport road	30.84	
7	Airport-Tripoli road	35.54	

Table (2) shows that the overall rate of concentration is 34.22µg/100 cm^2 which is still within the allowable limit but the use of alkyl lead compounds as antiknock and freezing additives in fuel (Ward, 1990; Choudhary *et l.*, 1998; Carlosena *et al.*, 1998) needs more attention and suggests that some necessary steps should be adopted to reduce lead pollution in the country. Similar results were obtained by Tumi et al (1990) who studied lead contamination of roadside vegetation at different locations in Tripoli center and suggested that automobiles on the road with enormous consumption of gasoline is the main reason for lead contamination.

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