IJST (2015) 39A3: 341-343
Iranian Journal of Science & Technology

http://ijsts.shirazu.ac.ir

Effects of lead pollution on soil and plants around the powered generators

S. M. A. Hamdy*, A. H. M. J. Al Obiady and A. A. M. Al Mashhady

Environmental Research Center, University of Technology, Baghdad, Iraq
E-mails: shaymamun1977@yahoo.com

Abstract

Because of the everyday use of power generators in Iraq, which exist in residential neighborhoods, it is necessary to study the impact on soils and plants surrounding areas of those generators. Lead is one the most heavy metals released especially, as a result of the combustion of diesel fuel during operation of the powered generators. However, a study was conducted to investigate the lead concentration in soils and Bitter orange leaves affected by powered generators. Forty-eight soil s and sixteen plant samples were collected nearby and around the powered generators. It was found that soil and plant samples that fall under the influence of more than one generator exhibit higher concentration of lead than the soil and plant samples collected from the sites affected by one generator only, also the geographical location of the area in terms of the proximity of other pollutants, such as roads and factories in addition to the movement of wind are all factors that affect the concentration of lead in the soil and thus in the plant located there.

Keywords*:* Powered generators; lead; bitter orange; soil

1. Introduction

Heavy metal accumulation in soil from natural and anthropogenic sources poses important threats to ecological phenomena that need to be addressed (Al Obaidy et al., 2013). Another concern is that heavy metals can be absorbed by plants. Therefore, it is important to determine the spatial distribution and mobility of heavy metals in soils and plants in close proximity to human activities. The heavy metals pollution resulting from vehicle exhausts, factories and powered generators is spread over large areas, which in turn transmits those metals to soils and plants surrounding buildings and through accumulation on the roofs of those buildings, or absorb to settle within the plant tissue (Alloway, 1995; Kabata, 2010).

Lead is considered one of the most important metals emitted from the exhaust of generators, and the combustion of fuel, which contains the addition of Lead is considered one of the most important sources of soil pollution (Banerjee, 2003; Imperato et al., 2003). Uptake of Pb by plants and vegetables occurs through roots and leaves from water and soil only in the form of Pb ion (Stohs and Bagchi 1995). Plants take up heavy metals by absorbing them from deposits on parts of the plants exposed to the air from polluted environment as well as from contaminated soils (Al-Jassir et al., 2005).

In this study four sites were selected within Baghdad city the capital of Iraq to investigate the distribution of lead content in the soil and the bioaccumulation of lead in the plant leaves affected by the local powered generators.

2. Materials and Methods:

2.1. Study area

Soil and plant samples were collected from a residencial area in Al-Ghazaliya district in Baghdad, Iraq, around four powered generators zones. The area that has been sampled contains a dense residential area on several streets also has a garage for parking and a local market in addition to football fields Fig .1.

This Figure represents the generator locations and is symbolized by (G1, G2, G3 and G4), while the points (G1W3+G2E3), (G2W3+G3E3) and (G2N3+G4S3) refers to a specific areas under the influence of more than one generator.

*Corresponding author
Received: 28 December 2014 / Accepted: 16 June 2015

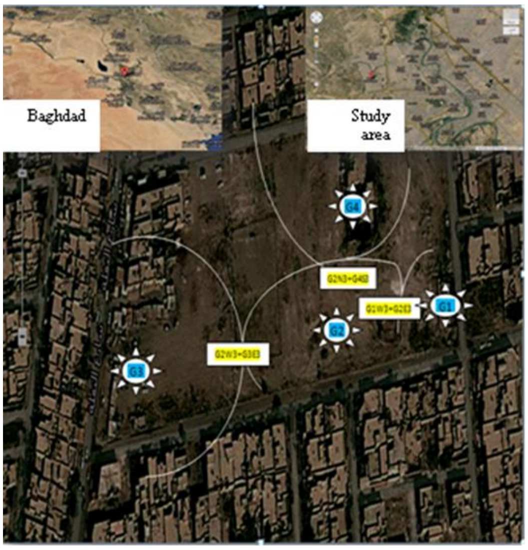

Fig. 1. Sample collection sites within the study areas in Al-Ghazaliya district

2.2. Samples Collection and Analyses

Forty-eight surface soil samples (0-20cm) were collected from four sites, twelve samples from each site. Soil samples were taken from four directions around each site. The samples were collected from three dimension, each point of which is generated (0, midway between two generators and the meeting point between two generators), stainless spatulas were used and samples stored in polypropylene bags. After collection, pebbles and twigs were removed, and then the soil samples were air dried and passed through a 2 mm sieve. The soil samples were stored in plastic bags for further analysis. 0.2 gm from each soil sample was transferred into 100 ml Pyrex beaker. 40 ml of Aqua Regia (1:3 HNO_3: HCl) was added to digest the sample. The solution was evaporated to near dryness on a hot plate at a temperature of 105ºC. After cooling, the solution was transferred to a 100 ml volumetric flask and filled up to volume using deionized distilled water. The solution was kept for 24 hours to allow sandy grains to settle.

Sixteen plant samples (leaf samples from Bitter orange) were collected from the same sites randomly. 1 g of plant samples was weighed into porcelain crucibles and was heated in a muffle furnace for 6 h at a temperature of 450-500 C^o. The ash samples were allowed to cool and then 10 ml of 2M HNO_3 was added. The solution was evaporated to near dryness on a hot plate and the cooled residues were re-dissolved in 10 mL 2M HNO_3. The solutions were then filtered into 25 mL volumetric flasks. Both the crucible and the filter paper were washed into the flasks, filled up with deionized distilled water and then stored in polyethylene bottle for instrumental analysis. Lead (Pb) in both soil and plant samples was analyzed in the Environmental Research Center, University of Technology, Baghdad, using Atomic Absorption Spectrophotometer.

3. Results and Discussion

The statistical analysis results are summarized as minimum, maximum, mean and standard deviation of Pb concentration for soil and plant samples in Table 1. The lead can enter the environment during numerous activities and can be very toxic for human health (Romic and Romic, 2003) .The Pb content in the soil samples varies from not detectable to 338.30 mg/Kg with a mean value of 116.39 mg/Kg. The observed values are higher than the calculated world average of unpolluted soils (44.0 mg/Kg) (Kabata and Pendias, 2001).

Table 1. Lead concentration (mg/Kg) in the soil and plant samples

Sample types	Descriptive statistics			
	Min.	Max.	Mean	Std. Deviation
Soil	ND	338.30	116.39	±82.45
Plant	10.15	38.60	20.55	±5.03

At the same time we have been studying the concentration of Pb in the leaf of Bitter Orange, the samples of which taken from different areas around the generator under study, where the presence of a significant content of Pb in the leaves, rangeing from (10.15-28.60 mg/Kg) was noted. Excessive concentrations of lead in plants have been found to cause a number of biochemical effects, including upon the processes of respiration, photosynthesis, transpiration and the proper functioning of dark green leaves Kabata and Pendias (2001). Normal concentrations of lead generally found in plant leaves (in the range of 5-10 mg/Kg) are not far below concentrations which cause toxic effects (30-300 mg/Kg) (Alloway, 1995). However, the observed mean values of Pb in the plant leaves were higher than the normal concentration reported in the plant leaves (Alloway, 1995).

The green plants are accumulating Pb via pollutant released by powered generators; this is in agreement with Al-Jassir *et al.*, (2005), who reported the ability of plants to assemble the Pb in the leaves and fruits as a result of absorption of contaminated soils and especially industrial zones, thermal power stations and mines.

Table 2 shows the generators under study (G1, G2, G3 and G4). The four characters (E, W, N and S) refer to the four specific directions around each generator (East, West, North, and South, respectively), beginning with the number 1, which represents the site generator seen to head away from it in 2 and 3 for each direction.

Table 2. Lead concentration for soil (mg/kg), the values in bold represent sites located under the influence of more than one generator

Sites	G1	G2	G3	G4
E1	23.35	174.6	139.5	46
E2	17.75	104.4	177.5	81
E3	58.9	**129.9**	**171.7**	86.9
W1	128.05	136.6	37.2	ND
W2	131.8	239	95.6	ND
W3	**129.9**	**171.7**	81	ND
N1	109.35	151.2	218.4	19.6
N2	167.3	130.7	285.7	ND
N3	111.2	113.2	**338.3**	13.8
S1	79.45	107.3	34.2	239
S2	86.9	107.3	92.7	192.1
S3	100	43	145.3	**338.3**

The results indicated increases of Pb concentration in the soil samples as we move away from the generator sites because of the design of the exhaust those generators which are characterized by an increase those emissions from the surface of the ground a 3m distance, leading to pollutants being carried away from the generator sites as the study area was open around the generators (G1, G2 or G3) which helps to move away the lack of Buildings repel track pollutants. Site (G3) represents the highest values of the rest of the other areas located under the influence of the powered generator as well as the site of a parking space and is also a commercial area was also noted, as well as site-generator on two main streets are all factors that led to the increased Pb concentration in the atmosphere, leading to its accumulation on the soil and thus is absorbed by plant roots to settle in the leaves or fruit away another part of the plant. This is consistent with the policies included in previous research, which explained the mechanism of faithful transmission of lead from the atmosphere through the soil and its impact on the plant (Stohs and Bagchi, 1995; Chandra and Kulshreshtha, 2004). On the other hand, we note that the areas of convergence between generators (G1W3+G2E3), (G2W3+G3E3) and (G2N3+G4S3) represent the Supreme focused than other areas around the generators due to falling under the influence of two generators, this is consistent with what is stated in Habib *et al.*, (2012), they found higher Pb concentration in Baghdad than other cities in Iraq due to multiple sources of pollution in the region.

For (G4) site, the soil samples displayed lower Pb concentration because of its distance from the main street and the popular market as well as the car park, in addition to all this it is a residential area surrounded by several condominiums, which is bloching the movement of pollutants in the air where the area is not open, which leads to the accumulation of Pb on the surfaces of these surrounding buildings.

4. Conclusions

The present study aims to evaluate soil and plant contamination with lead in/and around powered generators sites located in Al-Ghazaliya district within Baghdad city, Iraq. The results indicated that the local powered generators have a direct impact on the contamination of soils and plants with lead and this influence is widely spread due to weather conditions and wind as well as the geographic location of where the existence and the presence of bumpers for the movement of such pollutants from buildings and trees. Also, the presence of more than one source of pollutants has a negative impact in increasing the proportion of lead in soil and plants.

References

Al-Jassir, M. S., Shaker, A., & Khaliq, M. A. (2005). Deposition of Heavy Metals on Green Leafy Vegetables Sold on Roadsides of Riyadh City, Saudi Arabia. *Bulletin of Environmental Contamination and Toxicology*, 75(5), 1020–1027.

Alloway, B. J. (1995). *Heavy Metals in Soils*. 2nd Ed. Blackie Academic and Professional, an imprint of Chapman and Hall, London.

Al Obaidy, A. H. M. J., & Al Mashhadi, A. A. M. (2013). Heavy Metal Contaminations in Urban Soil within Baghdad City, Iraq. *Journal of Environmental Protection*, 4(1), 72–82.

Banerjee, A. D. K. (2003). Heavy Metal Levels and Solid Phase Speciation in Street Dusts of Delhi, India. *Environmental Pollution*, 123(1), 95–105.

Chandra, P., & Kulshreshtha K. (2004). Chromium Accumulation and Toxicity in Aquatic Vascular Plants. *Botanical Review*, 70(3), 313–327.

Habib R. H, Awadh, S. M., & Muslim, M. Z. (2012).Toxic Heavy Metals in Soil andSome Plants in Baghdad, Iraq. *Journal of Al- Nahrain University*, 15(2), 1–16.

Imperato, M., Adamo, P., Naimo, D., Arienzo, M., Stanzione, D., & Violante, P. (2003). Spatial Distribution of Heavy Metals in Urban Soils of Naples City (Italy). *Environmental Pollution*, 124(2), 247–256.

Kabata-Pendias, A., & Pendias, H. (2001). *Trace Element in Soils and Plants*. CRC Press, London.

Kabata-Pendias, A. (2010). *Trace Element in Soils and Plants*. 4th Ed, CRC Press, London.

Romic, M., & Romic, D. (2003). Heavy Metals Distribution in Agricultural Topsoils in Urban Area. *Environmental Geology*, 43(7), 795–805.

Stohs, S. J., & Bagchi, D. (1995). Oxidative Mechanisms of the Toxicity of Metal Ions. *Free Radical Biology and Medicine*, 18(2), 321–336.