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Measurement of Lead Pollution in the Air of Babylon Governorate/Iraq during Year 2010

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***Abstract*—**This research aims to study the lead pollution in the air of Babylon governorate that resulted generally from vehicles exhausts in addition to industrial and human activities.Vehicles number in Babylon governorate increased significantly after year 2003 that resulted with increase in lead emissions into the air.Measurement of lead emissions was done in seven stations distributed randomly in Babylon governorate. These stations where located in Industrial (Al-Sena'ay) Quarter, 60 street (near to Babylon sewer directorate), 40 Street (near to the first intersection), Al-Hashmia city, Al-Mahaweel city, , Al- Musayab city in addition to another station in Sayd Idris village belong to Abugharaq district (Agricultural station for comparison). The measured concentrations in these stations were compared with the standard limits of Environmental Protection Agency EPA (2 µg /m^3). The results of this study showed that the average of lead concentrations ,in Babylon governorate during year 2010, was (3.13 µg/m^3) which was greater than standard limits (2 µg/m^3). The maximum concentration of lead was (6.41 µg / m^3) recorded in the Industrial (Al-Sena'ay) Quarter during April month, while the minimum concentrations was (0.36 µg / m^3) recorded in the agricultural station (Abugharaq) during December month.

***Keywords*—**Lead, pollution, lead concentration

I. Introduction

VEHICLES exhausts are the main source of lead pollution because of gasoline fuel that treated with lead in form of tetra lead ethyl or methyl as anti cracking agent, that resulting with spreading of lead element and its toxic compounds in to the urban air in form of small particulates. Most of lead emissions settle near the source of emission, but the small diameter particles move long distances and working on the pollution of surrounding areas, in addition, the large numbers of electricity generators which contribute to the production of electricity in different regions in the governorate and within the houses as well, which consuming leaded fuel that increased lead compounds in the urban air. The particulates that are spreading in the air are Carbon, dust, lead or particulates of other elements, but the most dangerous particulates in urban air are lead particles, the main source of these particulates is the vehicles exhausts, where about 97% of the amount of lead emissions in the atmosphere are due to emission of vehicles exhausts.

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Since between 60 -90% of lead used in the fuel is emitted into the air from vehicles exhaust in the form of small particles and there small size help to stay suspended in the air for longer time. [1], [2]

lead contamination represents a major threat to the environment and public health due to the ability of these molecules to accumulate in the human body, which works to increase blood pressure, the appearance of nervousness and depression, toxic effects on the kidney and liver.[3], [4].

Lead concentration and its impacts was studied and investigated globally and locally by many scientists and researchers. Where on global level, [5] studied the impact of human activities on the concentration of heavy metals in urban soils and presented a relation between lead concentration and the surrounding human activities. While, the researcher [6] found that concentration of suspended particulates in the atmosphere of Rio de Janeiro city of was 100 µg/m^3 which is greater than the allowable limits. After that, the researchers [7] investigated impact of vehicles exhausts on the concentration of heavy metals in urban soils and they found a significant relation between vehicles exhausts and lead concentration in the urban soils. [8] Studied the concentration of suspended particulates in the atmosphere of two cities in the Brazil (one coastal and the other industrial) and found that the concentration of suspended particulates in of the industrial city atmosphere was greater than it in the coastal city. Teneva, [9] reported that, in Bulgaria, the dust concentration has lowest value during the months of April to September and the highest value was during November – December. After that, [10] present a paper showed the relation between havey metals concentration in polluted soils and the attached air. In Spain, [11] found that lead concentration in the public parks and green areas of Seville city were higher than the acceptable limits. While Blagorodka [2] investigated time variation of dust concentration and deposits in Sofia and found it was similar to that in other European countries such as Denmark, Finland and Germany. Andreev [12] found a reverse relation between precipitation and dust deposits quantities. And finally, Tahirsylaj [13] focused on air pollution by dust deposition in Mitrovica-Kosovo during years 2006-2007 and reported that dustfull ranged from (79.361 to 2303.1 mg/m^2/day).

Locally, Amer [14] investigated the lead concentration in the atmosphere of Al-Najaf city and found that its concentration was greater than the allowable limits. While, Al-Khalidy 2008, made a study about the concentration of falling dust in the main transportation garages in Al-Hilla city and lead concentration in this dust and showed that this falling dust was polluted with lead.

II. Back ground for Babylon Governorate

Babylon governorate is one of the most ancient cities in the world, where it was constructed before 4100 years ago. This city which occupied about 5229 km2 in area lies in the middle of Iraq (100) km to the north of the capital Baghdad and considered as a home for more than 1,600,000 persons. It divided in to two parts by a big branch of Euphrates River called (Shat Al-Hilla). Administratively, this governorate divided in to (4) main cities (Al-Hilla, Al-Mahaweel, AL-Mosayb and AL- Hashimeyah city) and (12) districts (Al-Shomaly, Al-Talyaah, Al-Medhatyah, Al-Kasem, Al-Neel, Abughraq, Al-Mashroaa, Al-Imam, Al-Sadah, Al-Eskandaryah, Jurfalsakhar, Al-Kefeel district.), as shown figure (1).The flat ground of Babylon governorate which arise about (35 m) above sea level has extreme climate. Where in the hot and dry summer season, the average of wind blown duration is (4 days / month) with blown velocity reaches (3 m/sec), the sun shining about 12 hrs./ day arising the weather temperature to (50 C^0) and the precipitation rate decreased till (0 mm /month). But in winter season, the rainy and cold season, the average of wind blown duration becomes (3 days /month) with blown velocity reaches (7.4 m/sec), sun shining become (6.2 hrs./day) decreasing weather temperature till (10 C^0), and the precipitation rate increased till (24.9 mm/month).

Babylon governorate has a strategic location, where it represents the connection way between northern and southern Iraqi cities. This location applied traffic load in the main streets reaches (3388 vehicle / h). This traffic volume will increase dust quantity in the surrounding air. [1].

TABLE I
SOME OF IMPORTANT METEOROLOGICAL RECORDS OF BABYLON CITY, MINISTRY OF PLANNING (1977-2000)

Item	Months											
	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Actual Average of sun shining time (hrs./day).	6.4	7.3	7.9	8.8	9.5	12	12	12.5	10.1	8.5	7.3	6.2
Average of Temperature (C0).	10.1	12.8	17	22.9	28.5	32.4	34.8	34.3	31.3	25.6	17.3	12.3
Days of Wind blown (day/month).	3.1	3.5	3.8	3.6	3.5	4.2	4.4	3.8	3.3	2.9	2.9	2.9
Average of Wind Velocity (m/sec).	7.4	1.9	2.3	2.1	2.2	2.6	3	2.3	1.7	1.4	1.4	1.6
Average of Rain (mm/month).	24.9	17.3	15.4	11.5	3.0	0	0	0	0	3.6	12.1	13.3

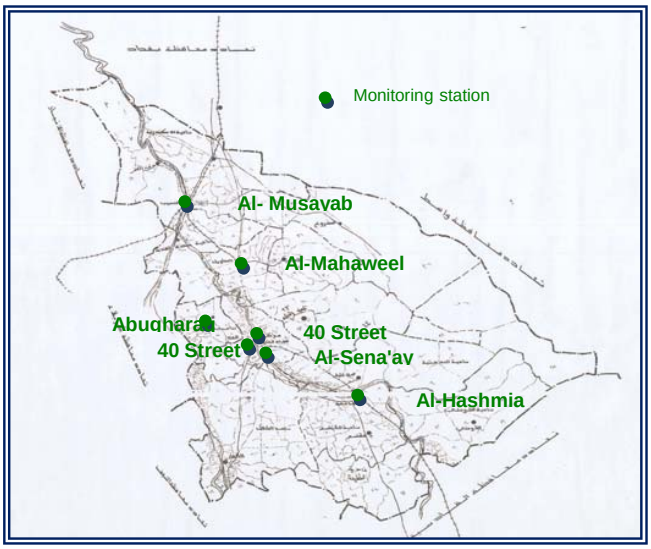

Fig. 1 Babylon Governorate Map showed the monitoring stations

III. Description of a Lead, Uses and Disadvantages

Lead (Pb) is a flexible, soft bluish-white color metal. Its heat-conductive is low and resistant to corrosion, atomic number is 82, atomic weight is 207,and the specific weight is 11.35. Lead ore usually contains the elements of sulfur, zinc, and copper. The most common type of lead ore is Galena ore which is consisted of lead sulfide and it used is in the mirrors coating and also used a blue dye. There are other forms of lead like various oxides of lead, including lead monoxide (PbO) which is the most commonly used in the manufacture of inorganic lead and also used in manufacturing of board batteries in addition to ceramics and glass manufacturing. another oxides of lead is the red lead oxide (Pb_3O_4) which is a bright red dye used in painting of houses and metal surfaces to prevent erosion and in the lubricants, glass and crystal manufacturing. Lead salts are also widespread in nature like lead sulphate ($PbSO_4$) that used in blue and white dyes manufacturing. silicates of lead ($PbSiO_3$) and lead chromate ($PbCrO_4$) are another forms of lead salts and used in paints, glass, ceramics, rubber, inks and leather industries. But, in the last 70 years the lead element was used in form of tetra lead ethyl or methyl in vehicles fuel as anti cracking agent, Which allowed lead element to emitted from vehicles exhausted to the atmosphere in the form of Lead bromide. This form of lead Remains in the atmosphere for not short time causing dangerous type of pollution.

Lead enters the human body through the respiratory system with the respiratory or digestive system with food and drink and through them reaches the blood and usually goes then to the brain and deposited in bones and teeth. Lead is very toxic to many members of human body, where high levels in the body may cause anemia, decrease of hemoglobin, severe damage to the kidneys, liver, brain and central nervous system and peripheral nervous system.

From the mentioned above, it is clear the seriousness of lead pollution and the importance of monitoring and controlling lead pollution and purify water, air and food sources from this type of pollution.

IV. Research Methodology

In order to estimate lead concentration in Babylon governorate air, seven monitoring stations were used to monitor and collect the required data for one year depending on monthly sampling system (5 samples per month for each one station). The data obtaining was done by taken a known volume of air in each station by using (Sniffer) device which contains paper filter. This filter is dried at $105C^0$ for 90 minutes and weight before using, then placed in device and start suction of air for one hour and recording air volume (by the device) in (m^3) units. After that the used filter taken to the laboratory and dried at $105C^0$ again and weighted again before digestion (this represent filter and pollutants weight). Filter digestion done by a solution of 1:4 volume of HNO_3, $HCIO_4$ acids respectively, then putted in a glass container covered with watch glass on a water path (450 C^0) for one hour then the solution poured into a volumetric bottle (25 ml in capacity) and filled till the mark. After digestion process the solution tested by using atomic absorption flam device in order to determine lead amount in the sample.

V. Results and Discussion

The results that obtained from monitoring and analysis of collected samples (table 2),represented graphically in figure (2), showed that the average of lead concentration in the air of Babylon governorate was (3.13 µg /m^3), while the normal values of lead concentration ranged between (0.36 -6.41 µg /m^3). As well as the results (that represented in Fig.2) showed that lead concentration decreased during winter month and increased during summer months that because the rain during winter months works on decreasing pollutants (in general) concentration in the air. The maximum value for lead concentration was (6.41 µg/m^3/month) and found in the Industrial (Al-Sena'ay) Quarter station during April month, while the minimum concentration of this element was (0.36 µg/m^3/month) found in Sayd Adrees village station during December month.

By comparison the obtained values for lead concentration with those of previous studies of other researchers, increasing tendency can be seen in this study. This tendency is because of the uncontrolled increasing in vehicles number in Babylon governorate which contributes mainly to increase the amount of lead compounds in the air. As well as the absence of a good system of roads in the province that resulting in a lot of jams and stops. as it known in the case of vehicle stopping and operation of the engine it will produce greatest quantity of lead.

TABLE II
Lead Concentration in the Studied Stations during Year 2010

Stations	Lead Concentration (µg/m^3/month) during Year 2010												
	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
Indusrial (Al-Sena'ay) Quarter	4.04	4.21	4.91	6.41	5.28	5.41	4.71	4.63	4.41	4.37	4.31	3.84	4.71
60 Street	3.21	3.37	3.86	4.33	4.98	4.87	4.66	3.89	3.97	3.92	3.73	3.03	3.99
40 Street	3.11	3.19	3,67	3.89	4.43	4.77	4.23	3.43	3.32	3.41	3.10	2.89	3.72
Al-Hashmia city	2.23	2.51	2.97	4.32	4.21	3.88	2.53	2.64	2.57	2.49	2.39	1.98	2.89
Sayd Idris village	0.43	1.09	1.13	1.26	1.51	1.39	0.99	0.55	0.67	0.55	0.41	0.36	0.86
Al- Musayab city	2.17	2.49	2.81	4.61	3.96	2.98	2.54	2.95	2.81	2.78	2.53	2.03	2.89
Al-Mahaweel city	2.42	2.49	3.04	3.86	3.56	3.24	2.96	2.72	2.93	2.84	2.29	2.12	2.87
Average	2.52	2.76	3.12	4.10	3.99	3.79	3.23	2.97	2.95	2.91	2.68	2.32	3.13

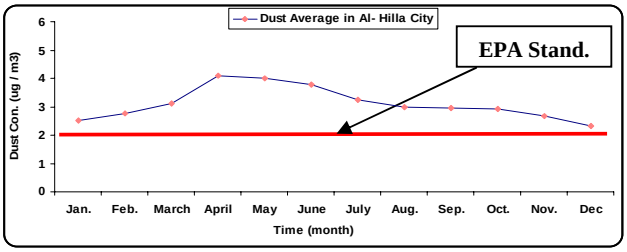

Fig. 2 Variation of lead concentration year 2010 in Babylon Governorate

VI. Conclusions and Recommendations

Results of this study showed that lead concentration were greater than the allowable limits of the Environmental Protection Agency EPA, where it was found that the yearly average of lead concentration in year 2010 was (3.13 µg /m^3) that exceeded (EPA) standard (2 µg /m^3).

Increasing tendency in lead concentration was observed clearly in urban areas as compared with agricultural areas where the lead concentration in urban areas reachs (6.41 µg /m^3) while the maximum concentration in the agricultural areas was (1.51 µg /m^3) , this due to large traffic volume in urban areas.

In order to minimize lead concentration in Babylon governorate, traffic volume inside city should be minimized by construction new roads and high ways. The present infrastructures, especially the streets of this governorate should be rehabilitated and get more of attention to prevent or minimize vehicles stopping or jams. As well as good quality of gasoline (unleaded gasoline) should be used in vehicles because the used gasoline in the present time is bad quality and causing more of lead pollution cases.

References

[1] Al-Khalidi, Khalid Safa'a, 2008 " Measurment of falling dust quantity in the main garages of Babylon governorate and its contamination with lead " Journal of Babylon university, Vol.17, No.3, 2008.

[2] Blagorodka Veleva, 2003 "Time Variation of the Dust Concentration and Deposition in Sofia During the Period 1981-2002", National Institute of Meteorology and Hydrology,Sofia, Bulgaria.
[3] UNEPA/GEMS (1992) The contamination of food. Environment library, No 5.
[4] Weatherall, D .j.; J.G.C Ledingha and D.A Warrell (1996) Oxford Text Book of medicine, THIRD Edit.
[5] Trindade, N.A. et al. (1981). Atmospheric concentration of metals and total suspended particulates in Rio De Janeiro. Env. Sci. and Tech. 15 : 84-88.
[6] Komai, Y., 1981. Heavy metal contamination in urban soils: I. Zinc accumulation phenomenon in urban environments as clues of study. Bulletin of the University of Osaka Prefecture 33, 7-15.
[7] Ikeda, A., Yoda, K., 1982. Soil pollution by heavy metals in Sakai City. Japanese Journal of Ecology 32, 241-249.
[8] Orsini, C. et al. (1986). Characteristics of fine and coarse particles of natural and urban aerosols of Brazil. Atmos. Enviro. 20: 2259 – 2269.
[9] Teneva M., E. Batchvarova. 1989. "Experimental Investigation of Urban Air Pollution". Bulgarian Geophysical Journal. 15(3). , p.62-69 (in Bulgarian).
[10] Chen, T.B., Wong, W.J.C., Zhou, H.Y., Wong, M.H., 1997._ Assessment of trace metal distribution and contamination in surface soil of Hong Kong. Environmental Pollution 96, 61-68.
[11] Madrid, L., Diaz-Barrientos, E., Madrid, F., 2002. Distribution of heavy metal contents of urban soils in parks of Seville. Chemosphere 49,1301-1308.
[12] Andreev V., et al. (2004a). Ecology of the City of Sofia. Species and Communities in an urban Environment. PENSOFT Publishers. Sofia-Moscow. pp. 25-54.
[13] Tahirsylaj, et al., (2008) "Spatial Distribution of Settled Air Pollution in Mitrovica : Comparison Between Seasons 2006-2007". Republic of Macedonia-27,31May 2008.
[14] Amer, M. J., (1999) "Study of the concentration of primary pollutants in the air of Al- Najaf Al-Ashraf city", MSc. Thesis, University of Kufa.
[15] EPA (Environment Protection Agency), 2008."The last update on Sunday, January 6th, 2008.