

Determination of Some Trace Elements in the Fallen Dust on Basra Governorate

H.T. Al-Saad, F.J.M. Al-Imarah and W.F. Hassan

Dept. of Marine Chem. And Environ. Poll., Marine Science Centre, Basra Univ.

**A. H. Jasim /Dept. of Environment, Basra Environmental Administration, Ministry of Environment
and Iqbal F. Hassan / Southern Refinery Company, Basrah**

Abstract:

During 2007, a study was conducted monthly from June – November, for the determination of trace metals Fe, Mn, Co and Cu in dust fallen on selected sites in Basra Governorate, 1)Al-Ashar, City centre, 2) The building of Basra Environment Directorate / Gazarah, in Basra, 3) Al-Qurnah, 4) Abu Al-Khaseeb, 5) Al-Fao and 6) Khor Al-Zubair. Fallen dust was collected by using metal containers of 15 cm diameter put on the roof of buildings for 30 days. Collected dust were put in plastic bags and transfer to the lab for analysis. In the lab 0.5 gm of each sample was weighted and put in taflon beaker, 6 ml of mixed nitric and perchloric acids 1:1 were added and digest to dryness. Deionised water then was added and volume made to 25 ml and samples were stored till trace metal analysis. Concentrations of trace metals Fe, Mn, Co and Cu were determined by using Atomic Absorption Spectrophotometer Pye Unicam model SP9, standard solutions were used for calibration and deionized water was used throughout the determination. Values of elements determined in dust fallen on Basra were alternatives, Fe was the highest trace element detected in Abu Al-Khaseeb during all months of study followed by Mn in Al-Qurnah, Al-Fao and Khor Al-Zubair, then Co in Al-Fao and Khor Al-Zubair, while Cu was the lowest in City centre during June, in Al-Qurnah during July, Abu Al-Khaseeb and Al-Qurnah during September and All sites during November. Results revealed that studied elements showed certain significant differences among selected stations as well as during different months.

1-Introduction :

Dust is a kind of atmospheric particulate matter, which deposits naturally because of gravity. A range of metals and chemical compounds found in the atmospheric dust are harmful (Shinggu et al., 2007) Pollutants can attack specific sites or organs of the body and disease can develop as a consequence to such exposure (Archer and Barratt, 1976; Ayodele and Gaya, 1998). Although there have been considerable number of studies on the concentration of heavy metals in street dust,

the vast majority have been carried out in developed countries with long histories of industrialization (Jaradat and Momani,1999). Very few studies have been carried out in developing countries like Iraq. Little interest has been focused upon concentrations of lead in the ambient air of Baghdad Governorate(Kamboor,1998).

Human activities such as fuel combustion, manufacturing industries or metal production and processing are sources of anthropogenic emissions of trace elements in the atmosphere. Trace elements in the

atmosphere may travel over large distance before being redeposit on soils. Conventional measurements of trace elements deposition are based on precipitation analysis (Harmens et al., 2007).

As Basrah is a major port in Southern Iraq it suffers from continuous pollution with dust and suspended particulates (Khattak,1982), suspended dust particles is a common problem almost all year round in this part of the world (Abo Rizq et al.2008) , due to wind and toxic pollutants they carry such as petroleum hydrocarbons and suspended particulates trace metals (Al-Mayahi, 2005). Al-Ali et al., have estimated the quantities of fallen dust at Basrah city in addition to indication, distribution and sizes of this dust, as well as its elemental structure (Al- Ali, et al., 2001). Trace metals Cu, Fe, Mn and Ni were estimated in the dust fallen at selected sites of Basrah Governorate (Carabidian, 2008).

Aim of the Study

Currently there is a need to study trace elements contamination generally in ambient air dust fallen at Basrah Governprate as such studies are still limited in Iraq.

This study is aimed at determining the elemental concentrations of some trace element pollutants that may be present in the atmospheric dust fallen in Basrah Governorate, Iraq.

MATERIALS AND METHODS

Study area

Sites were selected for the study along the major cities in Basrah Governorate, southern Iraq, as shown in the map, Figure 1.

Sampling

Samples were collected Between June, 2007 to November, 2007, the period in which no rain was fallen throughout, hence avoid

rain-washing out the trace elements. During this period the largest difference of trace elements concentration in fallen dust may occur.

Dust samples were collected, put in clean polyethylene bags, and transferred to the lab in Marine Science Centre. In the lab, the samples were stored in refrigerator prior to analysis. dried at 100 - 110°C to drive out moisture. On cooling each sample was sieved through a nylon sieve of 250 µm diameter.

Procedure

Analytical reagent grade chemicals were used throughout this work. The digestion of the dust samples were done according to Sturgeon et al (1982) in which 6 ml of 1:1 acid mixture of nitric and perchloric acids were added to 0.5 gm of each dust sample in Teflon beaker for the digestion till dryness. After the sample being dry, certain amounts of distilled water was added and sample transferred to 25 ml volumetric flask and the volume was completed to the marc with distilled water. Calibration standards were prepared from the stock solution by dilution and were matrix matched with the acid concentration of the digested samples (Whitehead, 1975). The digested samples were then analyzed for trace elements, Fe, Mn, Co and Cu by using flame Atomic Absorption Spectrophotometer model Pye Unicam SP9.

Results were analyzed statistically using the program SPSS model 11 by adopting the procedure of relative least significant difference (RLSD) within the probability level $p = 0.05$.

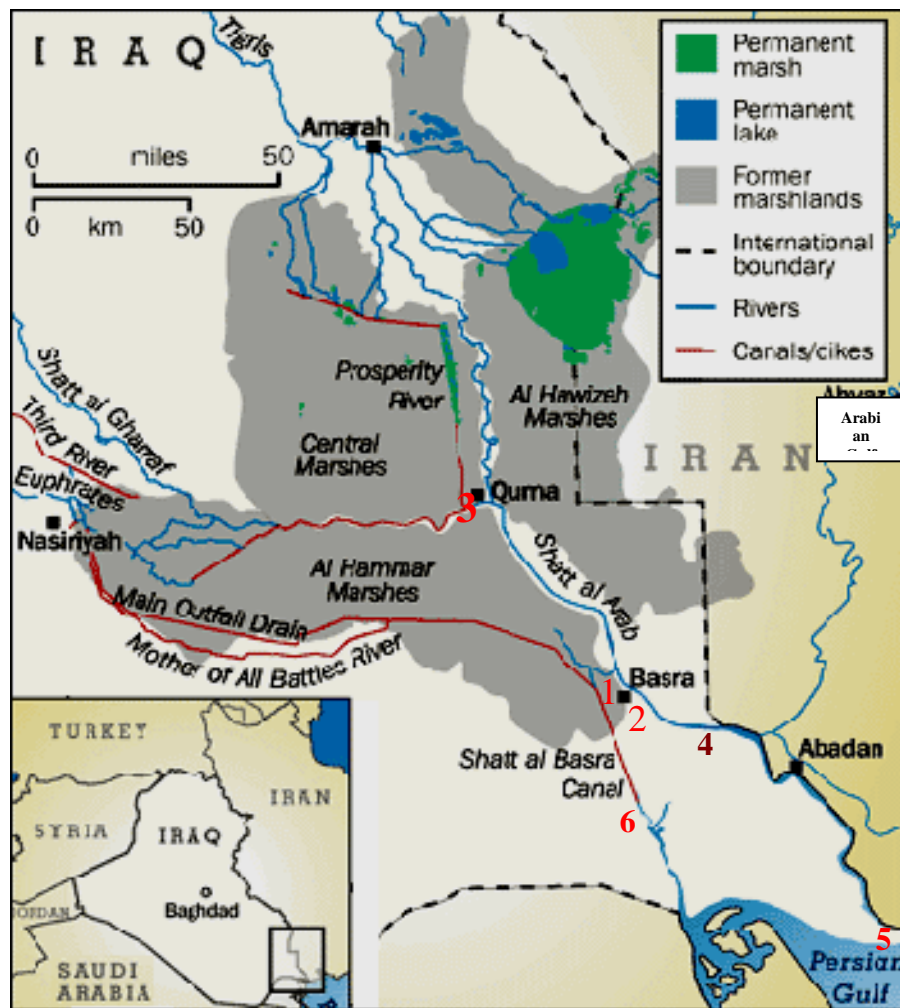


Figure 1. Map of Southern Iraq showing sampling sites (1-6) within Basrah Governorate

RESULT AND DISCUSSION

Table 1 presents the concentrations of some trace elements pollutants determined in the atmospheric dust samples in Basrah Governorate between June 2007 and November 2007. Fe had the highest concentration followed by Mn, Co and Cu in the six different sampling areas except in certain occasions the trend is $Fe > Mn > Cu > Co$ due to lack of sources. The high concentration of iron in the dust samples may

be attributed to the nature of southern Iraq soils, in addition to metal construction works, iron bending and welding of metals, which are a common practice overall Basrah governorate.

Monthly variations in the concentrations of trace elements Fe, Mn, Co and Cu determined in the fallen dust at Basrah Governorate are plotted in Figures 2-5 respectively

Table 1. Minimum and maximum concentration of trace elements($\mu\text{g/g}$) in the fallen dust at selected sites in Basrah Governorate, Southern Iraq, June 2007 – Nov. 2007, together with mean and standard deviation as well as statistical analysis.

STASIONS		Fe	Mn	Cu	Zn
1	Mean	513.74 ^{ac}	159.04 ^a	235.94 ^a	114.36 ^b
	SD	325.96	119.59	88.15	71.56
	Minimum	162.23	53.05	109.22	33.06
	Maximum	1045.51	394.07 ^a	347.83	209.46
2	Mean	905.81 ^{bc}	178.51 ^{ac}	361.28 ^{ab}	113.96 ^b
	SD	745.05 ^a	153.00	336.79	83.20
	Minimum	270.39	13.79	109.22	34.21
	Maximum	2442.53	487.37	925.59	231.95
3	Mean	289.92	257.87 ^{ace}	390.98 ^a	43.97 ^a
	SD	133.83	237.11	157.49	24.45
	Minimum	108.16	38.62	179.54	6.84
	Maximum	513.74	742.67	546.10	73.31
4	Mean	1853.82 ^d	159.03 ^a	176.39 ^c	33.48 ^a
	SD	694.40	46.61	107.54	21.02
	Minimum	910.31	84.88	43.69	7.43
	Maximum	3073.43	237.23	294.05	61.53
5	Mean	194.68 ^a	391.71 ^{de}	357.01 ^c	208.55 ^c
	SD	77.53	172.24	142.33	94.45
	Minimum	81.12	137.93	218.44	68.43
	Maximum	315.46	580.74	618.81	360.13
6	Mean	284.26 ^a	343.39 ^{bce}	409.13 ^{bc}	77.76 ^{ab}
	SD	178.71	339.65	265.81	37.10
	Minimum	54.08	123.52	81.51	25.38
	Maximum	495.72	935.08	740.47	115.97
Total	Mean	696.82	234.03	318.25	100.41
	SD	738.82	206.96	213.82	85.11
	Minimum	54.08	13.79	43.69	6.84
	Maximum	3073.43	935.08	925.59	360.13

MONTH		Fe	Mn	Cu	Zn
Jun	Mean	1644.87 ^a	140.68 ^a	87.38 ^a	34.19 ^a
	SD	1233.05	92.65	33.84	31.58
	Minimum	243.35	38.62	43.69	6.84
	Maximum	3073.43	237.23	109.22	61.53
Jul	Mean	567.82 ^b	401.69 ^b	494.15 ^c	106.67 ^{ab}
	SD	651.84	339.06	271.39	73.25
	Minimum	108.16	87.58	71.23	7.43
	Maximum	1874.70	935.08	740.47	195.50
Aug	Mean	477.83 ^b	194.13 ^a	211.48 ^{ab}	85.30 ^{ab}
	SD	574.44	159.68	91.69	67.87
	Minimum	108.16	53.05	81.51	17.19
	Maximum	1686.29	487.37	309.84	204.87
Sep	Mean	615.89 ^b	274.87 ^{ab}	324.53 ^{bc}	157.59 ^b
	SD	765.35	177.78	109.92	141.79
	Minimum	54.08	123.98	217.35	35.27
	Maximum	2226.21	580.74	528.43	360.13
Oct	Mean	420.61 ^b	228.52 ^{ab}	415.25 ^c	120.90 ^{ab}
	SD	266.41	166.38	316.62	77.25
	Minimum	81.12	84.88	218.44	48.88
	Maximum	910.31	496.53	925.59	231.95
Nov	Mean	776.62 ^b	135.58 ^a	306.48 ^{bc}	74.18 ^a
	SD	415.11	60.38	149.99	68.51
	Minimum	207.30	13.79	179.54	28.63
	Maximum	1351.95	188.94	564.93	213.83
Total	Mean	698.00	234.45	316.35	100.49
	SD	744.15	208.53	214.78	85.85
	Minimum	54.08	13.79	43.69	6.84
	Maximum	3073.43	935.08	925.59	360.13

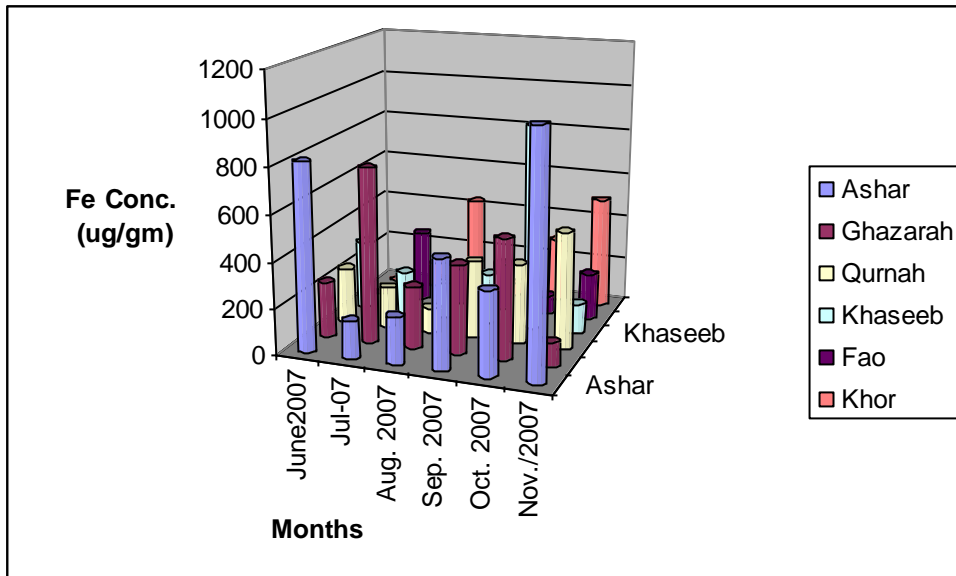


Figure 2. Variation of Fe concentrations in fallen dust at Basrah, June-Nov. 2007.

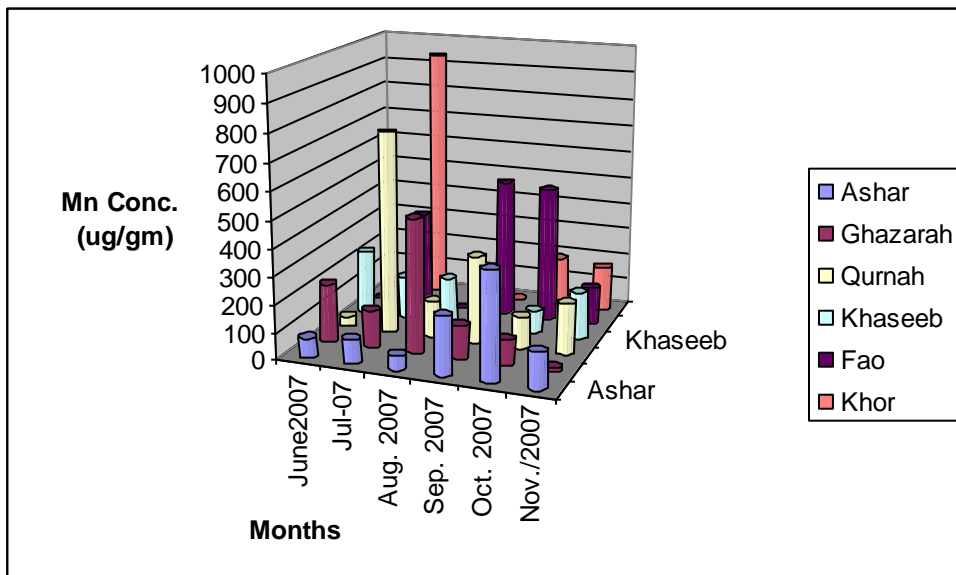


Figure 3. Variation of Mn concentrations in fallen dust at Basrah, June-Nov. 2007.

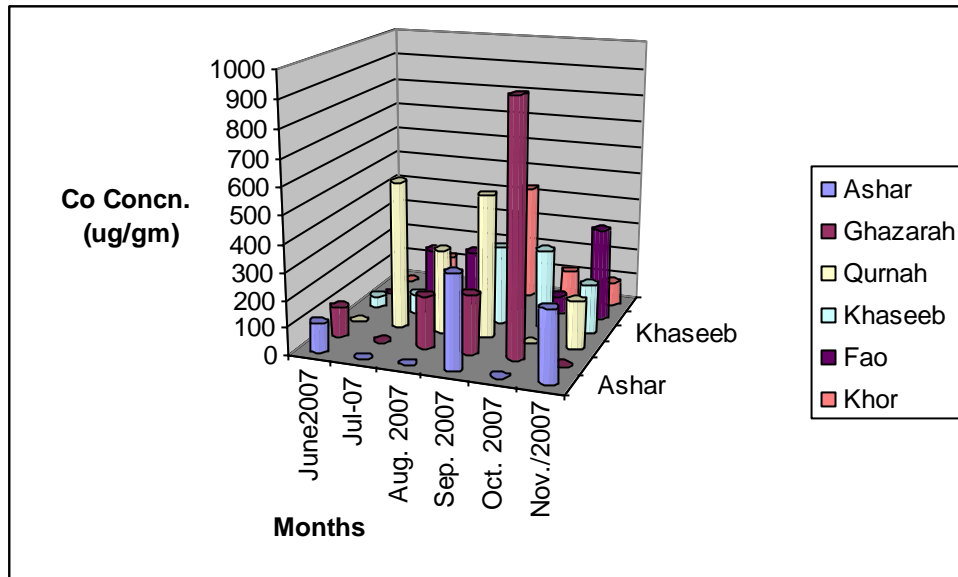


Figure 4. Variation of Co concentrations in fallen dust at Basrah, June-Nov. 2007.

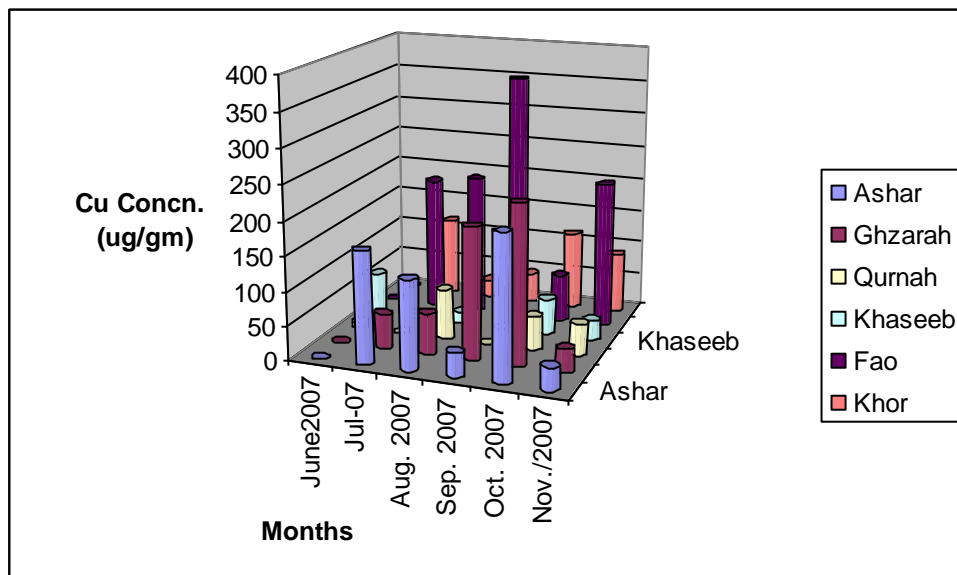


Figure 5. Variation of Cu concentrations in fallen dust at Basrah, June-Nov. 2007.

The variation in concentration of most of the trace elements determined from different sites decreases in an alternative trend represented as $4 > 2 > 1 > 3 > 5 > 6$. The trace elements showed a variation in the trend that $\text{Fe} \gg \text{Mn} > \text{Co} > \text{Cu}$, Iron (Fe) had the highest concentration in all sampling areas with range of $54.078 - 2442.53 \mu\text{g/g}$ (Shinggu et al., 2007). A lower value was

observed for Cu with respective range of $6.842 - 360.131 \mu\text{g/g}$.

The study area covers a wide spread agricultural land and wet lands in addition to industrial estates around Basrah city. Iraq as a part from Asia exposed to dust fallout taking place during different seasons of the year (Rowland and Hae-rym, (2008)). Most of these storms are characterized with trace

element contents in a concentrations mostly depend upon their original concentration and mostly are refused constructions (McGee,et al., 2003).

The trace element pollutants in the ambient air dust samples of Basrah could be originated from common natural sources as well as anthropogenic sources. Automobile emission, welding of metal and exhaust from generators, as well as construction refuse is represented as one of the major sources of pollution by trace elements in the dust fallen at sites 1,2 and 4 of Basrah Governorate(McGee,et al., 2003).

There is a decrease in elemental concentration from place of high activities for example, mechanical workshops (site 4), city centre (sites 1 &2) to places of lower activities like residential areas (sites 3&6). The concentrations of trace elements recorded in this study showed a decrease values in the following trend: industrial area (site 4) > other areas (sites 1,2, 3,4,5 and 6) (Tahir. et al., 2007).

Statically analysis for the results indicate that, for Fe, June month differs significantly from all other periods of study and there were no significant differences among other months. Moreover, station 2 significantly differs from all other stations except station 1, as well as station 4 which differs significantly from all other stations. For Cu, June differs significantly from all other months except August, and July differes significantly with months June, August and November. Station 4 differs significantly from stations 3 and 4, and there were no differences among other stations. For Mn, station 5 differs significantly from stations 1,2 and 4, as well

as , station 6 differs significantly from stations 1 and 4, and there were no significant differences among other stations within probability level ($p=0.05$), while July differs significantly from all other months except September and October. For Zn, station 5 differs significantly with all other stations while all stations showed a significant variations among them.

Conclusion

This study has shown that the atmospheric dust in Basrah is relatively contaminated with trace elements. The trace elements contaminations in atmospheric dust fallen at Basrah Governorate show a considerable decrease from place of high activities to a place of low activities (mechanical workshops to residential areas).This decrease might indicate aerial deposition of trace metal particulates in the ambient dust environment from anthropogenic sources and not only a function of soil source. Automobile and metal construction works as well as construction refused could be responsible for the build up of the trace elements in the atmospheric dust along the ambient air of Basrah Governorate through the emission of particulates. This ambient air had a high content of trace elements, especially Fe &Mn.

Reference

- Abo Rizq, H., M. Albaho, A. Christopher and B. Thomas. (2008). Influence of Foliar Dust Deposition on *Ficus Benjamina Variegata* Stomatal Conductance. European Journal of Scientific Research, 20(3):443-451

- Al-Ali, J. T. Kh., Hassan, A.J. Ch. And Al-Badran, B. N. A. (2001). Quantities of fallen dust at Basrah Governorate. *Marine Mesopotamica*, 16(2):261-272.
- Al-Mayahi, A. K. A. (2005). Environmental analysis for parameters affecting in the quality of atmospheric pollutants for Basrah Governorate. M. Sc. Thesis, Department of Geography, College of Education, Basrah University, Basrah Iraq, pp 241.
- Archer A, and Barratt RS (1976). Lead in the Environment: Monitoring for Lead. *Sci.Total Environ* 96:173-176
- Ayodele JT, and Gaya UM (1998). Chromium, Zinc and Manganese in Kano Municipality Street Dust. *J. Chem. Soc. Nig* 23:24-31
- Carabidian, S. A. K. (2008). Levels of some trace elements in the fallen dust at Basrah City. *Marine Mesopotamica*, In Press.
- Jaradat QM, and Momani AK (1999). Contamination of Road Side Soil, Plants, and Air with Heavy Metals in Jordan: A Comparative Study. *Turk J. Chem.* 23.209-220.
- Harmens H., Norris D.A., Koerber G.R., Buse A., Steinnes E., Rühling A. (2007) Temporal trends in the concentration of arsenic, chromium, copper, iron, nickel, vanadium and zinc in mosses across Europe between 1990 and 2000", *Atmospheric Environment* (41):6673-6687
- Kanpoor, F. I. (1998). Lead in automobile fuel. Environmental chair, United Nation of Environmental Programme, UNEP, 1(4):10-11.
- Khattak, M. N. 1982. Inorganic constituents in Dh ahran Atmospheric Aerosols. *J.A.P.C. A.*,32(2):176-176.
- McGee, J., Chen,L.G., Cohen,M.D.,Chee, G.R.,Prophete,C.M., Haykal-Coates,N., Wasson,S.J., Conner,T.L., Costa,D.L., and Gavett, S.H.2003. Chemical Analysis of World Trade Center Fine Particulate Matter for Use in Toxicologic Assessment. *Environmental Health Perspectives* Volume 111, Number 7, June 2003
- Rowland,A. and Hae-rym,h. 2008. Yellow dust storms spark concern in S. Korea www.seoul.amedd.army.mil.
- Shinggu, D. Y., Ogugbuaja, V. O., Barminas, J. T.1, and Toma, I.(2007). Analysis of street dust for heavy metal pollutants in Mubi, Adwamawa State, Nigeria. *International Journal of Physical Sciences*,2 (11):290-293.
- Sturgeon,R.E., Desauliners, J. A. H., Berman, S. S. And Russell, D. S., 1982. Determination of trace metals in easturaine sediments by graphic furnace atomic absorption spectrometry. *Anal. Chem. Acta*, 134:283-291.
- Tahir,. N. M., Chee, P. S. and Jaafar, M. (2007).Determination of heavy metals content in soils and indoor dust from nurseries in Dungun, Terengganu. *The Malaysian Journal of Analytical Sciences*, 1(1):280-286.
- Whitehead PJ (1975). *Pye Unicom Atomic absorption Data Book* 1st Ed., Pye Unicom Ltd. Cambridge, Engl.

تقدير بعض العناصر النزرة في الاتربة المتساقطة في محافظة البصرة

حامد طالب السعد وفارس جاسم محمد الامارة ووصال فخري حسن
قسم الكيمياء البحرية والتلوث البيئي، مركز علوم البحار، جامعة البصرة
احمد حنون جاسم /قسم تلوث الهواء، دائرة بيئة البصرة، وزارة البيئة
و اقبال فخري حسن / شركة مصافي الجنوب، البصرة

الخلاصة:

خلال عام 2007 ، اجريت دراسة شهرية حزيران - تشرين الثاني ، لتقدير مستويات بعض العناصر النزرة: الحديد والمنغنيز والكوبلت والنحاس في الاتربة المتساقطة في مناطق مختلفة من محافظة البصرة وهي (1 العشار مركز مدينة البصرة و 2) بناية مديرية البيئة/الكرارة في مدينة البصرة و (3 القرنة و 4) ابي الخصيب و (5) الفاو و(6) خور الزبير. تم جمع الاتربة المتساقطة بواسطة حاوية معدنية بقطر 15 سم والتي تنصب على اسطح البنايات لمدة 30 يوم، وبعد ان تجمع الاتربة تحفظ في اكياس نايلون وتنقل الى المختبر لاجراء التحاليل. في المختبر توزن 0.5 غم من كل عينة من التراب المتساقط وتوضع في دورق تفلون ويضاف اليها 6 مل مزيج حامض النتريك وحامض البيركلوريك بنسبة 1:1 وتهضم العينة الى حد الجفاف. وبعد ذلك يضاف الى العينة المجففة مقدار من الماء المقطر الخالي من الايونات ويكمل الحجم الى 25 مل وتحفظ لحين اجراء التحاليل. في كل عينة تم قياس تركيز العناصر النزرة الحديد والمنغنيز والكوبلت والنحاس بجهاز مقياس الامتصاص الذري نوع (Atomic Absorption Spectrophotometer Pye Unicam model SP9) باستخدام عينات قياسية والماء الخالي من الايونات كمرجع. تباينت قيم العناصر المقاسة في الاتربة المتساقطة على محافظة البصرة وكان الحديد اعلى العناصر المسجلة في ابي الخصيب خلال اشهر الدراسة كافة، يتبعه المنغنيز في القرنة والفاو وخور الزبير، ومن ثم الكوبلت في الفاو وخور الزبير، بينما كانت ادناها للنحاس في مركز مدينة البصرة خلال شهر حزيران والقرنة خلال شهر تموز و ابي الخصيب والقرنة خلال شهر ايلول وكل المواقع خلال شهر تشرين الثاني. اظهرت النتائج بعض الاختلافات المعنوية للعناصر المدروسة بين محطات الدراسة وخلال اشهر الدراسة.