An Investigation Into Some Air Pollutants Concentration At AL-Musaib City and It's Surrounding Areas[+]

تقصي تركيز بعض ملوثات الهواء في مدينة المسيب والمناطق المجاورة

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Abstract:

This research is intended to investigate the concentration of some air pollutants (particulates, Pb, CO, SO2) at AL-Musaib city and its surrounding areas. Ten test locations have been selected to cover the studied area.
The researched work period started from October 2007 and ended at July 2008. The results show that the air of studied area is polluted only with TSP and the other pollutant (Pb, CO, SO2) are not exceeding the maximum permissible limits according to the standard specifications. The contour lines map indicates that the concentration. of air pollutants increased at the west-north site and decreased at the east-south site of the studied area.
The industrial activity, high population density and traffic volume have direct effect on the increasing of air pollutants. The values of air pollutants (TSP, Pb, CO, SO2) become more negative effective during the warm months. Also it is shown that the effect of wind is not observed.
The study recommends many points to decrease the air pollution such as: using the unleaded fuel, using filters and especial technical devices to purify the air of factories, and reducing the traffic volume at main roads, besides the future study is required to analyze the effect of industrial factories and its production on air pollution at this area.

المستخلص:

اتجه هدف البحث نحو تقصي تركيز بعض ملوثات الهواء (الدقائقيات ، عنصر الرصاص ، غازات أول اوكسيد الكربون وثاني اوكسيد الكبريت) لمدينة المسيب والمناطق المجاورة لها . لقد اختيرت عشرة مواقع فحص لتغطية منطقة البحث.ابتدأت فترة عمل البحث من شهر تشرين أول ٢٠٠٧ وانتهت في شهر تموز ٢٠٠٨ .

لقد بينت النتائج ، إن هواء منطقة البحث ملوث فقط بمادة الدقائقيات ، وأما عناصر التلوث الأخرى فأنها لم تتجاوز الحدود القصوى للقيم المسموح بها وفقا" للمواصفات العالمية . كذلك أشارت خارطة الخطوط الكنتورية لمنطقة البحث إلى إن تركيز ملوثات الهواء يزداد عند الجانب الشمالي – الغربي للمنطقة بينما ينخفض عند الجانب الشرقي – الجنوبي لها .

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إن للنشاط الصناعي وزيادة عدد السكان تأثيرا مباشرا في ازدياد نسب ملوثات الهواء. تشير قيم ملوثات الهواء (الدقائقيات ، عنصر الرصاص ، غازات اول اوكسيد الكربون و ثاني اوكسيد الكبريت) الى انها تصبح ذات تأثير سلبي اكثر في الاشهر الحارة مقارنة بالاشهر الباردة . كذلك لوحظ عدم وجود تأثير واضح لحركة الرياح بسبب صغر مساحة موقع البحث. لقد أوصت الدراسة بنقاط متعددة لتقليل تركيز ملوثات الهواء ، ومنها استخدام الوقود غير الحاوي على الرصاص في تشغيل المركبات والأجهزة ، كذلك استخدام المرشحات والوسائل التقنية لتنقية هواء المصانع ، مع تقليل حجم الكثافة المرورية عند الطرق الرئيسية في منطقة البحث ، اضافة الى اجراء دراسة لتحليل تأثير المصانع و انتاجها لمنع تلوث الهواء في منطقة البحث .

Introduction:

An atmospheric condition in which substances exist at a concentration higher than a normal background or ambient levels is said to be polluted if it has measurable effects on humans, animals, flora or materials. The human body needs 15 kg air/day while it has need to 3 kg water/day, and 1 kg food/day, [1] The air pollution have more interesting in the space of environmental protection especially after the increasing of industry developing. Air pollutants divided into two parts (primary and secondary pollutants).The primary pollutants are those emitted by an identifiable source. The more significant of these are SO2, CO, NOx, Sox**,** particulates, hydrocarbons and metals. The secondary pollutants are those formed in the atmosphere by chemical reaction and include O3. Oxidized hydrocarbons and other photo chemical oxidants. [2]

The effective air pollutants defined with the name of criteria pollutants which include; CO, NO2, O3, SO2 , PM -10 (particulate matter of diameter < 10 μm) and lead, [3].

This study is intended to investigate the concentration of some air pollutants (CO, Pb, SO2, and particulates) at Al-Musaib city and its surrounding area. The investigation is based on comparing the results of sample analyses with the international standards issued by various regulations. Also this study has been introduced by model for contour lines map showing the pollutants level distribution at the studied area.

Analyses of Some Criteria Pollutants.

1- Particulates Matter (PM)

Airborne Particulates matter represents a complex mixture of organic and inorganic substances divided in two groups; Coarse (dia. > 10 μm) and Fine (dia. < 10 μm) [3.4]

Total suspended particulates (TSP) , (Coarse and Fine) are measured by gravimetric methods.

The effect of air pollution was studied in some industrial and residential areas, [5]. The researcher made a comparison between the Particulates concentration in these area. His research showed the increasing of Particulates in the industrial area comparing with residential area.

Also other research [6] explained the heating effect of Particulates on biological reactions in the tissues of human body. Also the research stated that the description of shape and size of Particulates helped to determine the pollution source.

2-Carbon Monoxide (CO)

CO is a colorless. odorless. tasteless gas that is the most abundant of the criteria pollutants with a per capita per annum emission in excess of 100 kg. it has adverse effects on human health replacing oxygen in the blood stream and forming carboxyhemoglobin . Some studies [4, 7] showed that the CO levels in 1990 are at approximately 100 kg per capita in the European countries, while those in the USA are approximately 300 kg per capita.

3- Sulfur Dioxide (SO_2)

Sulfur dioxides are the product of fossil fuel combustion usually oil and coal. The dominant gaseous emission of sulfur is as SO_2 with small amounts of SO_3.
It is seen that the European countries produce about 30 kg per person per year while the United Kingdom and USA produce about 60 and 90 kg respectively, [7]

4- Lead (Pb)

The heavy metals of cadmium, Lead and mercury are significant air pollutants. Lead is a bluish – grey soft metal with a melting point of 327.5 C˚ and a boiling point of 1740 c˚. The combustion of leaded petrol, mining and smelting of lead are the source of this pollutant. [8]
Some studies reported that the deposition of the majority of the lead from automobile exhaust occurs within 100m of the road way, [9, 10]. And the lead levels in the European Countries became at 0.04 kg / capita per year in the 1990, [7].
Also, the Iraqi study [11] indicated that Baghdad soil is contaminated with lead. It was found that the chemical properties of soil have been affected on the concentration of lead at the ground surface.

Dispersion Models of Gaseous Pollutants

The mathematical model of Gaussian plume equation has been used to calculate the pollutant concentration in the air arising from industrial and natural processes, [3].

$$C(x, y, 0) = \frac{Q}{\pi\, u\, \sigma_y\, \sigma_z} \exp\left[-0.5\left(-\frac{y}{\sigma_y}\right)\right] * \exp\left[-0.5\left(-\frac{H^2}{\sigma_z}\right)\right] \quad \ldots (1)$$

Where:-
C: the precipitated pollutant concentration at ground level from the source through the winds($\mu g/m^3$).
Q: source strength (gm/ s).
u: wind velocity (m/s) .
σ_y σ_z : wind dispersion in both (y) and (z) directions (m) .

y: distance of intersection the pollutant particle with soil surface (m) .
Z: the vertical distance of the pollutant particle with soil surface (m).
H: the height of source (m).

Several parameters have been affected on the building of dispersion models of gaseous pollutants. The following model was given to calculate the concentration of atmospheric pollutants near the roadways, [9].

$$\chi(x) = \left(\frac{2}{\pi}\right)^{0.5} \frac{q}{u\,w} \int_{x}^{x+w} \frac{dx}{\sigma z\,(x)} \qquad \ldots\ldots\ldots (٢)$$

Where:

χ (x) : the concentration of atmospheric pollutants near the roadway (μg/m³).
q: the source strength of pollutant (μg/ m .s).
u: the main wind velocity (m/s) .
w: the width of road way (m) .
бz (x): the standard deviation of the vertical spread of the plume which is equal to ($a^s x$)
Which (a) and (s) are parameters dependent upon atmospheric stability (m).

Sampling Area Description

The studied area is located within Babylon governorate. It is named of Al-Musaib city. This area consists of the centre of Al-Musaib besides the surrounding areas which are named Al-Askandariya and Al-Mashro'a cities. The residential sector is the major part of the studied area, while the industrial (chemical and mechanical industries), agricultural and small commercial activities represent the other parts of the studied area, fig. (1).

In this research, ten locations have been selected to cover nearly all the area of the study as follow:

* 4 locations in the center of Al-Musaib city.
* 3 locations in the Al-Askandariya city.
* 3 locations in the Al-Mashro'a city.

Experimental Works

Monthly, three air samples have been taken for each location to determine the concentration of the particulates, CO and SO_2 pollutants, while three soil samples have been taken from the ground surface to indicate the concentration of lead (Pb).
The selected test period started from October 2007 and ended at July 2008.

The apparatuses used in these experiments are the following:

* Atomic Absorption spectrophotometer
  Type: Perkin – Elmer 5000.
* Gas chromatography (fig 2)
  Type: GC. 6890
* TG-gas analyzer (For Field Testing) Type : TG-501 (fig 3)
* Air filter (Dust fall collecting) Instrument.
* Digital indicator balance with accuracy 0.0001 gm.

* Drying oven with maximum temperature degree of 200 C.

According to the standard methods [3, 4, 11], the concentration of criteria pollutants were determined.

Fig (1) General layout of the studied area

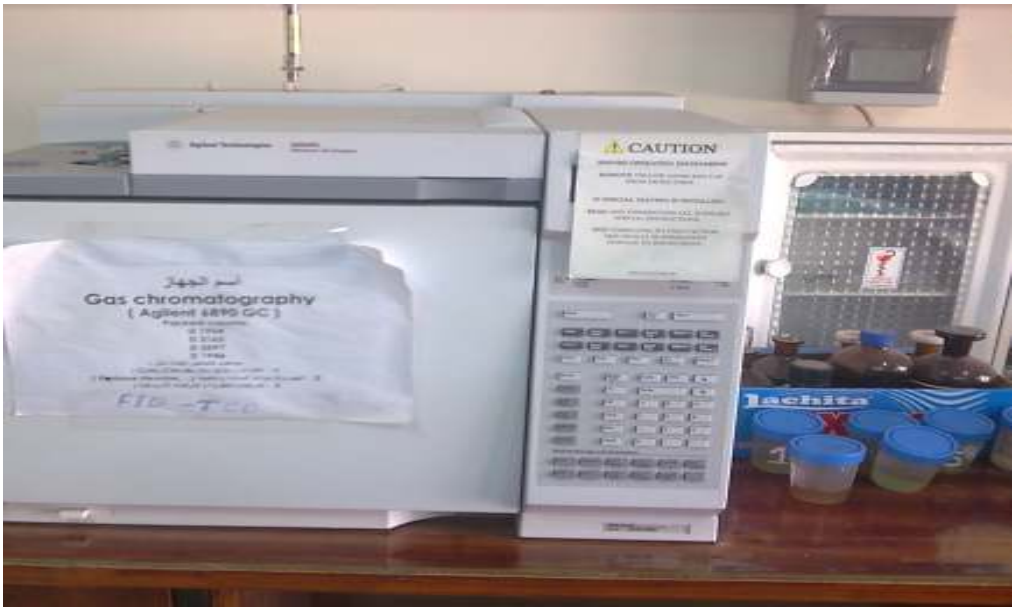

Fig (2) Gas Chromatography Instrument

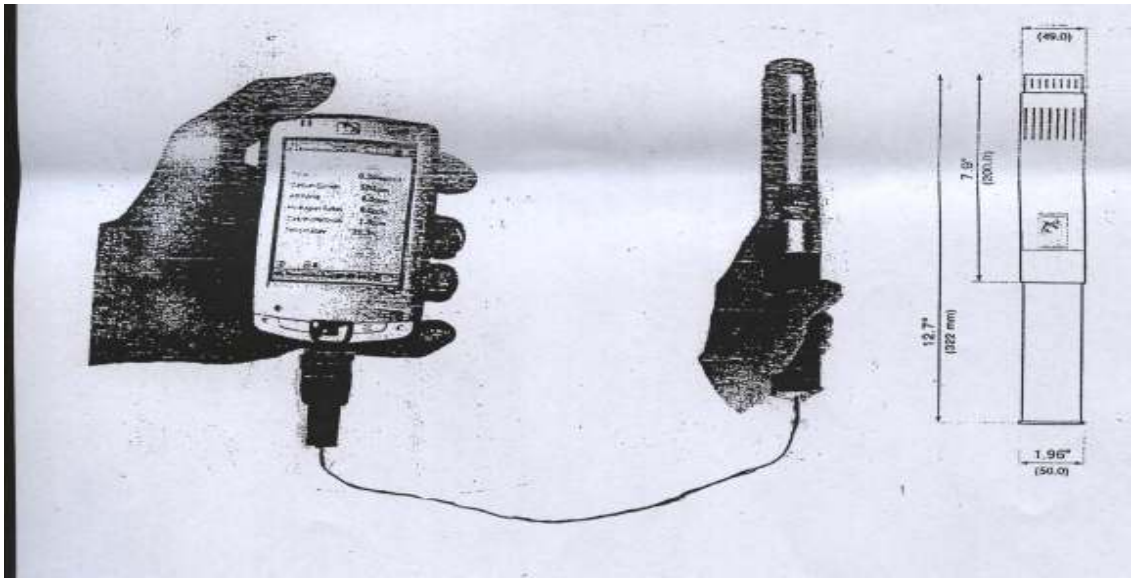

Fig (3) TG-501 (Gas Analyzer for Field Testing)

Results Analysis and Discussion

1- Analysis of pollutants concentration

Pollutants concentration levels have been measured in air and soil simples which where taken from the testing locations. The results of air and soil samples analysis from the studied area are listed in tables (1,2,3)

Month Item	Oct. 2007	Nov. 2007	Dec. 2007	Jan. 2008	Feb. 2008	Mar. 2008	Apr. 2008	May. 2008	June 2008	July 2008
TSP µg/m³	196	190	184	182	181	186	191	196	201	**204**
Pb µg/m³	0.60	0.57	0.60	0.51	0.52	0.60	0.65	0.78	0.83	**0.84**
CO µg/m³ * 10³	6.10	5.90	5.90	5.90	5.60	5.80	6.20	6.80	6.70	**7.10**
SO2 µg/m³	**41**	**40**	**39**	**36**	**34**	**42**	**41**	**42**	**47**	**48**

The ranges for measured TSP,Pb,CO and SO_2 are (170 -230 µg/m³) , (0.51 – 1.08 µg/m³) , (5.6 -9.25 * 10³ µg/m³) , (34 – 74 µg/m³) for AL-Musaib locations , and (186 – 256 µg/m³) , (0.61 – 1.26 µg/m³) , (6.2 – 9.95 * 10³ µg/m³) , (37 – 89 µg/m³) for AL-Askandariya locations, and (140 – 213 µg/m³) ,(0.43 – 0.94 µg/m³) ,(4.07 – 8.3 * 10³ µg/m³) , (31 – 62 µg/m³) for AL-Mashro'a locations respectively .

It is noticed that the average values of air pollutants (TSP, Pb, CO, CO_2) during the warm months are greater than that during the cold months.

This meant that these values become more negative effective during the warm months . Temperature and dry weather parameters play the dominant role by assisting other environmental parameters to increase the reaction and effect of the studied pollutants on human body.

The direction of wind is north – west on the studied area. It is shown that the effect of wind is not observed because the area of the testing locations is small.

The results given in table (4) and Figs (4,5,6,7) show that the most contaminated locations are No.4, No.6, No.7.These locations have the main property which represent the effect of industrial processes (chemical and mechanical industries) in these places, while the other locations show that the increasing of pollutants concentration are reaching the maximum limit of the permissible values .

Table (1) Concentration of Criteria Pollutants at Different Test Locations for AL_Musaib Area

Commercial Area No.1

Commercial Area No.1

Main Road No.2

Month Item	Oct. 2007	Nov. 2007	Dec. 2007	Jan. 2008	Feb. 2008	Mar. 2008	Apr. 2008	May. 2008	June 2008	July 2008
TSP µg/m³	183	181	180	174	171	197	191	206	211	**216**
Pb µg/m³	0.87	0.88	0.79	0.77	0.70	0.85	0.85	0.88	0.94	**0.97**
CO µg/m³ * 10³	8.10	8.05	7.90	7.6	7.15	8.10	8.20	8.90	8.90	**9.10**
SO2 µg/m³	**53**	**47**	**47**	**48**	**45**	**49**	**52**	**53**	**59**	**64**

Residential Area No.3

Month Item	Oct. 2007	Nov. 2007	Dec. 2007	Jan. 2008	Feb. 2008	Mar. 2008	Apr. 2008	May. 2008	June 2008	July 2008
TSP µg/m³	181	180	178	170	170	186	183	189	194	**199**
Pb µg/m³	0.72	0.71	0.66	0.68	0.67	0.76	0.75	0.79	0.86	**0.90**
CO µg/m³ * 10³	7.50	7.48	7.40	7.41	6.81	7.30	7.60	7.90	8.0	**8.60**
SO2 µg/m³	**46**	**42**	**45**	**41**	**37**	**44**	**45**	**48**	**49**	**53**

Industrial Area No.4 (Chemical Industries Company)

Month Item	Oct. 2007	Nov. 2007	Dec. 2007	Jan. 2008	Feb. 2008	Mar. 2008	Apr. 2008	May. 2008	June 2008	July 2008
TSP µg/m³	218	211	213	209	206	216	217	221	230	**229**
Pb µg/m³	0.98	0.93	0.94	0.96	0.80	0.95	0.97	1.04	1.05	**1.08**
CO µg/m³ * 10³	9.10	9.10	9.20	9.0	8.80	9.10	9.10	9.15	9.20	**9.25**
SO2 µg/m³	**65**	**65**	**56**	**57**	**52**	**62**	**63**	**65**	**71**	**74**

Table (2) Concentration of Criteria Pollutants at Different Test Locations for AL_Askandaria Area

Residential Area No.5

Month Item	Oct. 2007	Nov. 2007	Dec. 2007	Jan. 2008	Feb. 2008	Mar. 2008	Apr. 2008	May. 2008	June 2008	July 2008
TSP µg/m³	201	200	192	199	186	196	198	196	206	**206**
Pb µg/m³	0.68	0.65	0.66	0.63	0.61	0.68	0.67	0.69	0.70	**0.73**
CO µg/m³ * 10³	7.20	7.30	7.06	6.90	6.2	7.10	7.10	7.30	7.40	**7.45**
SO2 µg/m³	**45**	**47**	**41**	**40**	**37**	**44**	**46**	**51**	**50**	**59**

Industrial Area No.6 (Mechanical Industries Company)

Month Item	Oct. 2007	Nov. 2007	Dec. 2007	Jan. 2008	Feb. 2008	Mar. 2008	Apr. 2008	May. 2008	June 2008	July 2008
TSP µg/m³	215	214	207	196	196	205	210	216	219	**222**
Pb µg/m³	0.75	0.75	0.72	0.73	0.68	0.78	0.78	0.81	0,86	**0.94**
CO µg/m³ * 10³	9.20	9.12	9.10	8.90	8.80	9.05	9.10	9.18	9.22	**9.23**
SO2 µg/m³	**76**	**73**	**70**	**64**	**50**	**67**	**68**	**70**	**79**	**81**

Industrial Area No.7 (Automobiles Industry Company)

Month / Item	Oct. 2007	Nov. 2007	Dec. 2007	Jan. 2008	Feb. 2008	Mar. 2008	Apr. 2008	May. 2008	June 2008	July 2008
TSP µg/m³	231	229	224	220	213	235	232	236	244	**256**
Pb µg/m³	1.14	1.11	0.95	0.96	0.95	1.01	1.05	1.09	1.20	**1.26**
CO µg/m³ * 10³	9.58	9.56	9.57	9.50	9.42	9.40	9.60	9.60	9.75	**9.95**
SO2 µg/m³	**74**	**71**	**61**	**60**	**54**	**70**	**71**	**76**	**84**	**89**

Table (3) Concentration of Criteria Pollutants at Different Test Locations for AL_ Mashro'a Area

Residential Area No.8

Month / Item	Oct. 2007	Nov. 2007	Dec. 2007	Jan. 2008	Feb. 2008	Mar. 2008	Apr. 2008	May. 2008	June 2008	July 2008
TSP µg/m³	146	149	147	140	140	152	159	181	186	**192**
Pb µg/m³	0.58	0.47	0.48	0.44	0.43	0.58	0.60	0.79	0.81	**0.82**
CO µg/m³ * 10³	4.85	4.65	4.85	4.26	4.07	5.10	5.20	6.30	6.45	**6.62**
SO2 µg/m³	**38**	**36**	**33**	**34**	**31**	**40**	**39**	**43**	**49**	**47**

Lateral Road No.9

Month / Item	Oct. 2007	Nov. 2007	Dec. 2007	Jan. 2008	Feb. 2008	Mar. 2008	Apr. 2008	May. 2008	June 2008	July 2008
TSP µg/m³	156	153	154	152	150	163	168	191	194	**199**
Pb µg/m³	0.61	0.52	0.49	0.49	0.48	0.57	0.63	0.78	0.87	**0.9**
CO µg/m³ * 10³	6.10	6.0	6.10	5.41	5.10	6.20	6.10	7.10	7.10	**7.60**
SO2 µg/m³	**41**	**39**	**38**	**38**	**36**	**45**	**43**	**46**	**50**	**51**

Mian Road No.10

Month Item	Oct. 2007	Nov. 2007	Dec. 2007	Jan. 2008	Feb. 2008	Mar. 2008	Apr. 2008	May. 2008	June 2008	July 2008
TSP µg/m³	168	163	171	168	166	180	181	196	204	**213**
Pb µg/m³	o.64	0.61	0.60	0.55	0.51	0.68	0.70	0.80	0.93	**0.94**
CO µg/m³ * 10³	5.70	6.10	6.10	6.0	5.90	6.50	6.60	7.30	7.50	**8.30**
SO2 µg/m³	**40**	**41**	**40**	**36**	**37**	**36**	**44**	**47**	**57**	**62**

Table (4) Quantitative Analysis of the Results

Stations	Pollut-antes	Max. Value (µg/m³)	Min. Value (µg/m³)	Average Value (µg/m³)	Standard deviation	Coeff. of variation
Al-Musaib	TSP	230	170	195.66	14.35	7.3%
	Pb	1.08	0.60	0.805	0.139	17.2%
	CO *10³	9.25	5.60	7.783	1.140	14.6%
	SO_2	74	34	50.25	8.966	17.8%
Al-Askandariya	TSP	256	186	213.66	16.224	7.6%
	Pb	1.26	0.61	0.774	0.257	33.3%
	CO *10³	9.95	6.2	8.6	1.227	14.3%
	SO_2	89	37	61.66	11.832	19.1%
Al-Mashroa	TSP	213	140	169.55	10.736	6.3%
	Pb	0.94	0.43	0.644	0.044	6.8%
	CO *10³	8.3	4.07	5.955	0.615	10.3%
	SO_2	62	31	42.11	2.713	6.4%
Air Standard for Criteria Pollutants	Pollutants µg/m³	WHO	USEPA	TALUFT		
	TSP	75	75	50		
	Pb	0.5-1.0	1.5	2		
	CO	10000 at av .time 8hr	10000 at av .time 8hr	10000 at av .time 8hr		
	SO2	40-60	80	60		

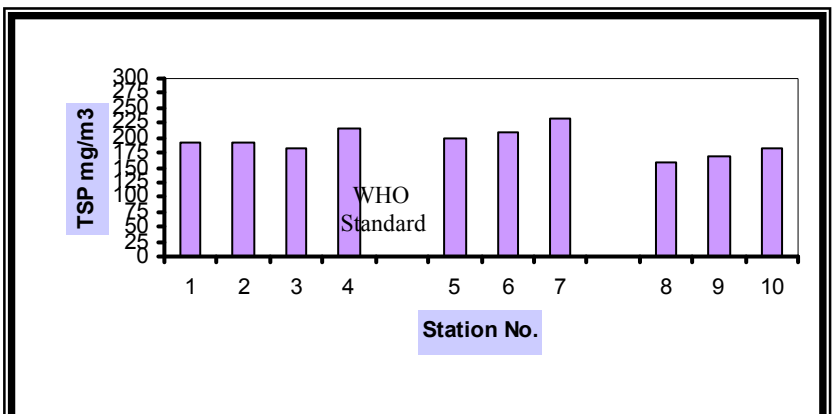

Fig. (4) Variation of TSP Concentration in different stations

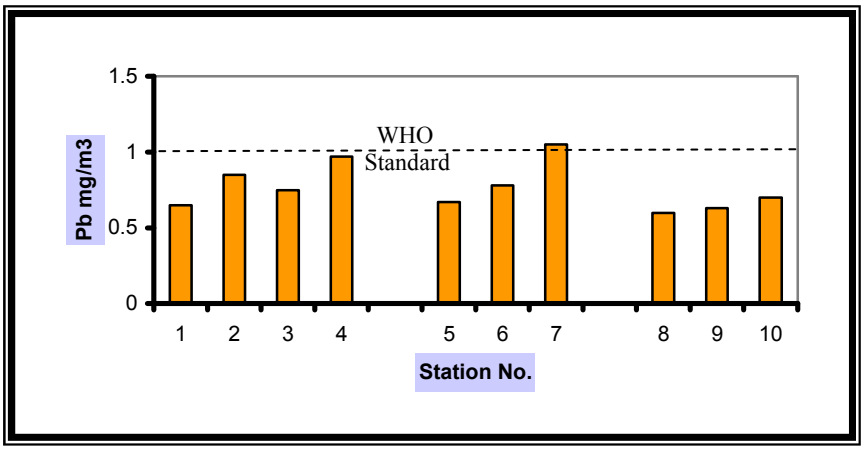

Fig. (5) Variation of Pb Concentration in different stations

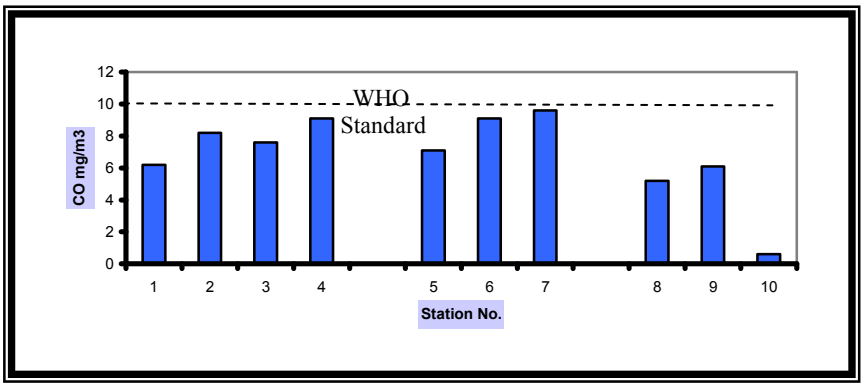

Fig. (6) Variation of CO Concentration in different stations

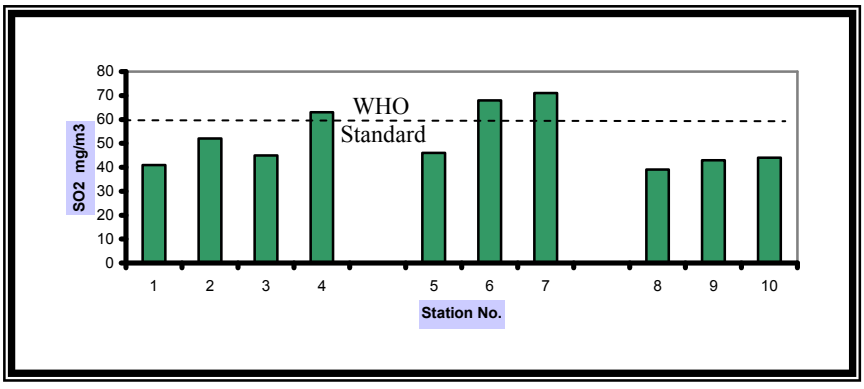

Fig. (7) Variation of SO_2 Concentration in different stations

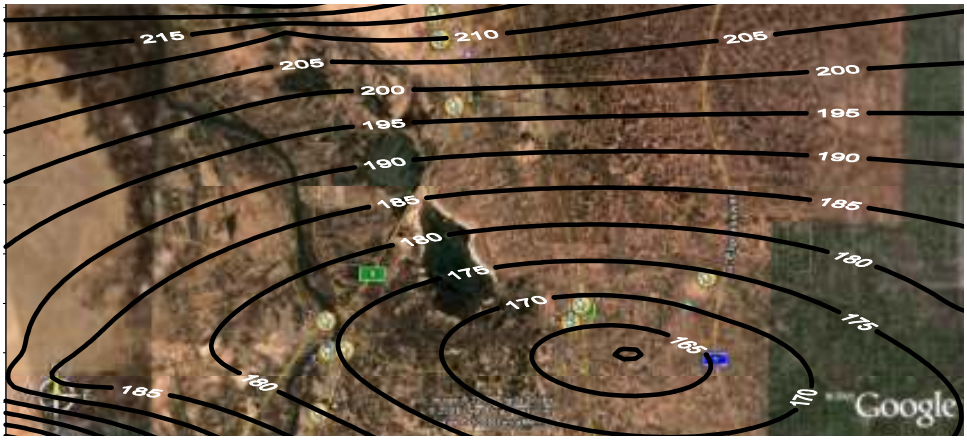

Fig.(8) The contour lines of TSP concentration

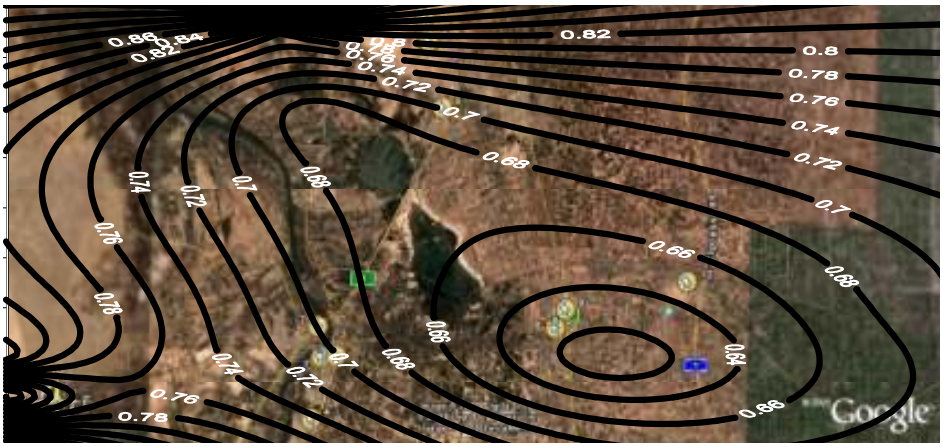

Fig.(9) The contour lines of Pb concentration

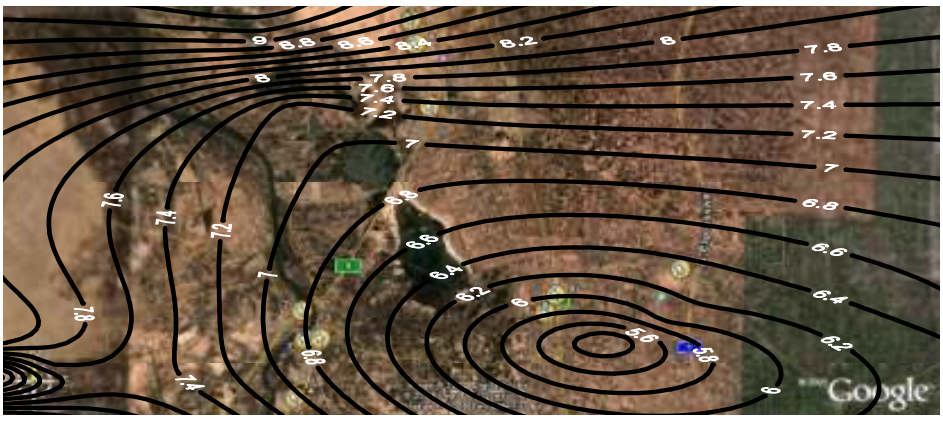

Fig.(10) The contour lines of CO concentration

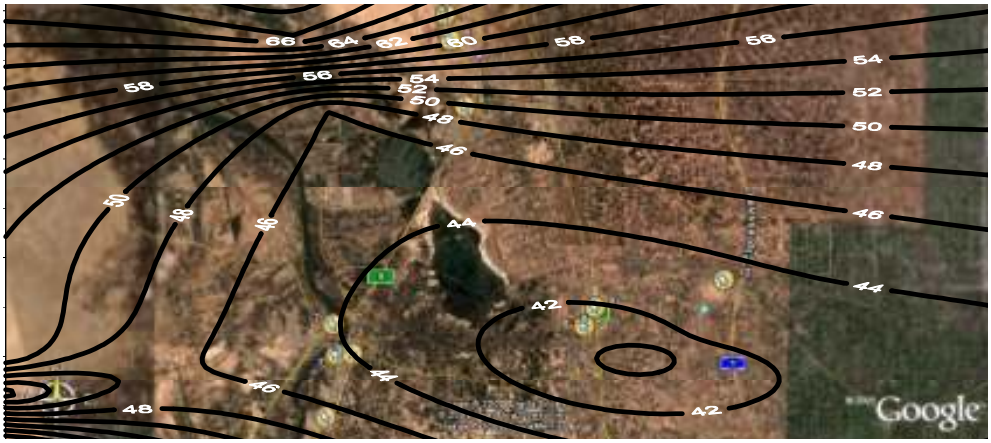

Fig.(11) The contour lines of SO_4 concentration

As compared with the classifications (WHO, USEPA, TA Luft), only the TSP concentration exceeds the permissible limits, while the other pollutants reach nearly the maximum values of the permissible limits. For this reason, the air of the studied area is polluted only with TSP.

There are several reasons besides the effect of industrial processes which may contribute these high pollutants level such as the traffic volume of roads network found in the studied area, population density economical conditions of people living in this area and the significant increase in use the electrical generators operated with leaded gasoline.

Quantitative Analysis Using Stepwise Regression Techniques:

Table (4) shows the descriptive statistics of the measured variables for air pollutants of the studied area. SPSS program was used for statistical treatment .

Table (4) shows that the standard deviation of each air pollutants for Al-Musaib area varied between 0.139- 14.35 $\mu g/m^3$, thus giving a coefficient of variation in the range of 7.3- 17.8 % .

While for Al-Askandariya area, the value of standard deviation of each air pollutants varied between 0.25-16.2 $\mu g/m^3$, thus giving a coefficient of variation in the range of 7.6- 33.3 % .

And for Al-Mashro'a area, the value of standard deviation varied between 0.04- 2.7 $\mu g/m^3$, thus giving a coefficient of variation in the range of 6.4- 10.3 % .

The results of variation coefficients for each areas tend to the stability of the air pollutants concentration according to the quantitative analysis of statistical methods . In addition these values variables is almost symmetrical .

Criteria Pollutants Distribution in the Studied Area

The distribution of criteria pollutants level in the air of studied area has been introduced as contour lines map by using surfer program as shown in figs (8,9,10,11). From this map, it's clear that pollutants concentration increased at the industrial locations (Nos.4, 6, 7) and at the main roads (Nos.2, 10) comparing with other locations.

The concentration of pollutants increased at the locations (Nos.1, 3, 5) lying in or near the city center. This case takes place because the crowded roads and their locations are near the industrial and commercial activities.

Generally, the concentration of air pollutants decreases when the locations are far away from the industrial factories and from the center towards the boards of the studied area. Also, it is noticed that the most contaminated locations lie in the west-north of studied area, while there is light contamination in the east- south site (Nos.8, 9). The last result has been formed because of the effect of industrial factories and high population density.

Conclusions and Recommendations

1- Conclusions

According to the results, the conclusions from this study can be summarized in the following Points:

1- The studied area has been divided into three parts according to the degree of air pollutants Concentration.

- The highly polluted locations (Nos.4, 6, 7).
- The moderately polluted locations (Nos.1, 2, 3, 5,10).
- The limited polluted locations (Nos. 8, 9).

2- The air of studied area is polluted only with the total suspended particulates matter.

3- Although the air pollutants (Pb, CO, SO_2) have high values of concentration, but they are not exceeding the maximum permissible limits.
4- The concentration of air pollutants increases at the west- north site of studied area, and decreases at the east- south site.
5- The industrial activity , high population density and traffic vlume have direct effect on the increasing of
criteria air pollutants concentration.

2- Recommendations

The following points are recommending to decrease the pollutants production in the atmosphere of studied area:
1- Reduce the traffic volume at the main roads especially near the highly polluted locations.
2- Reduce the amount of air pollutants emission from the industrial factories by using filters and
technical devices.
3- Use the unleaded fuel in vehicles, generators and other production machines.
4- It is required to analyze the effect of industrial factories and its production on air pollution at this area.

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