Measuring the concentration of Suspended Particulate Matter and some heavy metals in air of two areas of Rusafa in Baghdad

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Abstract

This study aimed to detect the present levels and distribution of air pollutants such as SPM, Pb, Cr, Cd , and Ni , in two urban sites within Al- Rusafa side in Baghdad city (Al-Waziriya as industrial site and Al-Andalus square as commercial site). Measurements were carried out from November 2013 until June 2014**.** SPM, Pb, Cr, Cd , and Ni were measured using Air intake device(Sniffer) . The average minimum concentrations of SPM, Pb, Cr, Cd , and Ni were 588 µg/m^3, 2.8 µg/m^3, 15.6 µg/m^3, 0.1 µg/m^3, and 6.3 µg/m^3. While the average maximum concentrations were 723 µg/m^3 , 3.4 µg/m^3 , 21.7 µg/m^3 , 0.125 µg/m^3 , and 6.8 µg/m^3 , respectively. The results indicate that commercial site was more polluted with SPM , Pb , and Ni compared to the industrial site, while Cr and Cd concentrations were high in industrial site .

Keywords: Air pollutants, Al-Andalus square**,** Al-Waziriya.

قياس تركيز جسيمات الدقائق العالقة وبعض المعادن الثقيلة في هواء منطقتين من جانب الرصافة في بغداد

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الخلاصة:

هدفت الدراسة الحالية إلى الكشف عن مستويات وتوزيع جسيمات الدقائق العالقة ، الرصاص، الكروم، الكادميوم، والنيكل في موقعين تم اختيارهم للقياس ضمن جانب الرصافة في مدينة بغداد (الوزيرية كموقع صناعي و ساحة الأندلس كموقع تجاري). اجريت الدراسة من تشرين الثاني 2013 حتى حزيران 2014. تم اجراء القياس لجسيمات الدقائق العالقة ، الرصاص، الكروم، الكادميوم، والنيكل باستخدام جهاز سحب الهواء . وكان معدل اوطئ التراكيز المسجلة 588 ميكروغرام /م^3، و 2.8 ميكروغرام /م^3، 15.6 ميكروغرام /م^3، 0.1 ميكروغرام /م^3، و 6.3 ميكروغرام /م^3. وكان معدل التركيزات القصوى لها 723 ميكروغرام /م^3، 3.4 ميكروغرام /م^3 ، 21.7 ميكروغرام /م^3 ، 0.125 ميكروغرام /م^3، و 6.8 ميكروغرام /م^3، على التوالي. وتشير النتائج إلى أن موقع ساحة الاندلس أكثر تلوثا بجسيمات الدقائق العالقة، والرصاص، والنيكل من الموقع الصناعي، في حين كان تركيز الكروم والكادميوم اعلى في الموقع الصناعي.

Introduction

Air pollution may be defined as any atmospheric condition in which certain substances are present at concentration well above normal limits in such concentrations that they may cause undesirable effects on man and his environment. These substances include gases (SO_x, NO_x, CO, HCs, etc), particulate matter (smoke, dust, fumes, aerosols) radioactive materials and many others**.** [1]. The

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substance can be solid particles, liquid droplets, or gases. A pollutant can be of natural origin or man-made.
Atmospheric particulate matter (PM), or fine particles, are tiny particles of solid or liquid suspended in a gas. In contrast, aerosol refers to combined particles and gas. Some particulates occur naturally, originating from volcanoes, dust storms, forest and grassland fires, living vegetation, and sea spray. Human activities, due to burning of fossil fuels in vehicles, power plants and various industrial processes also generate significant amounts of aerosols.
Averaged worldwide, anthropogenic aerosols—those made by human activities—currently account for approximately 10 percent of our atmosphere. Increased levels of fine particles in the air are linked to health hazards such as heart disease, altered lung function and lung cancer[2]. The heavy minutes with a diameter larger than (10 μm) tends to deposition near the surface of the ground, while the minutes of light with a diameter smaller than (1 μm) remain stuck in the lower part of the atmosphere for up to several weeks. The minutes diameter confined between (1-10 μm), they constitute a significant health risks as they are small enough to penetrate the lungs and cause acute respiratory disease. The lingering effect of the minutes be great to human health as the exposure to these minute particles for a long time increases respiratory diseases, especially asthma, and may result in damage of the tissues of the lungs [3] .
The lead (Pb) of the most common toxic elements in the air and pollutants dangerous to humans and the environment , it is possible that lead accumulates in the human body and leads to general weakness and prejudice to the nervous system , and may lead to mental retardation in children. The car exhaust most important source of lead since it is being added to gasoline from the fourth ethyl lead and the fourth instance of lead as additives improved fuel , and it causes evaporation of the fuel to the concentration of these two compounds in the air when emissions from vehicle exhausts and the consequent negative consequences for the environment. While are other sources of lead air iron and steel industry and dyes containing lead. Sources of Lead natural back to emissions of volcanic and forest fires , and the estimated normal level for the presence of lead in the air about ($5x10^{-5}$μg/m^3) and could increase the focus on the normal level as a result of Industrial activities carried out by the human[4].
Chromium (Cr) is a grey, hard metal most commonly found in the trivalent state in nature. Hexavalent chromium(VI) compounds are also found in small quantities. Chromite ($FeOCr_2O_3$) is the only ore containing a significant amount of chromium. The ore has not been found in the pure form; its highest grade contains about 55% chromic oxide . chromium in the air may originate from wind erosion of shales, clay and many other kinds of soil. In countries where chromite is mined, production processes may constitute a major source of airborne chromium. The bronchial tree is the primary target organ for carcinogenic effects of chromium(VI). Inhalation of chromium-containing aerosols is therefore a major concern with respect to exposure to chromium compounds [5]**.**
Nickel (Ni) is a lustrous white, hard . Nickel does not occur in nature as the pure metal but as a component of other minerals. The most prevalent forms of nickel minerals are sulfides, oxides, silicates, and arsenicals. Nickel sulfides, silicates, and oxides are the most important nickel minerals from a mining and natural resource standpoint. Nickel is an important metal because of its marked resistance to corrosion and oxidation in both air and aqueous environments. Atmospheric nickel emissions occur both from natural and anthropogenic sources. Natural nickel sources include windblown soil and dust, volcanoes, vegetation, forest fires, sea salt, and meteoric dust. Anthropogenic nickel emissions occur from two broad categories of sources: direct and indirect sources. The direct category primarily includes sources that either produce nickel or consume nickel or a nickel compound to manufacture a usable product like nickel ore mining and smelting and nickel matte refining. Indirect sources are generally those that do not produce nickel or nickel-containing products and only inadvertently handle nickel because it is present as an impurity in a feedstock or fuel [6]**.**
Cadmium(Cd) is an element and is classified as a transition metal. Occurs in an oxidation state of +2. Cadmium has been widely dispersed into the environment through the air by mining and smelting as well as by other human activitiy. Many studies have found that even very low-levels of cadmium may have adverse effects on the kidney. WHO currently states that 200 μg/g levels wet weight in kidney causes adverse changes in 10% of the population. In the past, several studies of occupationally and environmentally exposed populations have shown that the threshold for renal damage occurred at

urinary cadmium levels of 2-4 nmol/mmol creatinine **;** however, the OSCAR study found that those with a urine cadmium level of 1 nmol/mmol creatinine had a threefold risk of increased ά-1 microglobulin. However, at this time, it is not known if these early subclinical changes in kidney biomarkers associated with low levels of environmental cadmium exposure have any correlation with continued decline in renal function to clinical levels of concern [7].

Materials and Methods

Two sites were selected within Al- Rusafa side in Baghdad city (Al-Waziriya industrial rejoin and Al-Andalus square commercial rejoin). These sites were selected in order to monitor the concentrations of SPM, Pb, Cr, Cd , and Ni in the ambient air which carried out from November 2013 until June 2014**.** SPM, Pb, Cr, Cd , and Ni were measured using Air intake device(Sniffer) type Radeco American model. The survey took eight months to represented all seasons , and Sniffer were placed at the height of 1.5m above the ground to avoid the dust by the movement of wind and with the direction of the prevailing winds in the region[8]**.** Also represents the average human height, to ensure that it was possible to measure the average concentrations that most people inhale [9].The average of two readings was taken between morning and late afternoon for each site.

Calculation of suspended particulate matter

The concentration of the suspended particulate matter was calculated by the following steps:

1. After drying candidate (filter), which is empty in an electric oven (Oven) temperature (40 C °) for a period of quarter of an hour, to get rid of the moisture and then cooled candidate (filter) and then determines the weight (W1) fines accurately .
2. Flow rate is measured of air drawn in units liter / minute (L / min). Be read directly from the device(sniffer) when the device starts (V1).
3. After a full hour (t = 60 min) to turn on the air intake device is measured as the rate of airflow (V2) units (L / min) and read directly from the device .
4. Candidate weighed again after the completion of drawn air by the air intake device and determines the weight with its contents (W2) fines .
5. Calculated concentration minutes lingering in the air in units of (µg/m3) at all measurement locations after that converts weight in grams to units Micro grams beat in the (10^6) and converts flow rate of liter / minute (L / min) to units of volume cubic meters (m3) and dividing it on (1000) and the following equations describes these accounts :

$$(SPM) = \frac{(Wf - Wi)}{V_T} \times 10^6 \ldots\ldots\ldots\ldots(1)$$

Where:

Sp=mass concentration of suspended particular, µg/m^3

$W_{f=}$ final weight of filter, gm

W_i = initial weight of filter, gm

10^6= convertion of g to µg

V_T = total volume of air sample, m^3

Where:

$$V_T = \left(\frac{V_1 + V_2}{2}\right) \times \frac{t}{1000} \ldots\ldots\ldots\ldots(2)$$

Calculation of Pb, Cr ,Cd, and Ni

Pb, Cr ,Cd, and Ni concentration was calculated from measurement locations of the current study as follows:

1. Taken filter with its contents and are cut small pieces and placed in a beaker of polyethylene capacity (50 ml).
2. Has added (10 ml) of concentrated nitric acid (HNO_3) and a few drops of hydrofluoric acid (HF) to complete the process of melting of the minutes for suspended filter and covered tightly.
3. Beaker with its contents transferred to a water bath temperature (60 C °) and keep it for a period of 24 hours to complete the digestion process.
4. filtered the contents of the beaker using the filter papers in diameter (9 cm) of type (Whatman) and size to complement (50 ml) of Deionized water in volumetric flasks and then later transported to plastic containers is very clean and close tightly.
5. Use a flame atomic absorption spectrometer to determine the concentration of Pb, Cr ,Cd, and Ni unit (ppm) for all the plastic bottles that have been prepared [10].
6. Applied the following equation to calculate the concentration of Pb, Cr ,Cd, and Ni in the air units (µg / m3):

$$(x)Concentration.(\mu g / m^3) = C \times \frac{V_i}{V_T} \ldots\ldots\ldots\ldots(3)$$

Where:

C: concentration of the element unit (ppm)

Vi: the size of model and is equal to (50 ml)

VT: the total volume of air drawn unit (m^3)

t: time it takes to pull (t = 60 min)

Results and Discussion

The average concentrations of air pollutants measured in the two sites are listed in table -1, SPM in Andalus square site has reached (723 $\mu g/m^3$) which is higher than average in Al- Waziriya which reached (588 $\mu g / m^3$). Compared with the determinants of local and International for the concentration of SPM in the air for a period of exposure one hour amounting to 350$\mu g/m^3$, 150$\mu g/m^3$, respectively, we find that the concentration of SPM in the current study had exceeded the permissible limits both locally and internationally. The increase in concentration of SPM in commercial site rather than industrial site may related to heavy traffic in this area, where various transport types lead and play an important role in increasing the concentration of SPM in the air as a result of the movement that lead to the volatilization of dust as well as the minutes emission from vehicle [2]. As well as the presence of incinerator to burn waste, which emit different air pollutants as a result of the burning of waste, especially hospital waste present in this region, such as the Sheikh Zayed Hospital and Ibn Al Haitham Hospital and waste from shops.

The overall rate for the concentration of lead(Pb) in Al-Andalus Square has reached (3.4$\mu g/m^3$), higher than the overall rate recorded in the Al- Waziriya amounting to (2.8 $\mu g/m^3$). When comparing the concentration of lead with the determinants of local and global exposure for a period of one hour, amounting to (2, 0.5 $\mu g/m^3$) respectively, we find that both study sites have exceeded the global concentration of lead in the air**.** the high concentration of lead in Al-Andalus Square due to for being

Table 1- Average concentrations (μg/m^3) air pollutants in two sites in Baghdad city

Sampling sites	SPM	Pb	Cr	Cd	Ni
Al-Andalus square	440-1400 723	0.2-6.5 3.4	0.1-38 15.6	0-0.3 0.1	26.5-0.2 6.8
Al-Waziriya	339-922 588	0.5-6.5 2.8	0.2-48.6 21.7	0-0.4 0.125	0.1-18.1 6.3

One of the areas with high traffic, as the increasing number of vehicles in recent years and the poor quality of fuel used. The burning of lead additives (Tetra Ethyl Lead and Tetra methyl Lead) which are used as materials for improved cars fuel are the main source of increasing the concentration of lead in the air of the city.

The overall rate for the concentration of Chromium (Cr) in Al-Andalus Square has reached (15.6μg/m^3), less than the overall rate recorded in the Al- Waziriya amounting to (21.7 μg/m^3). When comparing the concentration of Cr with the determinants of global exposure, amounting to ($4*10^{-2}$μg/m^3) Lifetime, we find that both study sites have exceeded the global concentration of Cr in the air of Baghdad city. Cr average concentration in industrial station is higher than the average in commercial site . The high concentration of chromium in industrial site due to used in many industries[11], where it is used in the General Company for Electrical Industries during the coating process .As well as used in the manufacture of batteries and paint.

The overall rate for the concentration of Cadmium (Cd) in Al-Andalus Square has reached (0.1μg/m^3), less than the overall rate recorded in the Al- Waziriya amounting to (0.125μg/m^3). When comparing the concentration of Cd with the determinants of global exposure, amounting to (0.05μg/m^3) annual, we find that both stations study have exceeded the global concentration of Cd in the air of Baghdad city. Cd average concentration in industrial site is slightly higher than the average in commercial site. Industrial emission of Cd represents the main source of cadmium in the air, where it is used in production of nickel-cadmium batteries is currently the primary use of cadmium. Cadmium, a by-product of zinc- and sulfide-ore processing, is also used for metal plating and in pigments and plastics[12] .

The overall rate for the concentration of Nickel(Ni) in Al-Andalus Square has reached (6.8μg/m^3), higher than the overall rate recorded in the Al- Waziriya amounting to (6.3 μg/m^3). When comparing the concentration of Ni with the determinants of global exposure, amounting to (0.2 μg/m^3) Lifetime, we find that both study sites have exceeded the global concentration of Ni in the air of Baghdad city. Ni average concentration in commercial site is slightly higher than the average in industrial site. Nickel finds its way into the ambient air as a result of the combustion of coal, diesel oil and fuel oil, the incineration of waste and sewage, and miscellaneous sources . Environmental sources of lower levels of nickel include tobacco, dental or orthopaedic implants, stainless steel kitchen utensils and inexpensive jewellery[13]**.** This explains the rise in the industrial site more than commercial site.

Conclusion

The current results may reveal air pollution in the city of Baghdad despite the fact that many factories do not work at full optimum productivity. But the crowded streets, and the use of old transport modes and poor fuel used and the fuel additives to improve its quality, in addition to the proliferation of generators and waste incineration , and the lack of environmental conditions for that was the reason behind this pollution. But with government decisions issued in the last period of don't use of the old vehicles and impose sanctions on laboratories and factories are not subject to environmental conditions possible to note the low level of these pollutants**.**

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