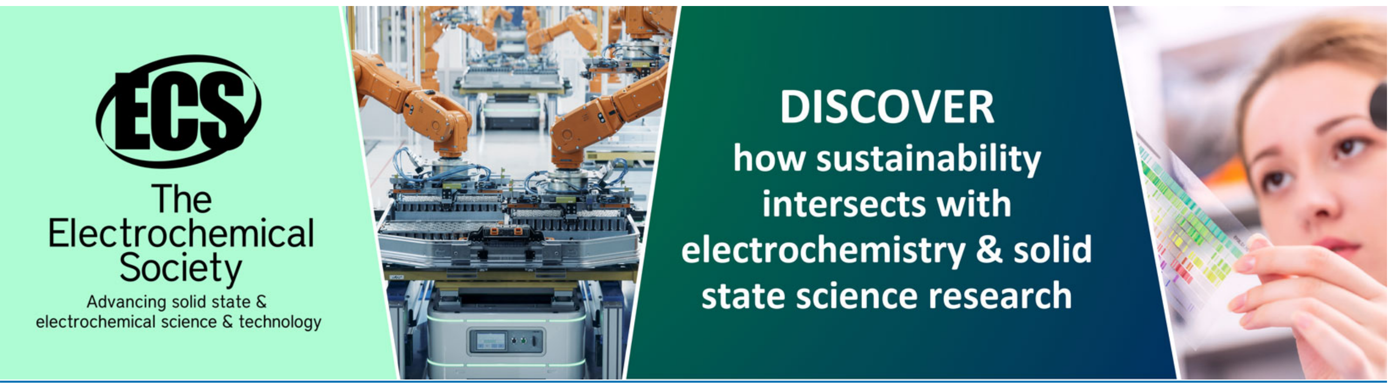
IOP Conference Series: Materials Science and Engineering

PAPER • OPEN ACCESS

Cancer Risk Assailments Due to Inhale Lead Fly Ash by People in Wasit Governorate – Iraq



IOP Conf. Series: Materials Science and Engineering **928** (2020) 072027 doi:10.1088/1757-899X/928/7/072027

Cancer Risk Assailments Due to Inhale Lead Fly Ash by People in Wasit Governorate – Iraq

Ali A. Jaber[1], Shafik S. Shafik[2, 3], and Hadi D. Alattabi[1]

[1]Department of Physics, College of Science, Wasit University, Wasit – Iraq
[2]University of Alayen, Thi-Qar, Iraq
[3]Department of Physics, College of Science, University of Baghdad, Baghdad, Iraq
shafeqsh76@gmail.com ; shafeq_sh@scbaghdad.edu.iq

Abstract:
The concentration of the heavy metal lead (Pb) has been measured for more than one hundred indoor air samples of different locations in Wasit Governorate that is frequented by many people. The samples were taken from the air conditioners of these locations and then washed with distilled water. The Atomic Absorption Spectroscopy (AAS) has been used to measure Pb concentration. The results showed that the concentration of Pb, in general, is higher than the allowed international values. The minimum, maximum, and overall average values of Pb concentration (in $mg\ m^{-3}$) for the investigated samples were 5.29E-03, 2.72E-05 and 9.56E-04, respectively. Finally, the cancer toxic risks and non-cancer toxic risks have been estimated, and its results were important and cannot be ignored.

1. Introduction

Recently, it is no secret to everyone, especially the Iraqis, about the extent of air pollution with dusty particles that content heavy metals, chemical materials and others pollutants. Many factors have led to an increase in air pollution in Iraq, especially in the cities of Wasit Governorate, the study area in the current study. One of these factors is the bulldozing of agricultural areas and their transformation into residential cities, and thus the loss of major cities to their green belt. The dependence of electricity production on diesel generators and even personal electric generators scattered in city alleys, it works with diesel, which causes a great pollution of air with ash that is saturated with toxic and dangerous lead (Pb) [1, 2]. In addition to all of this, the steadily increasing number of cars that use diesel fuel has led to an increase in the concentration of lead in the atmosphere. Also, the population increase in cities, which is a result of the migration of agricultural village people to cities, is considered an important reason for increasing pollution.

The countries of the world were interested in measuring and treating the air pollution [3-5]. In Thailand (for example) [3], the effect of fireworks on increasing concentrations of minerals in the atmosphere, including lead, was studied. In Nigeria

[4], the effect of soil dust on the health of school students was studied. There are many studies (reference [5] and references therein) in the countries of the world that have taken more accurate and detailed aspects of the air pollution. In Iraq, great interest has been in studying radon gas concentrations in the atmosphere and in various cities of Iraq [6-8]. As for the presence of minerals in the air and studying their impact on people, we have not found studies in this direction, especially in Wasit Governorate.

In Iraq, the increase in the incidence probability of all kinds of cancer is a dangerous indicator. Statistics studies have shown a significant increase in the incidence of cancer in all governorate of Iraq, especially breast and lung cancer [9].

Therefore, this study aimed to measure the concentration of an important element, which is lead in the atmosphere of Wasit governorate cities, and internal measurements were adopted in governmental offices such as hospitals, health centers, police stations, etc. to determine the contamination percentage with lead and calculate the possibility of cancer probability incidence.

2. Research Methodology

Special filters were used that contained 10 to 20 µm holes. These filters were placed on the air conditioners in the studied places for different periods of time, and then these filters were removed and treated with distilled water for the purpose of collecting dust attached to it. The collected samples were up to 100 samples.

A special calibration was made between what the air conditioner pulls from the amount of air and what a person breathes when resting from the air (which is 7 liters per minute), so the concentration of any metal can be calculated easily in units of mg/m^3.

The atomic absorption spectrometry with flame method was used to measure the lead concentration in the study samples. The flame method of atomic absorption is used as a technique known to determine mineral concentrations in environmental samples. In this technique, the thermal energy is sufficient to isolate the chemical compounds into free atoms. Most of the atoms, within the correct flame conditions, remain in the lower state and are able to absorb light within the wavelength of the analysis. The ease and speed in determining element concentrations make atomic absorption technology one of the most common methods of mineral analysis. The steps described in reference [10] were approved in the preparation of samples for examination.

However, in order to estimate the health risk due to inhale of lead minutes in air of the studied locations, the average exposure to selected metals by inhalation (D_{inh}) for both children and adults, based on individual's body weight during a given period, is computed using eq.(1) [5];

$$D_{inh} = \frac{C*InhR*EFq*ED}{BW*AT} \quad \text{...(1)}$$

where D_{inh} is exposure by respiratory inhalation ($mg\ kg^{-1}day^{-1}$); $InhR$ is inhalation rate (7.6 and 20 m^3day^{-1} for children ($InhR_{child}$) and adults ($InhR_{adult}$), respectively); EFq is exposure frequency ($day\ year^{-1}$); ED is exposure duration (6 years for children (ED_{child}), 24 years for adults (ED_{adult}), respectively); BW is average body weight (15 kg for children (BW_{child}), 70 kg for adults (BW_{adult}); AT is the averaging time (for non-cancer toxic risks, $AT\ (days) = ED * 365$; for cancer risks, $AT\ (days) = 70 * 365$; C is exposure-point concentration (mgm^{-3}). In this study, the lifetime average daily dose ($LADD$) of selected metals through inhalation is employed for evaluating health risk, as described in eq.(2) [4-5];

$$LADD = \frac{C*EFq}{AT} = \left(\frac{InhR_{child}*ED_{child}}{BW_{child}} + \frac{InhR_{adult}*ED_{adult}}{BW_{adult}}\right) \ldots\ldots\ldots(2)$$

It is also important to introduce the concept of a hazard quotient. Theoretically, a hazard quotient (HQ) is the ratio of the potential exposure to a selected metal, relative to the level at which no adverse effects is expected. After D_{inh} is computed, HQ can be obtained using eq. (3) [4-6];

$$HQ = \frac{D_{inh}}{RfD} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..(3)$$

$RfD$is the reference dose ($mg\ kg^{-1}\ day^{-1}$), which is value $3.52\ \times 10^{-3}$ for Pb [6].
If the calculated HQ is < 1, then no adverse health effects are expected because of exposure. Conversely, if HQ is >1, then negative health impacts are possible.

3. Results and Discussions

In this paper, the lead concentration was measured in samples collected from the air of different places in Wasit governorate. Table (1) shows the details of the places from which the samples were collected, which are different places, including governmental places, personal homes, super markets, mobile centers, and etc. These places were chosen on one basis, which is the large number of people who occupy them.

Figure (1) illustrates the histograms of Pb concentrations measured in the examined samples. From this figure, one can note the great variation in measured lead concentrations, which can be due to many reasons, such as distance from the street, cigarette smoking, proximity to emissions of personal electricity generators, and other reasons. Also, the maximum, minimum, and overall average values of Pb concentrations (in $mg\ m^{-3}$ unit) have been shown in Table (2), which are 5.29E-03, 2.72E-05 and 9.56E-04, respectively. The minimum value belongs to S47 sample while the maximum value belongs to S96 sample. However, the results of measuring lead concentrations were compared with the values of international organizations [11-13] such as the World Health Organization (WHO) and others, which indicated that most of the measurements were greater than the permissible international measurements and even the overall average of measurements of this paper was much greater, but when comparing these results with the results conducted in other countries such as China [6], the results of this research were approximately close to it, as shown in Table (1). In addition, the children and adults average exposure to Pb by inhalation (D_{inh}) (in $mg\ kg^{-1}day^{-1}$ unit), and children and adults hazard quotient (HQ) for both non-cancer toxic risks and cancer toxic risks have been calculated and illustrated in Table (1). Although the results of HQ were less than one, it is considered dangerous for non-cancer toxic risks and cancer toxic risks. This can attribute to the fact that the HQ parameter must be calculated for all measured heavy elements but in this paper was estimated for Pb only. Furthermore, the lifetime average daily dose (LADD) of Pb through inhalation has, also, calculated for the investigated samples. As expected, the values of LADD are consistent with the values of the measured concentration, because when calculating LADD parameter, it depends on the measurements of the concentration. Table (3) shows the minimum, maximum, and overall average values of LADD, which are 4.65E-06, 9.06E-04, and 1.64E-04, respectively.

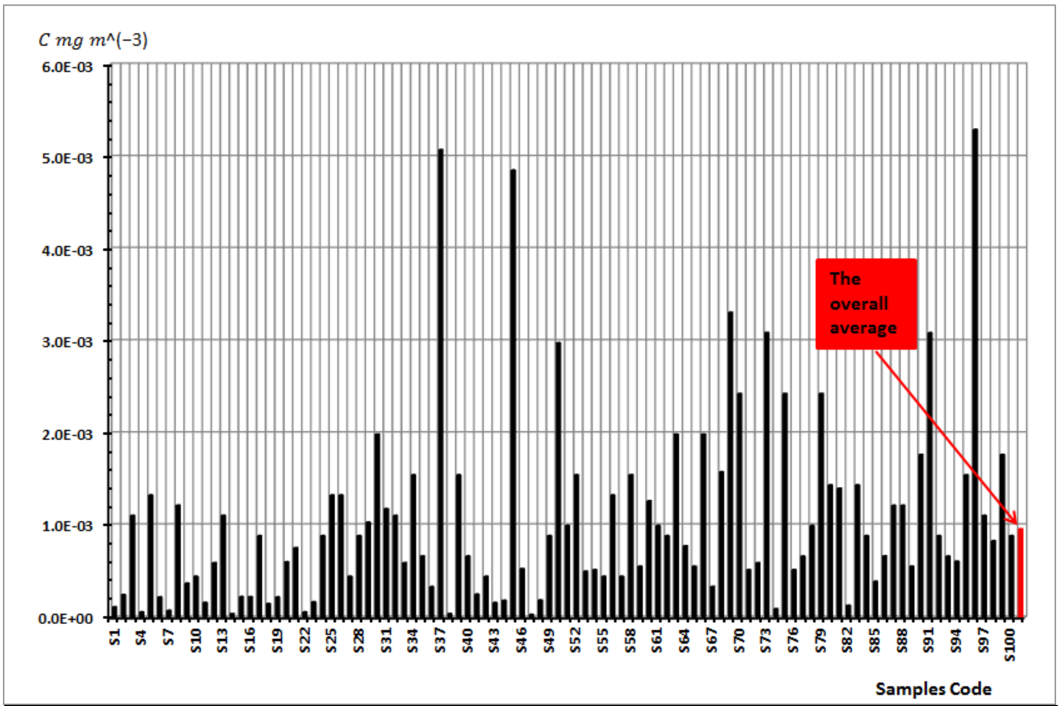


Figure (1); the lead concentrations of the measured samples

Table (1); the detailed locations of investigated samples

Code	City Name	Samples locations
S1	Sheik Saad	Health center of Sheik Saad /Baby care lobby
S2	Sheik Saad	Health center of Sheik Saad /Consulting room
S3	Sheik Saad	Health center of Sheik Saad /Reception
S4	Al-Kut	Directorate of Education in Wasit /Files room
S5	Al-Kut	Wasit health directorate /Department of individuals
S6	Sheik Saad	Gym
S7	Sheik Saad	Coffee Shop
S8	Sheik Saad	Pharmacy
S9	Sheik Saad	Personal house
S10	Al-Hawrah	Personal house
S11	Al-Kut	Wasit Governorate/ reception
S12	Al-Kut	Wasit Governorate / Inspection of women
S13	Al-Kut	Wasit Governorate / Cadre room
S14	Al-Hoora	Medical Clinic
S15	Al-Hoora	Noor Al-Mujtaba School /Class room
S16	Al-Hoora	Noor Al-Mujtaba School /Cafeteria
S17	Al-Kut	Appellate Court of Wasit /Contracts room
S18	Al-Kut	Appellate Court of Wasit /Social researcher room
S19	Al-Kut	Appellate Court of Wasit /Store
S20	Al-Kut	Zahra Teaching hospital /Pharmacy
S21	Al-Kut	Zahra Teaching hospital /X-ray room
S22	Al-Kut	Zahra Teaching hospital /X-ray room
S23	Sheik Saad	Vegetable store
S24	Sheik Saad	Motorcycle shop
S25	Al-Mashroo	Riadh Cafeteria
S26	Al-Mashroo	Al-Isnad Company
S27	Al-Mashroo	Drug store
S28	Hai Al-Hakeem	Filling station
S29	Hai Al-Hakeem	Super Market
S30	Hai Al-Hakeem	Super Market
S31	Al-Kut	Al-Kut Parking lot /Automotive oils store
S32	Al-Mashroo	Elsoosn Cafeteria
S33	Al-Mashroo	Kitchens Workshop
S34	Al-Zahra	Coffee shop
S35	Al-Zahra	Al-Chef Restaurant
S36	Al-Shohada	Coffee shop
S37	Al-Shohada	Gym
S38	Al-Shohada	Exchange port
S39	Al-Khajia	Super market
S40	Al-Khajia	Coffee shop
S41	Jassan	Jassan District directorate
S42	Jassan	Jassan Restaurant
S43	Jassan	Jassan Electricity directorate
S44	Jassan	Jassan Health Center
S45	Badra	Badra Health Center
S46	Badra	Badra Court
S47	Badra	Badra District council
S48	Badra	Badra Police station
S49	Badra	Filling station
S50	Al-Numaniya	Air Conditions Workshop
S51	Al-Numaniya	Al-Numaniya General Hospital/ Emergency hall
S52	Al-Numaniya	The Directorate of National Card Affairs in Al-Numaniya

S53	Al-Numaniya	Super Market
S54	Al-Husseiniya	Al-Husseiniya health Center
S55	Al-Husseiniya	The Directorate of National Card Affairs in Al-Husseiniya
S56	Al-Husseiniya	Ali Shakir Restaurant
S57	Sheik Saad	Personal house
S58	Sheik Saad	The Directorate of National Card Affairs in Sheik Saad
S59	Sheik Saad	Courthouse in Sheik Saad
S60	Al-Dubuni	Super Market
S61	Al-Dubuni	Al-Dubuni Health Center
S62	Al-Dubuni	Filling station
S63	Al-Zubaydiya	Al-Zubaydiya Health Center
S64	Al-Zubaydiya	The Directorate of National Card Affairs in Al-Zubaydiya
S65	Al-Zubaydiya	Directorate of municipalities of Al-Zubaydiya
S66	Al-Aziziya	Al-Aziziya Health Center
S67	Al-Aziziya	Al-Aziziya District Directorate
S68	Al-Aziziya	The Directorate of National Card Affairs in Al-Aziziya
S69	Al-Aziziya	Al-Assal Restaurant
S70	Hai Al-Kafaat	Super Market
S71	Hai Al-Jihad	Hai Al-Jihad health center/ Maintenance room
S72	Hai Al-Jihad	Hai Al-Jihad health center/ Consulting room
S73	Zain Al-Qaws	Health Center
S74	Al-Jaafari	Real estate registration
S75	Al-Jaafari	School
S76	District of Al-Dujaili	Health Center/ X-ray room
S77	District of Al-Dujaili	Health Center/ Men's emergency hall
S78	District of Al-Dujaili	District of Al-Dujaili Municipality
S79	District of Al-Dujaili	Super Market
S80	Al-Hayy	Filling station
S81	Al-Hayy	Al-Salam health center
S82	Al-Hayy	The Directorate of National Card Affairs in Al-Hayy
S83	Al-Hayy	Al-Hayy Health Center
S84	Al-Hayy	Super market
S85	Al-Hayy	Personal house
S86	Al-Muwafaqiya	Cell phones shop
S87	Al-Muwafaqiya	Coffee shop
S88	Al-Suwayra	Al-Suwayra General hospital/ Emergency hall
S89	Al-Suwayra	Al-Suwayra General hospital/ Emergency hall
S90	Al-Suwayra	The Directorate of National Card Affairs in Al-Suwayra
S91	Al-Suwayra	Cell phones shop
S92	Al-Suwayra	Super Market
S93	Al-Khajia	Super Market
S94	Al-Khajia	Personal house
S95	Al-khajia	Grocery store
S96	Al-Zahra	Al-Omal Restaurant
S97	Damok	Super Market
S98	Damok	Super Market
S99	Tammoz	Super Market
S100	Zain Al-Qaws	Super Market
S101	Al-Hoora	Photography Studio

Table (2): The minimum, maximum, and overall average values of the concentration (C) ($mg\ m^{-3}$), the children and adults average exposure to Lead (Pb) by inhalation (D_{inh}) ($mg\ kg^{-1}day^{-1}$), and children and adults hazard quotient (HQ) for both non--cancer toxic risks and cancer toxic risks

Non-cancer toxic risks					
Sample Code	C	D_{inh} children	D_{inh} adult	HQ children	HQ adult
Minimum in S47	2.72E-05	1.36E-05	7.66E-06	3.86E-03	2.18E-03
Maximum in S96	5.29E-03	2.64E-03	1.49E-03	7.51E-01	4.24E-01
The overall average	9.56E-04	4.78E-04	2.69E-04	1.36E-01	7.65E-02
WHO [13], DPR [12], and FEPA [11]	8.27E-05	4.13E-05	2.33E-05	1.17E-02	6.62E-03
In China [6]	0.12E-03	3.64E−06	2.05E−06	1.04E−03	5.84E−04
Cancer toxic risks					
Sample Code	C	D_{inh} child	D_{inh} adult	HQ child	HQ adult
Minimum in S47	2.72E-05	1.16E-06	2.63E-06	3.31E-04	7.46E-04
Maximum in S96	5.29E-03	2.27E-04	5.11E-04	6.44E-02	1.45E-01
The overall average	9.56E-04	4.10E-05	9.24E-05	1.16E-02	2.62E-02

Table (3); The minimum, maximum, and overall average values of lifetime average daily dose ($LADD$) of Pb through inhalation

Sample Code	$LADD$
Minimum in S47	4.65E-06
Maximum in S96	9.06E-04
overall average	1.64E-04

4. Conclusions

The results obtained in this work strongly support the hypothesis of large air pollution in Wasit Governorate, which can be generalized to all governorates of Iraq due to the great similarity in their environments. This pollution is considered very dangerous as it is caused by heavy lead, which has a high chemical toxicity, as well as the danger resulting from its large mass when inhaled. This conclusion can be confirmed by the results of this research, which are much higher than what is internationally permissible.

References

1. Israa K. Ahmed, Mahdi Hadi Jasim, and Shafik S .Shafik; "The concentrations of Natural Radioactivity in Fly Ash Released from Al-Dura thermal Power Plant in The south of Baghdad City"; Iraqi Journal of Science, Vol. 57, No.2B, pp:1192-1197, 2016.
2. Asia H. Al-Mashhadani, Shafik S. Shafik, and Muna A. Saeed; "Estimating excess of lung risk factor of radon gas for some houses in Al-Fallujah city"; Iraqi Journal of Physics, Vol.13, No.26, PP. 160-170, 2015.
3. Siwatt Pongpiachan, Akihiro Iijima, and Junji Cao; "Hazard Quotients, Hazard Indexes, and Cancer Risks of Toxic Metals in PM10 during Firework Displays", Atmosphere 2018, 9, 144; doi:10.3390/atmos9040144.
4. Olatunde S. Durowoju, Joshua N. Edokpayi, Oluseun E. Popoola and John O. Odiyo; "Health Risk Assessment of Heavy Metals on Primary School Learners from Dust and Soil within School Premises in Lagos State, Nigeria" chapter 18 of a book published by WEB of SCIENCE, 2018, http://dx.doi.org/10.5772/intechopen.74741 .
5. Jinglan Feng, Hao Yu, Xianfa Su, Shuhui Liu, Yi Li, Yuepeng Pan, and Jian-Hui Sun; "Chemical composition and source apportionment of PM2.5 during Chinese Spring Festival at Xinxiang, a heavily polluted city in North China: Fireworks and health risks", Atmospheric Research 182, 176–188, (2016).
6. Shafik S. Shafik, Basim Kh. Rejah, and Abdul Hussein Abdul Ameer, "Radon concentration measurements in sludge of oil fields in North Oil Company (N.O.C.) of Iraq"; Iraqi Journal of Physics, Vol.13, No.26, PP.139-145, 2015.
7. Shafik S. Shafik and Aamir A. Mohammed, "Measurement of Radon and Uranium Concentrations and Background Gamma Rays at the University of Baghdad -Jadiriyah Site", International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 2, Issue 5, May 2013.
8. Shafik S. Shafik and Noor Al-Huda Irzooqi, "Measurements of radon, thoron and their progeny concentrations using twin cup dosimeter for indoor Al-Madaan city – Baghdad – Iraq", Iraqi Journal of Physics, Vol.14, No.30, PP. 24-32, 2016.
9. Ministry of Health, Iraqi Cancer Registry Center (ICRC), "Report on the statics of cancers till 2009", Published in 2012.
10. Iijima, A.; Sato, K.; Ikeda, T.; Sato, H.; Kozawa, K.; Furuta, N. Concentration distributions of dissolved Sb(III) and Sb(V) species in size-classified inhalable airborne particulate matter. J. Anal. Atomic Spectrom., 25, 356–363, 2010.
11. DPR. Environmental Guidelines and Standards of the Petroleum Industry in Nigeria. UK: Ministry of Petroleum Resources Lagos; pp. 35-75, 1991.

IOP Conf. Series: Materials Science and Engineering **928** (2020) 072027 doi:10.1088/1757-899X/928/7/072027

12. FEPA. Guideline and Standard for Environmental Pollution Control in Nigeria. Federal Republic of Nigeria; pp. 61-63, 1991.
13. WHO/WMO. Air Monitoring Program Designed for Urban and Industrial Area Published for Global Environmental Monitoring System by UNEP. Geneva: WHO and WMO; 1971.