Plant Archives Volume 20 No. 2, 2020 pp. 5596-5602 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

MEASUREMENT OF ASBESTOS FIBERS CONCENTRATIONS IN SOME DENSE AREAS IN BAGHDAD, IRAQ, IN WINTER 2020

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Abstract

Asbestos is a hazard pollutant to human health, exposure to asbestos cause serious health effects and wide range of asbestos-related diseases such as asbestosis, lung cancer and malignant mesothelioma and it has been classified as carcinogen by the World Health Organization WHO which cause a carcinogenic effects. Fibers of asbestos are mainly released from friction product in brakes and clutch linings and from reinforce agent in the asbestos cement industry. The aim of this was to evaluate the levels of asbestos fibers in surroundings air of some dense traffic points in Baghdad, through winter 2020. Materials and Methods: Samples of airs was carried out by directing air flow to a mixed cellulose ester membrane filter mounted on an open faced filter holder using a low flow sampling pump. The asbestos fibers that present in the samples were analyzed and counted by using scanning electron microscopy SEM to identify non asbestos from asbestos fibers, SEM coupled to an energy dispersive X-ray EDS analysis method to know the chemical composition of these fibers. Through monitoring of asbestos fiber concentration indicated that a range from 0.097-0.142 f/ml and the average concentration of asbestos fibers in the studied points were 0.11825 f/ml. This values which is considerably higher than the threshold limit value (TLV) proposed by WHO and American conference of governmental industrial hygienist ACGIH which is 0.0022 and f/ml 0.1 f/ml respectively.

Key words: asbestos, brakes, dense traffic, TLV, SEM, EDS, asbestosis

Introduction

Asbestos is a unique mineral, Greek word meaning inextinguishable Asbestos is a naturally occurring mineral fiber, it has been widely used in numerous construction material and vehicle products due to its strength and ability to resist heat and corrosion before its dangerous health effects were discovered (ATSDR, 2001; IARC, 2012). Individual asbestos fibers cannot be seen by the naked eye, which puts workers at an increased risk (WHO, 2018). The Occupational Safety and Health Administration (OSHA) has regulations to protect workers from the hazards of asbestos (Sonja *et al*., 2020). Although the World Health Organization (WHO) and the International Labor Organization (ILO) emphasizes on abandoning the use of asbestos, Iraq and some other developing countries continue to use it for industrial purposes (Hannaniah and Stephen, 2019). According to the WHO, about 125 million individuals in the world are still exposed to asbestos through their occupations (Hannaniah and Stephen, 2019) and based on the report from the International Labor Office ILO, there are about 100,000 mortalities annually around the world due to occupational exposure to asbestos (Sonja *et al*., 2020).

However, asbestos causes serious health effects, such as lung cancer and malignant mesothelioma and it has been classified as a first-level carcinogen by the World Health Organization WHO (Visona *et al.,* 2018; Nakaya, 2015).

Asbestos health effects

Research shows fibers of asbestos can cause major breathing problems and cancer. Old and brittle asbestos products can release tiny, even microscopic, fibers. These fibers can remain suspended in the air and enter the lungs when were inhaled (Shahla and Yaghoub, 2016).

Airborne asbestos fibers have no odor or taste. Because of the health risks, the federal government has

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banned the use of asbestos in certain products, but it can still be used in others (Tunga, 2020).

The period of latency, that is the time between the first contact with asbestos and the appearance of the first symptoms, is long and may reach from 10 to 30 years (Mirabelli, 2010). The health risk related to exposure to asbestos and other mineral fibers depends on many factors, such as mineral composition, size of fibers, magnesium to silica Mg/Si proportion, degree of fiber condensation, concentration of asbestos dust, time of deposition in the lungs, time of exposition, mode of penetration into organism (inhalation, intake, skin), other accompanying substances (e.g. cigarette smoke, cement dust) and individual features of the organism (age, sex, genetic inclinations, style of life and health status) (Lotfi *et al.,* 2013).

Several studies have linked asbestos exposure to several serious health challenges such as lung cancer, mesothelioma, asbestosis, and other respiratory diseases (6). The first mention of an adverse effects of asbestos fibers was reported in 1906 and the results of the comprehensive study of the health effects of asbestos were published in 1928 (Myoung *et al.,* 2011; Tunga, 2020).

The principal exposure pathway for asbestos is inhalation and the associated effects are first seen in the respiratory system, these effects have been demonstrated mainly among workers and laboratory animals (IARC, 2016).

Hence, the assessment of airborne asbestos concentrations enables public health workers to determine the extent of exposure and, consequently, the risk to the population (Marioryad, 2011).

Over time, these fibers can accumulate and lead to serious health problems including asbestosis, mesothelioma, lung cancer and other lung problems such as pleural plaques, thickening of the membranes that surround the lungs, and pleural effusions (NIOSH, 2016).

Asbestos, as with other air pollutants has adverse health effects of human beings and animals (Mohammad and Yaghoub, 2016).

The relationship between presence of asbestos fibers in the air breathed by human and developing of serious diseases such as lung cancer (asbestosis) and mesothelioma has been proven (Farhad, 2019; Malgorzataand Ewa, 2019).

The American environmental protection organization has estimated that annually 32 million kg of asbestos is admitted into the environment in response to the abrasion of brake pads. Currently about 125 million of people exposure to asbestos, more than 107,000 people estimates die annually from asbestos-related lung cancer, mesothelioma, and asbestosis resulting from occupational exposure (Hannaniah and Stephen, 2019; Al- Ramahi, 2020).

Due to all forms of asbestos can cause malignant diseases, therefore many countries have decided to eliminate and banned the use of asbestos not only in large industries but also in many small industries such as Poland and Iran (Muqdad *et al.,* 2018).

Materials and Methods

Air pollutants such as asbestos, suspended particulate matter, and heavy metals collected by use sniffer device. The air samples were collected in winter 2020. During this period, four samples were collected from studied locations that characterized by high traffic and polluted areas; each sample of air was collected on filter served in plastic petri dish, then all samples transported to the nano laboratory laboratories of the minerals research office at the Iraqi Ministry of Science and Technology for analysis.

Sampling was carried out by directing air flow to a mixed cellulose ester membrane filter mounted on an open faced filter holder using a low flow sampling pump (Neonila *et al.,* 2012). Sniffer device were used for the collection of air samples. Fibers counting on the filters was conducted by using scanning electron microscopy SEM and energy dispersive X-ray system EDS analysis to determine asbestos fibers from nonasbestos and the total numbers of fibers (Neonila *et al.,* 2012).

Measurement unit of sniffer device that used in the field to collect samples of air pollutant was (l/min) (Sugio *et al.,* 2018).

Cellulose filters, before sampling, were dried at 40^0C for 30 minutes and then weighted to record initial weight Wi by using sensitive balance. The initial weight Wi of filters between 0.21153gm and 0.21216 gm then the filter was kept in sealed container and prepared to be used in the sampling location. In the sampling location, the filter placed in the sampler device sniffer device were put on the height of one meter or more above the ground to avoid the dust by the movement of wind and with the direction of the prevailing winds in the region (Markowitz *et al*., 2013).

Then at the end of sampling operation, the exposed filter removed from the sampler and kept inside a sealed container and weighted in the laboratory, this weight represent the final weight Wf (Murray, 1991).

Count of Asbestos Levels

The concentrations of fibers were determined via following formula:

$C = (E)\times(Ac)/(V\times10^3)$

Where:

C is the concentration of fibers (f/ml),

E the density of fibers (fibers/mm^2),

Ac the effective filter area (approx. 385 mm^2)

V is the air volume sampled (liter).

Sampling

Sampling points were selected by taking into account the dense of traffic, heavy population, the industrial sources of pollutants, and prevalent direction of winds.

Before sampling, filters of cellulose were dried at 40^{0}C for 30 minutes and then weighted to record initial weight W_1 by using sensitive balance (Mohammad *et al*., 2018). In the sampling points, the filter placed in the sniffer device were put on the height of one meter or more above the ground to reduce the dust by the movement of wind and with the direction of the prevailing winds in the region, (Mohammad *et al*., 2018; Ferdinando *et al*., 2019), then at the end of sampling process, the exposed filter removed from the sampler and kept inside a lidded container (plastic petri dish) and weighted, this weight represent the final weight W_2 (Roe *et al*., 2015).

Four air samples were collected from selected points which cover the four areas of Baghdad city. The city map and the sampling locations are shown in Fig. 1.

Analysis of Samples and Fibers Count

As mention above, the air samples that collected from selected areas were examined in the nano laboratory of the minerals research office at the Iraqi Ministry of Science and Technology.

Scanning electron microscope SEM coupled with energy dispersive X ray system EDS was utilized to count and diagnosis the target fibers, energy dispersive X ray system EDS method gives a spectrum showing elemental content of the fibers (Mansour *et al*., 2014).

The concentrations of asbestos fibers were determined by the following formula

$C = (E)\times(Ac)/(V\times10^3)$

Where:

C: is the concentration of fibers (f/ml),

E: the density of fibers (fibers/mm^2),

Ac: the effective filter area (approximately 385 mm^2), and

V is the air volume sampled (liter) (11).

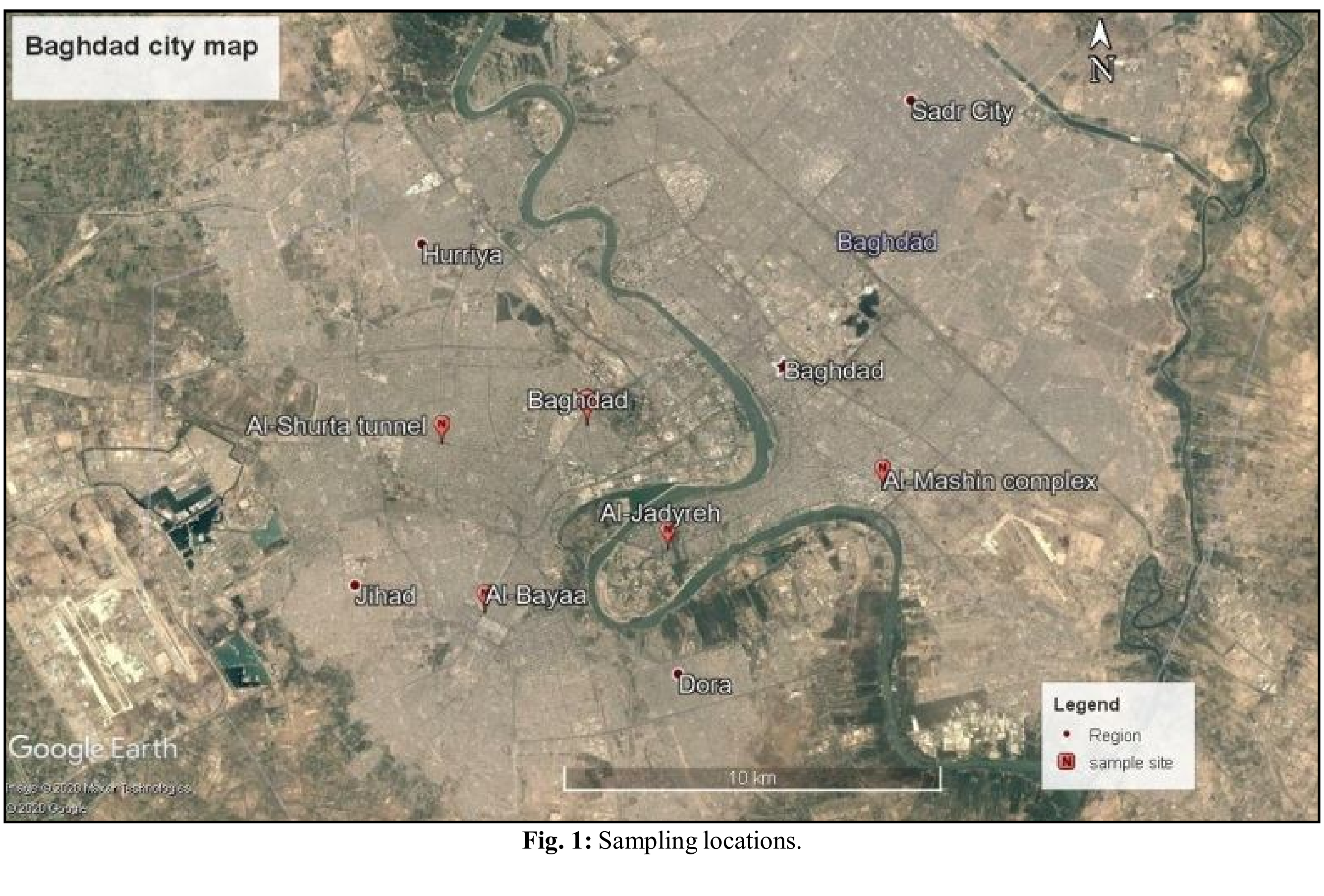

Fig. 1: Sampling locations.

Results and Discussion

Analysis and counting of the asbestos fibers in samples of air were collected from four locations was carried out by scanning electron microscope SEM and the chemical composition of the fibers was analyzed by EDX. Based on the data that obtained from scanning electron microscope analysis SEM, the levels of asbestos fibers in the ambient air of the studied points were range between 0.097 f/ml to 0.142 f/ml, while the average was 0.11825 f/ml and this values exceed limited suggested by WHO which is 0.0022 f/ml (WHO, 2014) and the standards of American Conference of Governmental Industrial Hygienist ACGIH which is 0.1 f/ml as shown in table 1 and Fig. 2, example of an SEM image of asbestos fibers shown in Fig. 3.

However, those levels were higher compared to the measured concentration in some countries. For example, study carry out by Neonila *et al.,* in several locations in Poland indicate that the average levels was 0.02702 f/ml (Sonja *et al*., 2020). Study in Iran conducted by Shahla and Yaghoub found that average level of asbestos fiber between 0.01364 f/ml and 0.01224 f/ml (IARC, 2016; Murray, 1991). The highest concentrations of asbestos fibers were founded in Meshen commercial complex due to repairing activities, release of asbestos fibers from building materials, very heavy traffic and commercial nature of this area. All these reasons led to high pollution with asbestos in this location. The second highly contaminated area Al-Gadria 0.127 f/ml this high level value attributed to this area consider the highest dense traffic in Baghdad, due to present of universities and many other governmental offices this make it heavy traffic in most times in addition to present of old building that consider an important source of asbestos fibers in the air.

Table 1: Concentration of airborne asbestos fiber by area.

Area name	concentration(f/ml)ml)
Bayaa	0.097
Gadria	0.127
Meshen complex	0.142
Shurta tunnel	0.107
Average value	0.11825
WHOACGIH	0.00220.1

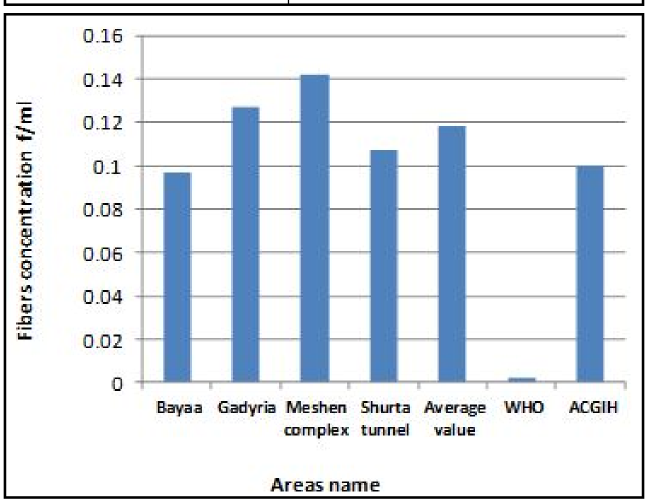

Fig. 2: Concentration of asbestos fibers in winter comparison with the WHO and ACGIH recommended standard.

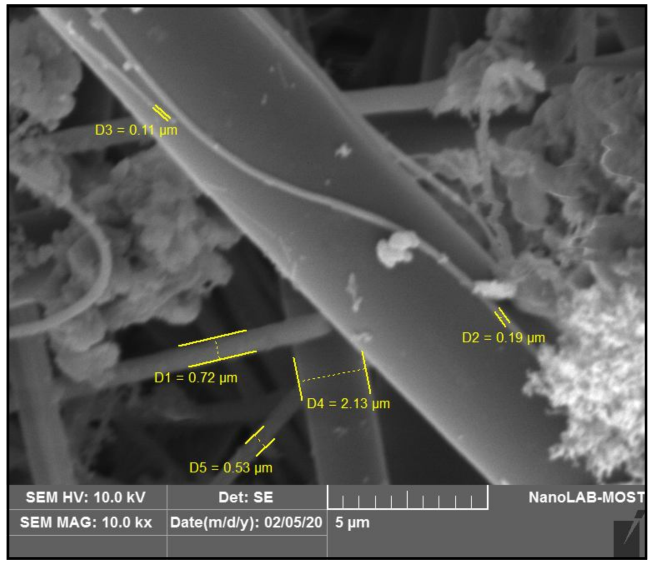

Fig. 3: Scanning electron microscope image showing asbestos fiber magnification 10,000×.

The others two studied areas, Al-Bayaa and Al-Shurta tunnel also recorded high level of asbestos fibers due to it is industrial areas and also characterized by high traffic.

Natural sources such as weathering and erosion are important causes for the increases concentration of asbestos in ambient air in Baghdad.

Correlation between Asbestos level and Meteorological Parameters

Weather parameters, such as speed of wind, temperatures and humidity were recorded for each sampling days. According to the results that gated from weather variables among the study period on the levels of airborne asbestos was revealed that increase of asbestos fibers with reduce temperature and relative humidity correlation between concentration of fibers of asbestos and meteorological parameters given in table 2.

Energy Dispersive X-Ray Spectrometry EDX Results

according to the results that obtained from energy dispersive x-ray spectrometry EDX analysis, The chemical composition of the asbestos fibers from the samples that collected from the fourth studied area consist

Table 2: Relation between metrological parameters in winter and level of asbestos.

Location name	level of asbestos f/ml	speed of winds m/s	Tempe-rature degree C°	Humidity RH %
Bayaa	0.097	2	13	44
Gadreyh	0.127	1.5	14	50
Meshen complex	0.142	2	12	61
Shurta tunnel	0.107	2.5	12	43

of several minerals such as magnesium Mg, and silica Si, which considers the main mineral in asbestos structure, from the results show that magnesium percent between 0.83% to 1.21%, while the percent of silica between 20.39% to 24.81%. Asbestos also contained other minerals such as calcium Ca, sodium Na, Aluminum Al, titanium Ti and others. Asbestos chemical composition shown in table 3 and Fig. 4, 5, 6 and 7.

Conclusion

According of the results of this research, in all of the sampling locations, the levels of asbestos fibers were not within the allowable standards that suggested by valid organizations, the results indicate that the levels of asbestos higher than the standards that recommended by the world health organization WHO and also greater than those reported for the environment of some other countries in the world.

The weather factors effect on the spread and the levels of asbestos fibers, through winter months and decrease temperature, increases the pressure where

Table 3: Chemical composition percent of asbestos fibers.

Area name Element	Al-Bayaa Wt%	Al-Gadyreh Wt%	Al-Shurta tunnel Wt%	Al-Mashin complex Wt%
C	17.71	13.86	18.75	24.16
O	38.30	41.39	37.50	36.16
Na	6.43	5.36	5.28	3.82
Mg	1.15	1.21	1.05	0.83
Al	2.58	2.41	2.00	2.08
Si	24.81	22.51	22.54	20.39
S	0.61	1.00	0.18	1.44
Cl	0.55	0.75	0.32	0.30
K	2.28	1.42	2.66	0.78
Ca	3.84	8.20	7.84	7.80
Ti	1.75	0.04	0.22	0.67
P	-	-	-	-
Fe	-	1.84	1.66	1.57
Total:	100.00	100.00	100	100.00

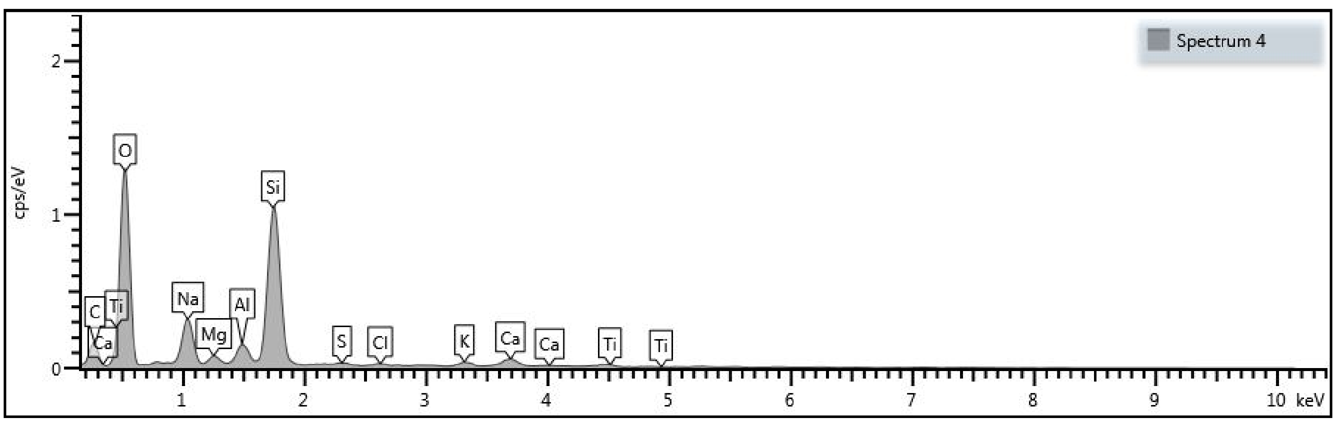

Fig. 4: EDS image of asbestos composition of Al- Bayaa air sample.

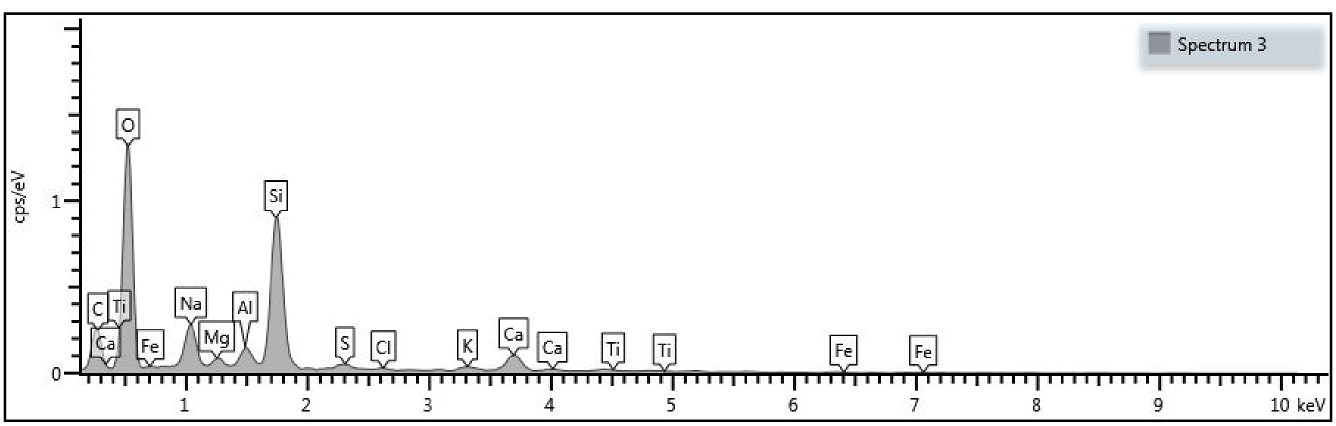

Fig. 5: EDS image of asbestos composition of Al- Gadreyh air sample.

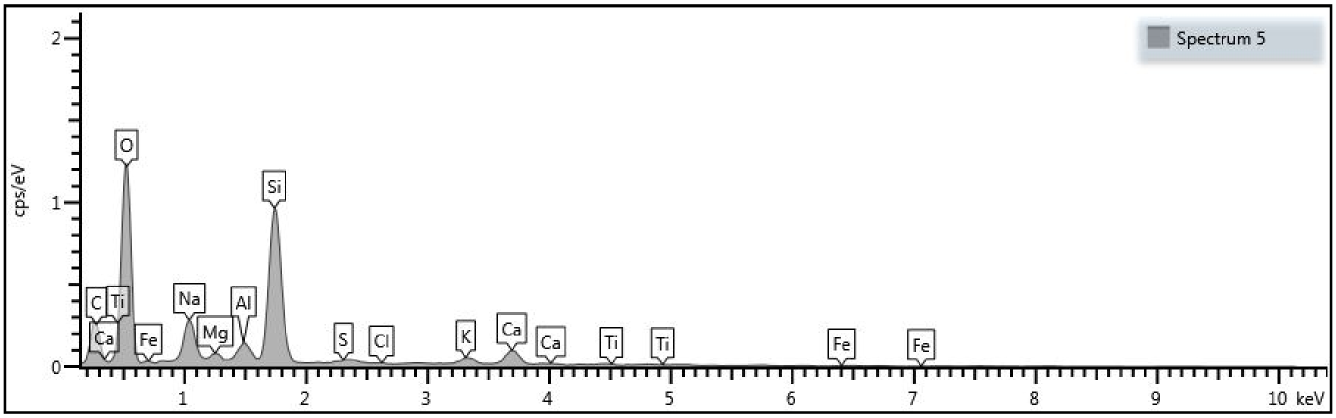

Fig. 6: EDS image of asbestos composition of Al-Shurta tunnel air sample.

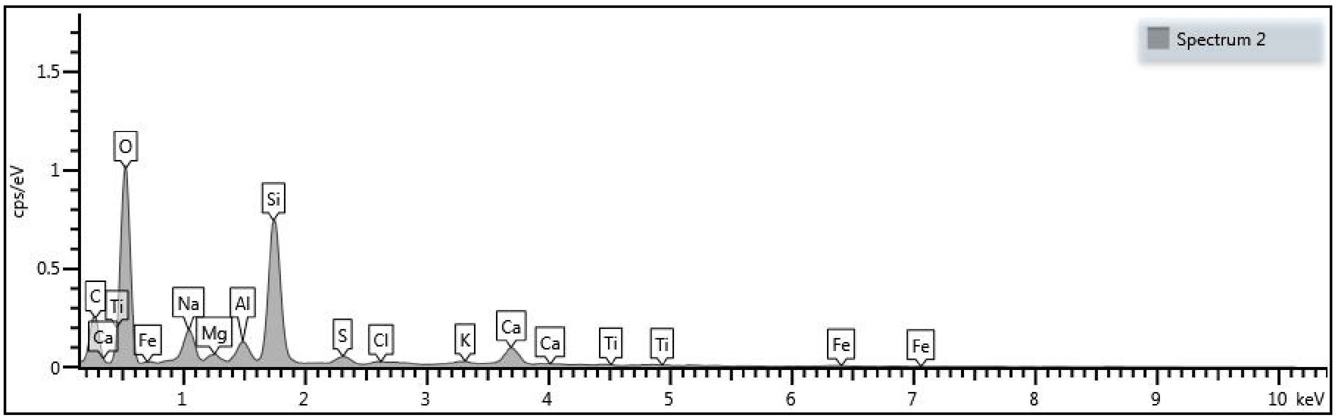

Fig. 7: EDS image of asbestos composition of Al-Meshin complex air sample.

inversely proportion and this high pressure system leads to a state of atmospheric stability and reduced wind speed and thus increase the concentration of pollutants near the surface of the earth such as asbestos, and on the contrary. During autumn as rising temperatures lead to the expansion of the air and decreasing pressure and increasing wind speed, which is working on the spread of these contaminants away from the surface of the earth and the sources of emission.

Also high level of asbestos in winter compare with autumn levels in previous study can be attributed to heavy traffic due to reopening of roads, universities, educational centers and others offices after temporary closed and stopped in autumn due to curfew and this led to reduce the heavy traffic.

Also increases levels of pollution with asbestos because the nature of these locations which considers as commercial and industrial specification and presence of industrial sources of asbestos in and around studied areas. Therefore, to minimize or eliminate asbestos emission most be replace asbestos fibers with other safe substances in products such as that present in clutch and brake pads, and management of traffic by reduce dense via preventing the entrance of heavy vehicles into the city at peak hours, increase green areas, transferring the industries that deal with asbestos fibers away city and with prevailing winds, all these performances can aid to reduce or even eliminate the asbestos fiber and other types of pollutants that emission to the air and help in improvement the beings health. Bans of asbestos fibers is remains the best way to getting rid of risks of asbestos fibers.

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