Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 5, No. 1, p. 300-305, 2014
http://www.innspub.net

RESEARCH PAPER OPEN ACCESS

Measuring the concentrations of heavy metals in dust in Ahvaz - Iran

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Article published on July 09, 2014

Key words: Heavy metals, Dust, Ahvaz, Natural Hazard.

Abstract

Ahvaz, Khuzestan province, some years with the greatest natural hazard faces the arrival of the dust of Iraq, Saudi Arabia and etc causing damage to numerous economic, social, and farmers. The purpose of this study is the analysis of heavy elements in its destructive effects on people's health Dust and Ahwaz and diseases caused by these elements. In this study, four samples from different locations in Ahvaz Dust a total weight of 100 grams and the use of satellite imagery and topographic and geological maps 1:50,000 Scale were used as materials. Identify key elements in fine dust and heavier elements compared to the standard rate of each method were used as the basis of charts and curves. The result was that the heavy elements Dust Ahwaz including manganese, nickel, chromium, copper, cadmium, lead, cobalt, nickel and lead are the most relevant elements that they will show twice the standard rate.

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Introduction

As one of the main centres of the population of our country, the metropolis Ahwaz has faced the greatest environmental hazard i.e. dust, during recent years, and this process has had some destructive effects on people's activities and health.

One of the important environmental hazards of the present time is dust which has natural and human causes. Entering from Iraq, Arabia, Kuwait, Jordan, and Syria, this phenomenon has been intensified in southwest of Iran and has caused many economic, social, and agricultural damages. Scholars of Natural Sciences state that the reasons of destruction of the region's ecosystem and dust movements include climatic changes such as drought, low precipitation, humidity and elimination of vegetation, manipulation in underground and surface water resources, the occurrence of the Imposed War as well as the presence of foreign troops in Iraq.

Wilkerson studied the regions that produced dust in south and west of Iran between1984_1988. He identified 14 individual sources of dust storms in the region, out of which 9 are located in Iraq (Wilkerson, 1991).

Arimoto considers dust as a kind of reaction to the change of earth vegetation which in this case, the role of human activities is of interest (Arimoto, 2000).

Goudie considers Sahara desert as the most contributing desert in producing dust in the world (Goudie *et al*., 2001, 179).

A study conducted in Seoul University, South Korea, in 2003 shows that lead concentration during Asian Dust can be one of the most important sources of coastal components (Al, Mg, Ca, Ti, Fe) in fine particles, and the ratio of fine particles to large particles increases significantly during Asian Dust phenomenon (Kim *et al*., 2003)

The dust that enters Iran can cause diseases such as chronic and severe headaches, severe allergies, and weakness in eyesight as well as respiratory and skin diseases (Analytical News Agency of Iran and the World's Oil, January 1, 2007).

The composition of the dust is actually that of the main body of which it has been produced. Dust may either have a mineral origin or result from breakup and decomposition of mineral stones and rocks or have an organic origin (Ghorbani, 2008). Dust may be either futile such as carbon, calcium and magnesium carbonates, cement, plaster, sandpaper, and iron dust, or toxic such as silica, asbestos, silicates, coal, tungsten carbide, lead, cadmium, manganese, chromium and chromates, arsenic, and other metallic compounds, insecticides, radioactive dust, organic dust, and dust resulting from cotton, sugarcane, alfalfa, and cereals.

The results of Zarasvandi and Mokhtari's study on dust samples from Ahwaz and the soils of Iran-Iraq boundary shows the existence of elements such as uranium, thorium, arsenic, lead, zinc, nickel, and cobalt, which their amount is slightly more than the natural allowed amount (Zarasvandi *et al.,* 2008).

Ghorbani considers dust containing arsenic, lead, silica, and silicates, and dust resulting from radioactive, metallic compounds, and organic materials, as toxic dust (Ghorbani, 2008).

During the presence of dust, referral of pulmonary patients to Ahwaz clinics has increased by 70%.Mosnadipour (Bita) mentions the existence of alkaline earth metals, silica, carbon, calcium, and potassium in dust entering Iran, which can have adverse effects on respiratory tract (cited by Moalemi, 2009, 5).

Karimi studied the environmental effects of suspended particles and air dust, and concluded that if Air Quality Index (AQI) is between 301 to 500, it is among the hazardous indices, and all people should

avoid having outdoor activities, specially that patients and the elderly should not go out of their home (Karimi *et al.*, 2010).

Abbasi *et al.* (2011) studied dispersion, morphology, and activities of sand dunes of Khuzestan Province.
Effati investigated the physical and chemical properties of surface soil particles of Hoor al-Azim swamp and concluded that soil texture is mostly made up of clay and silt (Effati *et al.*, 2011).

While studying the mineralogical and morphological composition of particles which form dust phenomenon in Khuzestan Province, and using XRD analyses and SEM images, Zarasvandi found 3 mineral groups: carbonate group, silicate group, and clay group and gypsum. Also, the average size of these particles is between 2 to 44 μm (Zarasvandi *et al.*, 2011).
Hosseini Nezhad Rahi *et al.* studied the effect of dust particles on qualitative and quantitative trend of sugarcane growth in southern part of Khuzestan and concluded that these particles have adverse effects on sugarcane photosynthesis in a way that they can affect the factors influencing the production of sugar out of sugarcane through reducing photosynthesis rate because of the dust residing on leaves' surface and consequently reducing oxygen and carbon dioxide exchange (Hosseini Nezhad Rahi *et al.*, 2011).

Jalali, the head of the Research Department of Soil Conservation and Watershed in the Faculty of Soil and Watershed, states in the 6th annual conference of sciences in Ahwaz University that dust pollution which is formed in Iraq contains uranium (Jalali, 2011).

Northern and western parts of China encounter heavy sand and dust storms in late Winter and early Spring, which damages millions of tons of surface soil. These storms that are developed in Gobi and Taklemakan deserts, transfer pollutants such as argon and industrial metals such as copper, cadmium, and lead, to the west and Korea and Japan (Zare *et al.*, 2011).

Zaleghi considered the analysis of dust particles and their health effects on the residents of Khuzestan Province and concluded that toxic metals, mercury, nickel, vanadium, arsenic, and zinc have the most serious dangers to people's health (Zaleghi *et al.*, 2012).

The purpose of this study is to analyze and investigate heavy elements which form dust and to determine diseases and their negative effects on people's health in Ahwaz. with regard to the phenomenon of dust in recent years, the aim of this research, study of heavy metals concentration in the dust of the city of Ahvaz and its effect on human health and the concentration of heavy elements with international standards

Materials and methods

- Collection of four samples of dust from different locations in Ahwaz with the total weight of 100 grams, by the author

-Topographical maps with $\frac{1}{50000}$, $\frac{1}{250000}$, and $\frac{1}{100000}$ scales, the Geographical Organization

-Geological map with $\frac{1}{50000}$ and $\frac{1}{250000}$ scales, the Geology Organization

-Aerial photos with $\frac{1}{550000}$ scale and Landsat and NASA satellite images, 2003, Ahwaz

Data analysis method

-Satellite images were considered visually and using topographical and geological maps of Ahwaz sheet with 1:50000 scale in order to identify the morphology of the materials of the formations in the studied region.

-In order to identify heavy elements of dust, atomic absorption method was applied on four samples of dust in the Soil Laboratory.

-Using diagrams and curves so as to have an accurate interpretation and comparison of the obtained elements with the standard elements (Figs. 2 and 3)

Results and discussion

Concentrations of heavy metals and compared with international standards

The studied zone is located between 31 degrees and 25-31 minutes north latitude and 30-48 and 48-50 degrees east longitude (Fig. 1). Ahwaz is located in a plain place and in the provincial capital of Khuzestan Province. This city is situated on the surface of young tertiary sediments and has 18 meters height from the sea level (topographical map of Geographical Organization, Ahwaz sheet).

Dust analysis was conducted on four samples of sediments with 100 grams weight in Soil Laboratory of Khorasan Science and Technology Park. The author collected these samples from 22 Bahman St. in Golestan, the campus of Oil University of Ahwaz in Koot-e Abd Allah, the floor of several parking lots in Esfahan St. of Golestan, and the dust remaining on automobiles around Kargar Sq. in Ahwaz, in dusty days on January 9, 2013, January 8, 2013, March 5, 2013, March 1, 2013, and February 20, 2013. The samples were then analyzed. Since XRF method was not suitable for specifying these elements, atomic absorption method was used to obtain more accurate results.

Table 1. Standard concentration amount of heavy metals.

Elements	Mn	Ni	Cr	Co	Pb	As
	Manganese	Nickel	Chromium	Cobalt	Lead	Arsenic
Standard	600	25	50	8	15	5

If concentration of any of these heavy elements is higher than the standard amount, it will cause disease symptoms to appear as follows:

- Nickel causes allergy, skin inflammation, and nose and lung cancers.
- Copper causes depression and eye inflammation.
- Cadmium causes cramp, diarrheal, kidney diseases, and prostate cancer.
- Cobalt causes asthma, pneumonia, visual impairment, heart diseases, and damage to thyroid, vomiting, and nausea.
- Lead can damage children's brain.
- By being solved in water, chromium poisons people.
- In addition to poisoning, Arsenic in drinking water causes general weaknesses in muscles, bronchitis, gangrene, and nausea.
- Manganese causes Parkinson disease (infection and disorder in hands and fingers movement)
- Lead causes toxic encephalitis, kidney failure, damage to the function of male reproductive system, women's fertility decline, and anaemia. It also causes behavioural problems and mental retardation.

Though not fatal, these diseases harm the suffering person for months, years, or even to the end of his/her life, and lead to disability and sickness.

Conducted studies show that cadmium, lead, mercury, arsenic, and some products of uranium will have detrimental physiological effects even in their small amounts (Mills, 1996, cited by Biabangard *et al.*, 2011).

Heavy metals concentrations in Ahwaz dust

In the following figure, these diseases from left to right include the elements of manganese, nickel, chromium, cobalt, lead, and arsenic. Among these elements, only allergy, skin inflammation, and nose and lung cancers (for nickel, Ni), and toxic encephalitis, fertility decline, and increase of anaemia (for lead, Pb) pertain to Ahwaz city.

Table 2. Concentration amount of heavy metals (ppm) obtained from dust samples in Ahvaz

No.	Sample	Amount	No.	Sample	Amount
1	Manganese	421.750	5	Cadmium	1.55
2	Nickel	55.306	6	Cobalt	Trace
3	Chromium	36.386	7	Lead	27.2
4	Copper	26.200	8	Arsenic	ND

Among the heavy metals, manganese has the highest amount (421.750 ppm), and cadmium (1.55 ppm) and cobalt have the lowest amount.

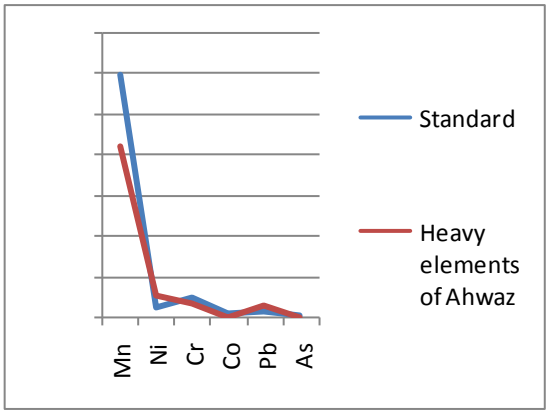

Fig. 1. Heavy metals standard and levels of heavy metals of dust samples in Ahvaz.

Comparison of the two diagrams of standard amount and heavy elements obtained from dust samples in Ahwaz shows that nickel and lead have the highest amount among others.

Although the amount of manganese is higher than other dust elements, it is lower than the standard amount, and cobalt is also very low. Arsenic and mercury elements are not observed.

Fortunately, in the studied samples, arsenic and mercury elements are not observed and cobalt is low (1.55 ppm). Elements such as copper, nickel, and chromium are among the most dangerous heavy elements which can seriously damage people's health. Although manganese has the highest amount, i.e. 421.750 ppm, it is lower than the standard amount; however, this very amount can cause Parkinson disease.

Lead with 27.2 ppm is higher than the standard amount, which can damage children's brain. Nickel shows 55 ppm amount which is double the standard amount and can cause allergy, skin inflammation, and nose and lung cancers.

Since lead, cadmium, manganese, and chromium are observed among the heavy elements obtained from the above samples, dust in Ahwaz can be considered as toxic dust.

Conclusion

Heavy elements in dust in Ahwaz include manganese, nickel, chromium, copper, cadmium, lead, and cobalt, among nickel and lead are higher than the standard amount. Nickel and lead can endanger people's health, destroy agriculture, and make elites immigrate. Therefore, this dust is considered among toxic pollutants which are detrimental to people's health and can bring disease symptoms and consequences.

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