Study the Lead contamination in groundwater and plant samples using extraction method and Atomic AbsorptionSpectrometer

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Abstract

Lead is a neurotoxic heavy metal that may accumulate in our bodies and can harm some organs in the human body. The present work was under taken to show the different sources of Pb in the environment and study the distribution of Pb in underground water and plant samples. In this work, underground water and plant samples were collected from different regions at Sabha city, Libyia. The Pb in collected underground water samples is extracted using strong cation exchange resin and eluted with nitric acid, then determined by atomic absorption spectrophotometer. Plant samples were washed and dried then digested using nitric acid (HNO3) and Pb determined as usual. The data of study showed that, the range of Pb in underground waters is 1.739 to 2.745 µg/l with regional average 2.152 ± 0.412µg/l which lie below the maximum acceptable level (10 µg/l) .However, the level of Pb in plant samples are varied between a high value of (42.75 µg/gm) and a low value of (13.61 µg/gm) at locations IV and I ,respectively. The source of Pb in underground water are pollutants added to the groundwater system through human and natural processes corrosion of plumbing pipes, while for plant samples was the atmospheric deposition of Pb from vehicles and pesticides. The data were treatment using statistical analysis for the pb results in water and plant samples.

Keywords: Copper, Anthropogenic, Heavy metal, Ion regulation.

Introduction

Ground water is the vital resource, necessary for all aspects of human and ecosystem survival and health. Depending on the quality, ground water may be used for human consumption, irrigation purposes and livestock. Beside the normal changes in the aquatic environment due to metals, lead has its own characteristics. The chemical properties of lead make it a useful material, so it is used widely in pipes, batteries, paints, ceramic pots, dishware which can leach lead into foods, food packaging-poly ethylene plastic bags, candy packaging, steel industry, fungicides (e.g. lead arsenate). Tetra ethyl lead is used as a petrol additive as anti-knock agent, mining industries especially the galeno ore (PbS) which has been the most important source of lead to the environment On the other hand. scientific research papers showed that lead concentrations in water affect on the fish where it accumulates in the blood and tissues. Also, the study indicated organ– specific distribution, with high levels in the blood followed by kidney, gill, liver, brain and comparatively lower amounts in muscles. Mayo studied the effect of Pb on the growth rate of micro organisms in the effluent samples, where the data indicated that the presence of Pb inhibits the activity of microorganisms as shown by Biological Oxygen Demand (BOD) values. Furthermore,the study of awad indicated that the total concentrations of Pb in the outflow effluents are greater than those in the inflow water at Suez oil processing company in Egypt. Further, the fractionation of Pb clearly showed that the mean content of dissolved Pb (160.7 mg/l) is lower than of particulate Pb (421.2mg/l). Such increase in content of particulate Pb is mostly due to the discharge of the wastewater of coal carbonization sector of that company lead has numerous acute and chronic adverse effects on human beings especially for infants and children. The use of Pb based paints, in houses, garages, barns, on fences and furniture, can damage the intellectual functioning at even lower Pb levels. Furthermore, lead affects practically all system with in the body, the high level (80µg/l) can cause convulsions, because adverse health effects on the central nervous system, kidney, and blood cells. The effects of Pb exposure on young children can be severe. They include delays in physical and mental development, shortened

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attention spans, and increased behavioral problems .Pb can be taken up by some crops; roots usually contain more Pb than stems, leaves and fruits. However, surface contamination by Pb in soil is considered a greater problem. Soil and rock layers naturally filter the ground water to a high degree of clarity before the treatment plant. Such water may emerge as springs, artesian springs, or may be extracted from boreholes or wells. Deep ground water is generally of very high bacteriological quality (i.e., pathogenic bacteria or the pathogenic protozoa are typically absent), but the water typically is rich in dissolved solids, especially carbonates and sulfates of calcium and magnesium. Depending on the strata through which the water has flowed, other ions may also be present including chloride, and bicarbonate. The present study was conducted to investigate the different sources of Pb in the underground water at Sebhe region-Libya and evaluate the levels of Pb in underground water, and plant samples. Also some recommendations will be given to reduce the toxicity of lead.

Materials and method

Water samples: These were collected from underground water in clean plastic bottlesusing water sampler from the following locations I ,II ,III ,VI ,V ,IV which represent, Faculty of science , Faculty of agriculture , EL – Mahdi , Oqba school , El- Qala hotel, Africa hotel respectively, and preserved using (2N HNO3).

Standard metal solution

Aqueous solutions containing Pb+2, (1000µgL-1) were prepared from Lead nitrate (Aldrich) in double distilled water.

Extraction method: The Pb+2 was extracted usingstrong cation exchange resin (Amber jet 1200H) after adjusting pH 4-7,then made elution with nitric acid, and finally determined by atomic absorption spectrometry (6-7), Analytik JenaA (07745 Jena) Germany(Figure 1 & 2).

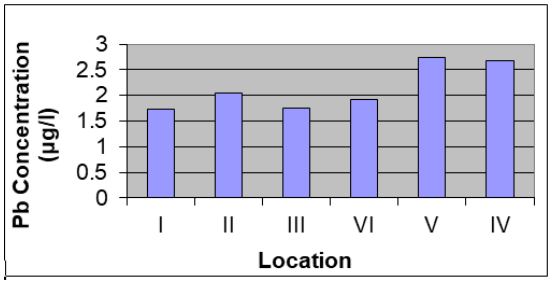

Figure 1. Regional variation of Pb concentration in under ground water (µg/l) at sebha city.

Plant samples

plant samples: Dodonaea Viscosa were collected from different sites atSebhaCity- Libyia from the following locations I, II, III, VI, V, IV which represent,Faculty of science , Faculty of agriculture , El–Sonia ,Oqba school , El–Qalae hotel , Africa hotels respectively. These were washed with de- ionized water and oven dried at 150˚C to constant weight. The dried samples were digested using nitric acid (HNO3).The extracts were analyzed Pb+2 using the atomic absorption spectrophotometer (6-7).

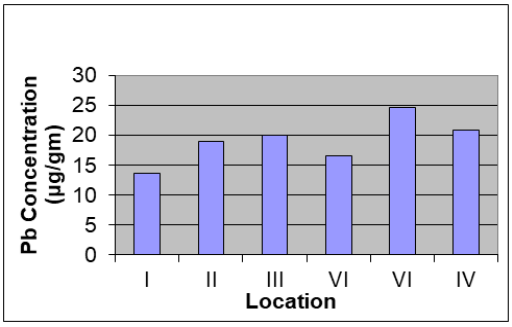

Figure 2. Regional variation of Pb Concentration in plant (µg/gm) at sebha city.

Results and Discussion

Water: It was reported that Pb is the most important metallic pollutant in the atmosphere(7), and explained the highest concentration at the surface water of the oceans and seas (0.015 ppm).On the other hand, the lowest Pb concentration was recorded at the bottom water samples of the ocean (0.001 ppm). (8) This may be due to the fall out of the atmospheric Pb to the surface of water. While, the level of Pb in fresh water is (0.20 mg/l) of high content compared to saline water (0.001-0.015mg/l)This is mainly attributed to the human activities as the result of exhaust fumes of motor vehicles which contain lead gasoline.

Concentrations of Pb in the collected samples of underground water at Sebha region are presented in Table (1) and Figure (1). Lead contents are varied highest at location V (2.745 µg/l) to lowest at location I (1.739 µg/l) with regional average (2.15 ± 0.41µg/l). The high concentration of Pb may be related to the leaching of Pb from old plumbing pipes. The corrosion of such materials will lead to the increased concentration of lead in municipal drinking (8). Furthermore, the wind may carry the air pollutants to sites far from the region of its production (9). Residential areas far from the industrial areas too, since water table constantly shifts underground carrying the contaminants with them. On the whole, all concentration of Pb recorded at different sites lie below the maximum acceptable levels of Pb (10 µg/l).

On the other hand, the level of Pb in drinking water was examined in Germany, through 1434 stagnation samples, 3.1% had Pb concentrations greater than 0.01 mg/l (maximum acceptable level of Pb) and 0.6% had concentrations above 0.04 mg/l. The intake of Pb through drinking water is commonly due to the metal corrosion of Lead pipes; where Pb can be leached into the water after prolonged contact (10).

Plant as a bio indicator is an organism or biological response

that reveals the presence of the pollutants by the accurance of typical symptoms or measurable responses, and is therefore more qualitative (11). These organisms (or communities of organisms) deliver information on alterations in the environment or the quantity of environmental pollutants by changing in one of the following ways: physiologically, chemically or behaviorally. There are several types of bio indicator The presence or absence of certain plant or other vegetative life in an ecosystem can provide important clues about the health of the environment. There are several types of plant can be used as bio monitors, including mosses, lichens, tree bark, bark pockets, tree rings, leaves, and fungi .The plant samples were collected from different locations at Sebha City. The Pb data are represented graphically in Figure (2). It can be concluded that the concentration of Pb in plant samples are varied from the high value of (24.75 µg/gm) at location V to the low value of (13.61 µg/gm) at location I. This is most probably attributed to the exhaust emission from leaded petrol driven vehicles which not only polluted the air, but settled on soil and plants. Also, the relatively higher values of Pb reported at locations III and V are mainly related to high dense traffic of vehicles at these regions. The statistical analysis of data for Pb in water and plant indicated that, the correlation coefficient ($r = 0.5$), ($p<0.05$) between Pb in plant and water is not significant. This showed that, the main source ofPb is atmospheric deposition of Pb from vehicles and not from water used to irrigate it (11) (Table 1& 2).

Table 1. The level of Pb concentration in underground water at Sebha city.

Locations	I	II	III	VI	V	IV	Average
Pb Conc. µg/ gm	13.61	18.93	19.99	16.62	24.75	20.86	19.13 ± 3.8

Table 2. The variation of Pb contents in plant at Sebha City.

Conclusion

Drinking water and plant samples were collected from different locations at Sebha city to analyze the Pblevels. The data obtained indicated that the highest level of Pb in drinking water was recorded at location V. similarly; the maximum concentration of Pb in plant samples was reported at location V and IV. The high level Pb in drinking water is mainly related to the erosion of rocks in aquifer and lead-based paint as well as, corrosion of pipes lines, while, high value of Pb in plant samples is attributed to atmospheric deposition of Pb which emitted in motor vehicle exhaust.

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