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Heavy Metals Concentrations in Some Roadsides with Different Traffic Volumes in Rasht City-Iran

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Abstract

Concerns around the usage of motor vehicle emissions on human health issues are especially concentrated on aerial pollution and are regulated via controls on tailpipe emissions. Toxic heavy metals are mentioned as a variety of important environmental contaminants cause of their none-degraded or none-destroyed properties. In this study, we investigated the pollution of heavy metal of pointed locations in the roadside dust in Rasht province (center of Guilan province in Iran northern). In this study, we have tried to considerate to road dust aspects in roadside soils of two distinct points: along road with dense traffic (20 street, high traffic volume) and road with lower traffic, a local road (20 street, low traffic volume). Samples of road dust (20 in general) were gathered under stable weather conditions during June and July of 2020. Samples of road dust were collected and analyzed for their variety of lead (Pb), Zinc (Zn), Nickel (Ni), Cobalt (Co) and Cadmium (Cd) concentrations by ICP-OES. The results have demonstrated that all heavy metal amounts except Cd, are higher than acceptable values in the target soils. Tend to illnesses, especially carcinogenic effects affected by these toxic metals are predictable.

Keywords: Heavy metals; Roadside; Rasht, Toxic; Health

Introduction

Changing the life style and using the machinery gadgets are being varied daily. The main value of the heavy metals are toxic to the living organism and even those considered as essential could be toxic if present in excess. The heavy metals can follow significant biochemical process posing a threat to human health, plant growth and animal life. [1-7]. Accumulation of metals in soil could affect the ecosystem safety and pose a threat to animals, plants, and human. High concentrations of metals in the plant could inhibit the ability of the plant to produce chlorophyll, increase the plant oxidative stress and weaken stomata resistance. Roads, plastics, industrial effluents, and sewage have polluted and occurred many issues for vegetation, animals, and humans [8-25]. One of the most pointed chemical contaminants is heavy metals, causing irreparable damage [26]. Human activity increases the level of heavy metals pollution in the nature [27]. Because these compounds are not metabolized in the body, they could be stored in body tissues such as muscles and bones. Heavy metals have the potential to cause illnesses such as mental retardation, hearing impairment, immune system dysfunction, brain diseases, blindness, muscle weakness, and cancer [28,29]. Roads are usually rich in Pb, Zn and copper [30-32].

The pollution of soils by heavy metals from automobile

source is a serious worldwide environmental issue. These metals are released during different operations of the road transport such as combustion, component wear, fluid leakage and corrosion of metals. Lead, cadmium, copper and zinc are the major metal pollutants of the roadside environments and are released from burning of fuel, wearing out of tyres, leakage of oils, and corrosion of batteries and metallic parts such as radiators etc. The presence of these metals on the road is usually due to leaded gasoline, tire wear, corrosion of roadside safety fences, and wear of brake linings [33,34]. Also, the source of Ni and chromium in road dust is probably due to corrosion of vehicular parts. Moreover, heavy metals can enter the environment through natural paths, such as mineral erosion, wind, river, groundwater, and volcanic activities where all the items are connected each other. Malkoc (2010) did the research on the levels of heavy metal pollution in roadside soils of Eskisehir, Turkey. Fifteen soil samples were taken from three different lines: only - tramway lines, only - traffic lines, and both traffic and tramway lines and analysed for different heavy metals viz., Cd, Cu, Cr, Fe, Hg, Mn, Ni, Pb, and Zn. The level of pollution in soil was estimated based on the geoaccumulation index (Igeo), enrichment factor (EF), pollution index and integrated pollution index (IPI). The values of the integrated pollution index (IPI) were found to be in the order of Pb > Zn > Cu > Fe > Mn > Ni > Cr > Cd [34-40]. In this research, the concentrations of heavy metals such as lead (Pb), Zinc (Zn), Nickle (Ni), Cobalt (Co), and Cadmium (Cd) in road in Rasht province areas (Iran northern) were studied using inductively coupled plasma atomic emission spectroscopy (ICP-OES).

Experimental

Study Area

Rasht city center was the place for selecting the samples. All samples were randomly selected from several points, where mainly the vehicles running on these roads use gasoline and diesel engines which were or target. A mass of people traveling daily on these roads are subjected to its dusty environment to introduce as a point.

Measurements and Characterization

A PerkinElmer (Shelton, CT, USA) Optima 3300 DV ICP-OES instrument was used for determinations.

Preparation of Samples

Totally, we have tried prepare samples according to routine methods which were used in literatures. At each of these points, dust samples were collected within 0.5 m distance from the edge of the pavement. These surface soil samples were taken from the top (0-2) cm of soil. At each sampling point, three sub-samples were taken and then mixed to achieve a bulk sample. Such a sampling strategy was adopted in order to decrease the possibility of random effect of urban waste not obviously visible. Samples were placed in plastic bags, labeled by attention, and taken to the laboratories for further processes. Soil samples were digested with HCl, NHO3, and H2O2 according to U. S. EPA 3050B method and prepared for results [35-39].

Results and Discussion

The results of heavy metals from the samples are given in (Tables 1 & 2). The results have shown that all heavy metal amounts except Cd, are higher than reasonable values in natural soils which were investigated. The average concentration of Pb was 822.1 mg/kg. Pb is remarkably affected by car exhaust and vehicle emissions, eg tire wear, bearing wear. This high concentration of lead mostly is due to the non-standard gasoline applications. The average concentration of Zn was 712.2 mg/kg, which is due to the application of Zn compounds as antioxidants and as detergent/dispersants improving agents for motor oil in the car and machinery industries. We express that the source of Ni in street dust is cause of the corrosion of vehicular parts or related industries. The high rate of corrosion and wear from old vehicles (due to the use of worn-out cars in Iran) plying these roads could have accounted for the significant levels of anthropogenic contributions of Ni in the road dust. The average street concentration of Co was 32.20 mg / kg, which was reasonable value.

Table 1: Mean concentration of metals (mg/kg) in street dust (dense traffic).

Heavy metal	Concentrations
Pb	822.1
Zn	712.2
Ni	99.9
Co	32.20
Cd	2.06

Table 2: Mean concentration of metals (mg/kg) in street dust (lower traffic).

Heavy metal	Concentrations
Pb	329.4
Zn	270.2
Ni	21.29
Co	11.10
Cd	0.27

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The mean Cd concentration has been measured in the street 2.06 mg/kg. Cd is a relatively rare heavy metal, which occurs naturally in combination with other metals. Cd has been observed in road dust due to its presence in both automobile fuel and in soil. Prolonged exposure to Cd could affect some related organs with the kidney being the principal target where it is being researched as more in literatures every day. Because of the special climatic condition of Rasht, which is significantly rainy in the year, there is a concern that these toxic heavy metals will enter the surface water or groundwater which are usable in different applications and have daily usages. In northern Iran, natural products and farm harvestings are also irrigated from surface and groundwater, increasing the concerns that these metals may enter the food chain or play some dependable roles in the health tips of the people in this area [40-42].

Conclusions

Generally, the average concentration of some heavy metals in roadside soils of Rasht province area (northern Iran) was measured and compared by attention. The results have showed that the amounts of studied heavy metals are high in some areas and threaten the health of all organisms especially the neighbourhoods. Cause of the rapidly increasing population of Rasht city, the pollution rate along this roads is expected to increase in the coming years. Some protective measures such as the use of public transportation, conversion of liquid fossil fuel to gaseous fuel or other clean energies, having more green landscapes as well as storing the natural sources and assessing the pollution centers to control and better managements are suggested to combat this problem.

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