Analysis of heavy metals contamination in urban dust

Literatur

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Review

2. 1REVIEW OF REPORTED STUDIES

2. 1. 1 Assessment of Heavy Metal in Street Dust in Kathmandu Metropolitan City and their Possible Impacts on the Environment.

Chirika S. T. & Pawan R. S. [9] conducted a study in 2011 to determine the levels of heavy metals in street dust at different localities in the Metropolitan City of Kathmandu, Nepal. A total of 20 street dust samples were collected from four sampling sites such as mechanical workshops, motor parks, market areas and residential areas as well as dust were collected from sites which were not affected by traffic.

The collected samples were digested using aqua regia through microwave digestion and heavy metals were determined using a SOLAAR M5 Dual Automizer Atomic Absorption Spectrophotometer. The mean concentration of level of lead and nickel were 80. 3 and 52. 9 µg/g. However, the highest lead concentration was 116. 8 µg/g at the mechanical workshop, which were directly associated with the emissions from vehicles exhaust since vehicles were still using leaded gasoline although it was banned in Nepal.

2. 1. 2 Multivariate analysis of heavy metals contamination in urban dust of Xi’an, Central China

For this study undertaken in 2005, Yongming H. *et al.* [23] collected sixty-five samples of urban dust in Xi'an. The aim of this study was to determine the level of heavy metals such as Pb, Cr, Ag, Hg, Mn, Sb, Zn, Cu and As, as well as to identity their natural sources. Xi'an was selected for this study since it was the central city consisting of heavy metals industries, textile industries and chemical industries. The collected samples were digested using HF, HNO_3, H_2SO_4 and $HClO_4$. The determination of heavy metals such as Cu, Pb, Zn, Cr, Ag and Mn where carried out using Vario 6 atomic absorption spectrophotometer whereas Hg, As and Sb were analyzed by cold vapor atomic spectrometry.

The highest mean concentration was found to be of lead, Zinc, Manganese and Chromium which were 230. 5, 421. 3, 687 and 167. 3 µg/g respectively. It was concluded that the high concentration originate mainly from industrial sources as well as traffic sources. Further, the high concentration of Mn was found to originate from soil sources which were considered to be a mixture of natural and anthropogenic sources.

2. 1. 3Determination of Heavy Metals content in Soils and Indoor Dusts From nurseries in Dungun, Terengganu

Tahir M. N. *et al.* [22] determined the concentrations of certain heavy metals such as Al, Fe, Pb, Zn, Cd, Mn and Cu, in indoor dusts and outdoor soils from nurseries located in industrial, town and village area found in Dungun district, which was one of the coastal towns located in Malaysia. For this study carried out in 2007, eighteen sampling sites where chosen which were nursery schools. The sampling sites were divided into three groups: the first group was at the center of the town and near heavily frequented urban traffic routes; the second group selected was found in the south region of the town and was considered as industrial area. This region had high density of petroleum chemical industry, power plant and main roads with heavy traffic loads. The Third group was village, situated at the edge of the urban area which was a quiet residential district with low volume of traffic and negligible industry.

The collected samples were then digested and heavy metals concentrations in both soils and dust indoors were determined using atomic absorption spectrometer (FS 220A VARIAN). The range of metal observed were 46. 9 µg/g for Cu, 338 µg/g for Mn, 4. 66 µg/g for Cd, 130 µg/g for Zn, 91. 7 µg/g for Pb and 114000 µg/g for Al. However, from the result obtained, it was found that the village areas had higher level of toxic metals compared to both town and industrial areas for outdoor soils. On the other hand, industrial areas had exhibited higher mean concentration of Cu, Mn, Fe, Pb and Zn in their indoor dusts which originated from infiltration of outdoor particles, dust, soils, internal ventilation system, cooking smoke, old paint and furniture materials.

In general, results obtained from this study showed that some nursery schools in Dungun had high levels of heavy metals content in soils and indoor dust. It was suggested that the major source of these heavy metals in soils was due to the road vehicular emission.

2. 1. 4 Metals Levels in Indoor and Outdoor Dust in Riyadh, Saudi Arabia

Al-Rajhi A. S. *et al* . [3] conducted a study to determine the concentration of heavy metals in outdoor and indoor dusts in Riyadh, Saudi Arabia. In 1996 , outdoor dust samples were collected from 231 sites including various rural, suburban, and urban, motorway and two industrials sites and indoor samples were collected from 20 public community centres. The samples were digested using aqua regia and were then analyzed for heavy metals using atomic absorption spectrometer (Perkin-Elmer model 1100).

The mean concentration of indoor dust were 639 and 52. 9 µg/g respectively for lead and nickel and the outdoor dust concentrations for lead and nickel were 1762 and 43. 9 µg/g respectively. Among all these metals analyzed, lead had the highest concentrations. This was due to the use of leaded fuel, with levels being especially high near motorways as a result of high traffic density. However, it was observed that there was a decreased in lead levels in suburban and rural areas where automobile emissions were much less than in urban areas.

2. 1. 5 Investigation of Trace Heavy metal Concentrations in the Street Dust Samples Collected from Kayseri, Turkey

Divrikli U. *et al.* [12] investigated the levels of heavy metal ions of the street dusts from Kayseri, Turkey. A total of 77 street dust samples were collected during the period of April 2000 till June 2000 and control samples were collected from three hills outside Kayseri that were not affected by metal sources. After digestion with aqua regia, the samples were analyzed using flame atomic absorption spectrometry.

The range of concentrations of heavy metals was 84 -532 µg/g for lead and 49 -381 for nickel. It was observed that high levels of lead in dust were from combustion of gasoline. The highest concentration of lead (165. 5 µg/g) was observed around street carrying heavy traffic and the minimum concentration was 103. 3 µg/g which was from school garden.

For nickel, the source was from abrasion and corrosion of nickel containing parts of the vehicles in the traffic. The highest concentration was 57. 3 µg/g which was observed in heavy traffic.

2. 1. 6Lead Distribution in Near-Surface Soils of Two Florida Cities: Gainesville and Miami, USA

In 2004, Chirenje T. *et al.* [8] conducted a study to determine lead distribution in soil in two Florida urban areas, having different levels of industrial development and population. 240 samples were collected from three land-use classes: residential, commercial and public land. They were digested using USEPA method (hot plate digestion) and analyzed using graphite furnace AAS.

After analysis of the samples, it was found that the average concentration of lead in Gainesville was 16 mg/kg while 93 mg/kg was observed in Miami. Considering Gainesville, the lead concentration increased as follows: public parks (10 mg/kg), commercial areas (18 mg/kg), public buildings (20 mg/kg) and residential areas (23 mg/kg) whereas for Miami the increased was from: public buildings (77 mg/kg), public parks (79 mg/kg), residential (102 mg/kg) to commercial areas (120 mg/kg). Hence, the higher lead concentration was found in Miami, which was mainly due to the soil properties rather than just anthropogenic factors.

2. 1. 7 Heavy Metal Concentrations in Street and Leaf Deposited Dust in Anand City, India

Bhattacharya T. *et al.* [6] investigated the heavy metal concentrations in street and leaf deposited dust in Anand City, India in 2011 . Street dust samples and leaf deposited dust samples were collected from five major roadways selected on the basis of traffic load, population density and anthropogenic activities and analysis for Cu, Ni, Pb and Zn were carried out. The samples were digested and analyzed using AAS (Perkin Elmeyer model).

The mean metal concentration in street dust sample varied with sampling location. Lead concentration (105. 4 mg/kg) in dust samples was consistently high. The high Pb concentration was interpreted as resulting from the continued use of leaded gasoline on the outskirts of the city since some petrol stations were stilling selling unleaded petrol. In addition, Pb was also used in manufacture of pesticides, fertilizers, paints, dyes and batteries. Therefore industrial sources had also contributed to Pb levels from vehicle emission. The concentration of nickel in the street dusts ranged from (56. 9-75. 81 mg/kg). The main source of nickel in street dust was the combustion of diesel fuel. Unexpectedly, nickel content was relatively higher, compared to other metals, in the rural area suggesting that the extensive use of diesel in three wheelers, tractors and water pumps used for irrigation in rural areas was contributing the elevated level in dust.

2. 1. 8 Heavy Metal Concentration in Road Deposited Dust at Ketu-South District, Ghana

Addo M. A *et al.* [1] carried out a study in 2012 to determine the metal concentration in deposited dust along the road of Ketu-South District, Ghana. Fifty sampling sites were selected from popular roads that experiences intense traffic conditions within the district. The collected samples were allowed to dry for 10 days and were analyzed by X-ray Fluorescence Analysis.

The lowest metal concentration was: 0. 4 µg/g for As; 284 µg/g for Cr; 18. 4µg/g for Cu; 233 µg/g for Mn; 12. 3 for Ni; 3. 1 µg/g for Pb; and 18. 2 µg/g for Zn. It was noted in a roadway which runs through a host of rural communities. The maximum concentration of Cr (9106. 0 µg/g), Mn (1240. 0 µg/g), and Pb (67. 80 µg/g) were found in road soil samples collected from the roadway normally patronized by heavy trucks used in conveying cement products and raw materials to and from the cement factory. Therefore, much cement dusts were spread along the road as loaded cement trucks made use of the road. The source of Cu and Zn in the samples was indicated by research as tire abrasion, the corrosion of metallic parts of cars, lubricant and industrial.

2. 1. 9 Heavy Metal Determination in Household Dust from Ilorin City, Nigeria

Adekola F. A *et al.* [2] collected samples from 18 different locations in Ilorin, which was the capital of Nigeria, to determine the levels of lead, cadmium, nickel, copper and iron in indoor dusts. Sampling was done daily in the morning between the months June and September, 1998. The collected samples were digested and the concentrations of metals were determined using atomic absorption spectrophotometer (Pye Unicam Model 2900).

The mean metal concentration in dust sample varied with sampling location. The range of concentration of heavy metals was (2. 34 -10. 17) mg/kg for Pb, (0. 19 -1. 99) mg/kg for Cu, (0. 001 – 0. 38) mg/kg for Cd, (0. 006 -2. 19) mg/kg for Ni and (28. 6 -45. 4) mg/kg for Fe. The high levels of concentration of Pb, Ni and Fe were mostly likely originated from sources such as emission from automobiles and fall out from wall paint. Further, the important levels of Fe observed in all locations were due to the nature of the local soil and the intensity of human activities in the various localities.

2. 1. 10 Water-Soluble Species and Heavy Metals Contamination of The petroleum Refinery Area, Jordan

In 2002 , Momami A. K *et al.* [16] investigated the levels of Pb, Cd, Cu, Zn, Al, Cr and Fe in street dust, soil, and plants in the Jordanian petroleum refinery. Eighty- one street dust samples, coded D1-D18, were collected from different sites such as highway, housing area, manufacturing area, main gates, loading parking area, tanker loading area and major refining units. The collected samples were dried and digested using concentrated nitric acid. Heavy metals were then determined using a Thermo Jarrel Ash Flame Atomic Absorption spectrometer, (Model Smith-Hieftje 11, USA, with SH back-ground correction. For determination of low concentrations of heavy metals, a Graphite Furnace Atomic Absorption Spectrometer (GFAAS) was utilized.

The mean concentration of heavy metals obtained was as follows: Pb (77 µg/g), Cu (69 µg/g), Zn (178 µg/g), Fe (4510 µg/g), Cr (21 µg/g) and Cd (1. 38 µg/g). The highest levels of lead were observed in the housing area, streets between loading parking area, the road tanker loading area and at streets near the main gate of the refinery. The high lead contamination at the housing area and at the main gate was due to automobile exhaust emission since most automobiles passed through these sites. Also fuel leaks, spills, and exhaust emissions from tankers in the loading parking area and tanker loading area was responsible for lead contamination occurring at these sites.

Further, high concentrations of the other metals: Cu, Zn, Cd and Cr were commonly found in the manufacturing area, and around the major refining units. These findings indicated that materials used in manufacturing cylinders, major refining processes, leaks of oil product during loading of tankers, and motor vehicles were the primary sources of these heavy metals. Additionally, existence of CU in street dust was derived from engine wear of automobiles, while attrition of automobile tires and lubricating oils were possible sources of Zn and Cd.

2. 1. 11Soil Lead Pollution alongside Some Major Roads In Mauritius

In 2000 , Choong Kwet Yive N. S *et al.* [10] conducted a study to determine the lead levels in soil alongside main roads in Mauritius which were caused mainly by vehicular exhaust. Four Mauritian roads with different traffic densities were selected for sampling. The collected samples were digested using Milestone microwave digester and the lead determination was carried out using atomic absorption spectrometer (UNICAM 929).

The mean lead concentration in dust sample varied with sampling location. The highest lead concentration, 1938 µg/g, was found at Rd1, which was the major motorway having the highest traffic density. Further, it was also reported that the west side of Rd1 had a concentration of 786 µg/g compared to that on the east side (536 µg/g). This was due to the South-East Trade Wind which blows the lead particulate to the left side of the road. The low concentration of lead found was 12 µg/g, which was due to the dry weather and compact soil. It was concluded that the major sources of lead pollution in street dust was due to vehicular emission.

2. 1. 12 Monitoring of Pb and Ni in Street Dust Coming from Vandermeersch Street

Jhurry K. R. [15] conducted a study in street dust coming from Vandermeersch Street, to determine Pd and Ni concentration. Sixty- four dust samples were collected over a period of four months from August to November 2011. The collected samples were acid digested using microwave digester system and then analyzed using FAAS.

The mean concentration of heavy metals was 65. 4 ppm for lead and 208. 2 ppm for nickel. Further, it was also reported that the left side of the road had the highest metal concentration compared to that on the right side. This was due to the South-East Trade Wind, blowing the dust particulate toward the left. The high Ni concentration observed was due to traffic density. Considering the lead concentration, it has decrease considerably since there was a shift from leaded gasoline to unleaded one. Further, other factors affecting lead level from one place to another was seasonal behavior and human activities.

2. 1. 13 Lead and Nickel Levels near Vandermeersch Street.

Summoogum Y. P. [21] carried out a study to determine the lead and nickel levels in street dust at Vandermeersch Street, Mauritius. A total of 80 samples were collected from 8 different sampling sites over a period of five months from August to December 2012. The concentration of lead and nickel were determined using FAAS after digestion in acids using microwave digester.

The mean concentration of heavy metals obtained was 32. 6 ppm for lead and 52. 5 ppm for nickel. The concentration of nickel was explained by the increase in traffic volume, which was mainly due to abrasion and corrosion of vehicular parts. Moreover, it was seen that the left side of the road was more polluted than that of the right, showing the effect of the South-East Trade Wind which blow the dust particulate toward the west side of the road, causing accumulation. For lead, it was seen that there was significant decrease since the use of leaded gasoline was banned in September 2002 and unleaded gasoline was introduced all over the island.