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Assessment of Kermanshah Province Atmospheric DustContamination with Selected Heavy Metals Using Pollution IndexesDuring the Summer 2013

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Introduction: Atmospheric dust is an important source of heavy metals, particularly in urban environments. Heavy metals can easily attach to dust particles and be distributed in large areas. Therefore, assessing the extent of heavy metals pollution present in nuisance dust is important for establishing pollution control strategies and evaluating the results of previous measurements. Heavy metals contamination in atmospheric dust of Kermanshah provinehas not been previously investigated. The main objective of this initial study was to determine the concentrations of heavy metals in atmospheric dust samples that were collected from Kermanshah province and to assess their contamination level. The results can provide a baseline for use in future environmental impact assessments and to guide pollution mitigation targets.

Materials and Methods: Dust samples were collected from 49 sites across the province, during the summer 2013. Dust sampling sites were selected in different urban (35 site)and suburban (14 site) locations in Kermanshah, Songhor, Gilangharb, Ghasre-Shirin, Sahneh, Sarpolzahab, Kangavar, Paveh and Javanrood cities. Dust collectors were installed on the roof of buildings about 3–4 m above the ground level. Each collection tray consisted of a circular plastic surface (320 mm in diameter, 120 mm depth) that was fixed on holders with 33 cm height and covered with a 2 mm PVC mesh on top to form a rough area for trapping saltant particles. The dust samples were analyzed for their Zn, Cu, Ni, Cr, Mn and Fe concentrations using an Atomic Absorption Spectrophotometer. In the present study, geo-accumulation index (I_{geo}), enrichment factor (EF), pollution index (PI) and integrated pollution index (IPI) were calculated to assess the heavy metal contamination level in the atmospheric dust.

Results and Discussion: The results showed that except for Fe and Mn, all heavy metal concentrations of atmospheric dust in Kermanshah provinewere higher than in the background soils of world, showing that these heavy metals are likely from anthropogenic sources. The order of mean I_{geo} values was Ni> Zn> Cu> Cr>Mn> Fe, similar to the order of their EFs and PIs, which can also be seen as the decreasing order of their overall contamination degrees inatmospheric dust ofKermanshah province. The mean I_{geo} for Ni points to moderately to strongly pollution. 59% of calculated $I_{geo}$for Ni falls into class 2 (moderately polluted) and 37% into class 3(moderately to strongly polluted), while according to the I_{geo}values for Mn (98%) and Fe (100%), they were practically unpolluted (class 0). The maximum EFs of Zn, Cu and Ni were higher than 10, which show that Zn, Cu and Ni in atmospheric dusts mainly originate from anthropogenic sources. It seems that EFs can also be an effective tool to differentiate the natural origins from anthropogenic sources.The mean EF (11.2) and 94% of Ni EFs were in the range of 5–20 indicating that Ni was a maincontaminant in studied samples. Mn had 41% EFsless than 2 and 59% EFs in the range of 2–5, with mean EF less than 2, indicating minimal enrichment. The analytical results of heavy metals I_{geo} are same as the analytical results of EFs. The PIs of Zn, Cu and Ni were in the ranges of 2.1 to 11.3, 1.7 to 18.3 and 3.3 to 13.6, with an average of 3.8, 3.3 and 6.9, respectively. These data indicate that Zn, Cu and Ni may cause serious pollution in atmospheric dust of Kermanshah. The IPIs of atmospheric dust samples vary from 1.9 to 6.2 with mean value of 2.9, indicating that all studiedsamples were polluted by heavy metals.

Conclusion: The concentrations of heavy metals that were investigated in this studywere compared with the reported data of other cities and with the background values of elements in the world soils. The concentrations of Zn, Cu, Ni and Cr in urban dust samples, and Fe and Mn in suburban dust samples were higher than their respective values in the world soils. The results indicate that atmospheric dusts in Kermanshah provinhave elevated metal concentrations in general. The calculated values of I_{geo} and EF of heavy metals revealed the order

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of I_{geo} and EF as Ni> Zn> Cu> Cr>Mn> Fe. The high I_{geo} and EF for Ni, Zn and Cu in atmospheric dusts indicated that there was a considerable Ni, Zn and Cu pollution (Especially nickel), which possibly originate from traffic and industrial activities. The I_{geo} and EF of Mn and Fe were low. The results of PI also supported Zn, Cu and Ni serious pollution in atmospheric dust. Similarly, IPI resultsconfirmed atmospheric dust samples pollution by heavy metals. These findings indicated that more attention should be paid to heavy metal contamination of atmospheric dusts in Kermanshah, especially in case of Ni.

Keywords: Atmosphericdust,Contamination assessment, Heavy metals, Kermanshah

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