Application of Lead Isotopic Ratios and Multivariate Statistical Analysis in Source Apportionment with a Health Risk Assessment of Heavy Metals in the Street Dust Of Kolkata, India

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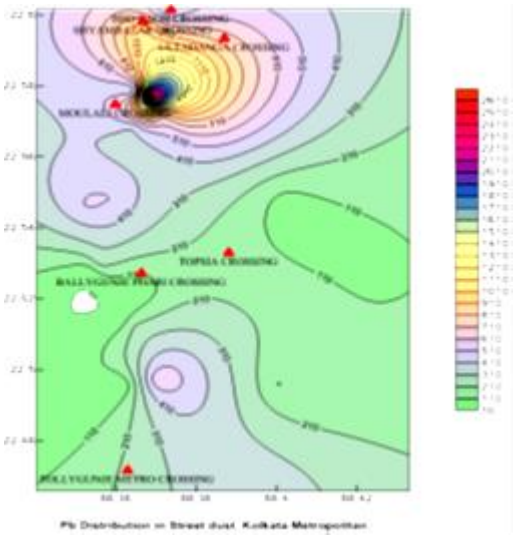
Street dust are powerful indicators of anthropogenic interference because these are the repositories of heavy metals from multiple sources [1].Research on heavy metal contamination in urban street dust of major cities of the world have focussed on concentration, distribution, source identification and pollution assessment. In addition, health risk assessments from metal exposure by using USEPA standard methods have also been reported widely[2]. The use of multivariate statistical analysis and lead isotopic ratios are some of the most powerful tools used in source apportionment of metal contamination in such urban environmental studies.



Street dust from twenty nine locations, in some of the busiest parts of north and south Kolkata were analysed for heavy metal composition and lead isotopic ratios. The source identification of the heavy metals were done by analysing the 206/207 Pb isotopic ratios and also by employing the Principle Component Analysis. Carcinogenic as well as non-carcinogenic health risk assessment from the metals was done to find the Hazard Index arising from ingestion, inhalation and through dermal contact.

Figure 1: Lead distribution in the street dust of Kolkata

The I_{geo} (geoaccumulation index) and the PLI (pollution load index) values obtained in this study revealed heavy to extreme levels of pollution in some of the oldest and busiest commercial areas of north Kolkata. The decreasing order of average metal concentrations (ppm) found was Mn (392.87) > Pb (383.42) > Zn (303.23) >As (95.64) >Cr (43.25) >Co (12.55) >Ag (2.06). Road crossings in north of Kolkata had the maximum concentration of Pb (*Figure 1*). The PCA done on the heavy metal enriched street dust extracted two components. Component 1 identified the anthropogenic contribution load to the pollution by grouping Cu, Mn, Cr and Pb together while Component 2 identified the geogenic contribution from As, Ag and Mn to the pollution load. The 206/207 Pb IRs of the dust samples ranged from 1.111 – 1.209 while the range of 208/206 IRs obtained was between 2.001 -2.169.

The low 206/207 isotopic ratios corresponded to sampling sites having significant enrichment ratio (ER) for Pb. The health risk assessment study of the dust indicated no significant non-cancerous risks from

Cu, Zn, Mn, Cr, As and Pb by ingestion, inhalation or through dermal contact. However, As and Cr had significant carcinogenic risk implication with HI (hazard index) values of 3.63E-05 and 4.14E-03 respectively.

References:

[1] Manta D et al.(2002) The Science of the Total Environment, 300 :, 229-243

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