

# **Chemical Characteristics, Source Apportionment and Health Risk Assessment on Human Exposed to Heavy Metals in PM<sub>10</sub> at a Traffic Site**

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The present study investigated the content, source apportionment and health risk associated with inhalation exposure pathway to heavy metals (Fe, Zn, Cu, Ni, Pb, Co, Cr, Mn, As and Cd). Samples of PM<sub>10</sub> were collected on quartz microfiber filters using an APM-550 particulate sampler at a flow rate of 16.67 L min<sup>-1</sup> from the traffic site of Agra, India. Heavy metals were analyzed by ICP-MS (Inductively Coupled Plasma Mass Spectrometry) after acid digestion. The concentration of PM<sub>10</sub> was ranged between 85.7-297.6 µg m<sup>-3</sup>. The average concentrations of Fe, Zn, Cu, Ni, Pb, Co, Cr, Mn, As and Cd were 3178.6, 360.2, 212.6, 197.2, 177.8, 173.6, 166.5, 106.9, 31.7 and 7.8 ng m<sup>-3</sup>, respectively. Mn and Fe had EF<10 and were minimally enriched. Cr, Ni and Cu were moderately enriched (10<EF<100). Co, Zn, As, Pb and Cd had very high EF (>100) and were greatly enriched. Principal component analysis (PCA) was applied for the source identification. Four rotated factor loadings explain more than 83.2 % of total variance. Factor 1 corresponds to 34.5 % loading with the metals of Fe, Co, Ni, Cu and Zn. The second factor 20.9% shows high loading for Mn and Pb. The third factor 14.8 % shows high loading of As and Cd. The fourth factor 12.9% shows high loading of Cr. PCA identified wind-blown soil dusts, industrial activities, petroleum and coal combustion, vehicle emission, waste incineration, electronic wastes and constructional activities as probable sources for the heavy metals. Non-carcinogenic health risk for Mn, Ni, As and Co (HQ>1) signified adverse effect on children and adults whereas Cr and Cd (HQ<1) for children and adults are under safe limit. The carcinogenic risks of Cr for children and adults, and Co for adults through inhalation exposure exceeded 1×10<sup>-4</sup> and lower for Ni, As, Pb and Cd (<1×10<sup>-4</sup>).

**Key words:** PM<sub>10</sub>, Heavy metals, Enrichment factor, Source apportionment, Health risk assessment