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Presence of heavy metals and polycyclic aromatic hydrocarbons in the atmosphere of Kandy City and associated health risks

L. Weerasundara,[1] D.N. Magana-Arachchi,[2] D.G.G.P. Karunarathne,[3] and M. Vithanage[1,4*]

[1]*Environmental Chemodynamics Project, National Institute of Fundamental Studies, Kandy, Sri Lanka*
[2]*Molecular Microbiology and Human Diseases Project, National Institute of Fundamental Studies, Kandy, Sri Lanka*
[3]*Department of Chemical and Process Engineering, Faculty of Engineering, University of Peradeniya, Sri Lanka*
[4]*Faculty of Applied Sciences, University of Sri Jayawardenepura, Sri Lanka*

The presence of heavy metals (HMs) and polycyclic aromatic hydrocarbons (PAHs) in atmospheric deposition was investigated for nine sampling sites in Kandy, Sri Lanka, which is a typical city in the developing world with significant traffic congestion. Deposition samples were analyzed for Al, Cr, Mn, Fe, Ni, Cu, Zn, Cd, and Pb, which are HMs common to urban environments, following the method of USEPA 200.8. *Crocynia pyxinoides*, a lichen species was also analyzed from same sampling sites. USEPA priority 16 PAHs were analyzed following the method of USEPA 610. Human and ecological health risks were assessed using risk indexes, while the cancer risk was evaluated based on life time daily cancer risk. Al and Fe were found in high concentrations (0.007 – 115.4 mg/m^2/day) due to the presence of natural sources, but may also be re-suspended by vehicular traffic. Relatively high concentrations of toxic metals such as Cr and Pb were also found (0.5 and 0.65 mg/m^2/day respectively). High Zn loads can be attributed to vehicular emissions and Zn coated roofing materials. The metal concentrations among the sampling sites significantly differ ($p<0.001$) depending on the traffic conditions. Only five PAHs, namely, Phenanthrene, Anthracene, Fluoranthene, Pyrene, and Napthalene were found in deposition loads. The changing patterns of HMs were similar in both lichen and deposition samples as Fe>Al>Zn>Pb>Mn>Cu>Cr>Ni> Cd. Contamination factor and geo-accumulation index showed that Al and Fe are at uncontaminated levels currently and other metals are in the range of uncontaminated to contaminated levels, but with the potential to become exacerbated in the long-term. The risk values for children (for Fe, HI-0.58) were higher than that for adults (for Fe, HI-0.06), indicating that children may be subjected to potentially higher health risks. Regarding PAHs, all the cancer risk values are above the acceptable levels. The ecological risk levels on HMs were also higher,with Cd responsible for the highest ecological risk. The study provided fundamental knowledge to determine appropriate mitigation measures in relation to HM and PAH pollution in city environments in the developing world, where to-date only very limited research has been undertaken.

Keywords: Heavy metals, polycyclic aromatic hydrocarbons, deposition, human health risk, ecological risk, Kandy City.

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meththikavithanage@gmail.com 0750279477