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Refined Analysis and Characterization Methods for Metals in Urban Residential Air

MITHE-SN • CANADIAN NETWORK OF TOXICOLOGY CENTRES

Research of Benefit to Canadians

The study team refined the methods for measuring human exposure to metals in urban residential air. These studies were needed because the "state-of-the-art" approach is unreliable in up to 40% of samples. This research will improve the accuracy of human exposure assessments for metals associated with airborne particulate matter in urban environments and influence the development of next generation personal exposure samplers for children and other vulnerable populations.

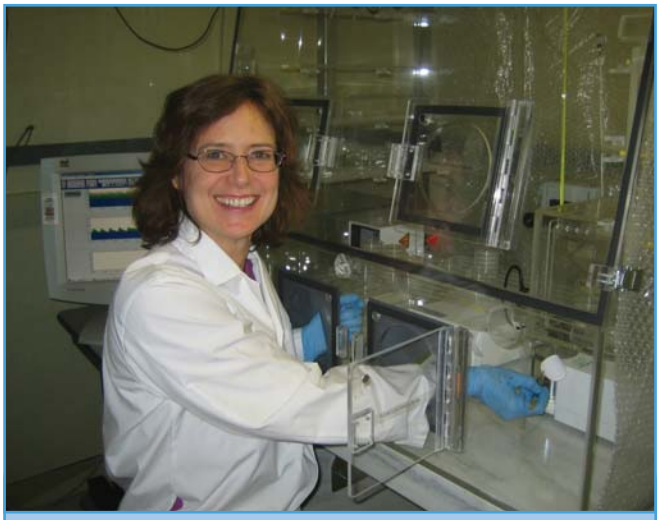
Personal, Indoor and Outdoor Exposures

This study addresses the growing demand for information on exposures of urban populations to metal concentrations in airborne particulate matter (PM). Metals present in airborne PM have been implicated in a variety of cardio-respiratory illnesses associated with exposure to urban air pollution.

Scientists believe that particle-induced cardio-vascular and pulmonary effects related to particles found in urban air, especially those containing elevated levels of some metals, may damage human cells by interfering with certain

Metals in urban air particles are linked with cardio-respiratory disorders

biochemical processes, such as oxidative stress and destabilization of essential proteins and lipids. By comparing personal, indoor, and outdoor exposures to metals (in Windsor), researchers expected to identify errors in the way in which exposures are currently being measured. The results will help determine whether ambient air pollution monitors



Dr. Pat Rasmussen measuring air filter samples in her environmentally controlled chamber Archimedes M3™, which was awarded a USA Patent in April 2008.

are an appropriate basis for predicting personal and indoor exposures.

24 Hour Pilot Study in Windsor, Ontario

Serious challenges exist in reliably sampling and analyzing indoor residential air samples. The team identified several important steps that must be taken to overcome some of these problems, including contamination of indoor air filter samples with metals during sampling, handling and analysis. In addition, several key handling steps were also identified, including the manner in which samplers are assembled and disassembled, that may profoundly influence the reliability of the sample. Unless appropriate precautions are taken,

Indoor air metal concentrations in the study homes are below detection limits of standard protocols

the inadvertent contamination of samples can easily exceed the contribution from the airborne particulate matter being sampled, leading to inappropriate and incorrect conclusions about the contribution of airborne metals to adverse health outcomes.

Metals in Airborne Particulate Matter

The accuracy of exposure assessments is improved by the development of various techniques for characterization of particle-bound metals. The elements known as transition metals (e.g., manganese, chromium, copper, nickel, and zinc) receive particular emphasis due to association between exposure to these metals and impaired

Particle size is a key factor affecting metal bioaccessibility

lung function. With respect to airborne PM, the degree to which these metals can penetrate the respiratory tract is a direct function of several physical characteristics. Assessment of total metal concentrations over the complete range of variables indicates a general trend of increasing metal contents as a function of decreases in the size of the particles. Thus, particle size is one of the most influential factors affecting the biologically relevant metal concentration and is therefore critical in sampling urban air.

Implications for Future Exposure Monitoring

This research contributes to a better understanding of human exposure to metals associated with airborne particulate matter. Contamination of samples is a clear and potentially significant complication in the collection of samples, and samples should not be subjected to a series of multiple analyses where the risk of contamination

Careful assessment of background contribution must be incorporated into the study design

outweighs the benefits. Sources of contamination are associated with every process involved in handling, transport, sampling, and analysis. Unless appropriate steps are taken in every aspect of sample collection, observations about the concentration of metals in airborne PM may be very unreliable.

This research is supported by the NSERC Metals in the Human Environment Strategic Network (MITHE-SN); lead investigator is Dr. Pat Rasmussen, University of Ottawa and Health Canada.

About MITHE-SN

The **Metals in the Human Environment Strategic Network** is a collaboration of academia, government, and industry. The Network conducts research in support of science-based environmental and human health risk assessments for metals in water, soil, and food, within well articulated and planned inter-disciplinary research themes. Our research program is strongly linked across Canada, with field sites in the Maritimes, Québec, Ontario, The Prairies, British Columbia, the Yukon, and Nunavut. The Network also features strong links among academic and government scientists. Implicit in the MITHE-SN approach is a commitment to joint, interactive, centralized planning, project accountability for both intellectual and financial objectives, and regular reporting of research progress beyond the usual publication in scientific journals.

Reference Link: **www.mithe-sn.org** Telephone: **519-824-4120**, Ext. **52950**
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