odour@UNSW water research centre

UNSW THE UNIVERSITY OF NEW SOUTH WALES SYDNEY • AUSTRALIA

PROJECT OUTLINE

Project Title
Airborne particulate matter fingerprinting to assess the impact of transport emissions on air quality

PhD Supervisor
Dr Eric Sivret, UNSW Water Research Centre
Dr Gautam Chattopadhyay, School of Civil and Environmental Engineering
Prof Richard Stuetz, School of Civil and Environmental Engineering

Project Summary
Vehicle emissions mainly consist of fine particulate matter (<1 micron in size). Current air quality guidelines are typically based on PM_{10} and $PM_{2.5}$ measurements and do not adequately reflect the harmful nature of vehicle emission particulates. Furthermore, the impact of these emissions on indoor environments has not been satisfactorily investigated. Combining the collection of particle samples into specific size fractions with analyses of polycyclic aromatic hydrocarbon (PAH) compounds will provide a chemical marker for automotive emissions that will enable the impact of automotive emissions on indoor and outdoor environments to be assessed.

Background
Roadway emissions are most commonly characterised based on an existing series of pollutants for which air quality standards have been developed to minimise average health impacts associated with short or long term exposure. Regulation of these emissions is based on the principle that the National Environment Protection Measure (NEPM) air quality goals should not be exceeded at ground level as a result of the discharges. The air quality parameters currently measured include the amount of particulate matter less than 10 µm in size (PM_{10}), carbon monoxide, oxides of nitrogen and non-methane volatile organic compounds.

Current measurement protocols and regulations do not distinguish between the finer and coarser particles in the size fractions up to 10 µm. The finer particles from vehicle emissions are loaded with by-products of the combustion process including polycyclic aromatic hydrocarbon (PAH) compounds, many of which are probable human carcinogens. Existing studies of the impact of roadway emissions on residential health have focused on PM_{10} emissions and not on finer particulates that are known to have a more harmful impact, and it is generally accepted that the understanding of the environmental and health impact of operating roadways is incomplete. This has prolonged community consultation in many jurisdictions, and limits the selection and design of suitable control technology.

Project Objectives
1. Develop analytical techniques to assess PAH concentrations in particulate matter fractions.
2. Develop a fingerprinting methodology for fine particulates to allow source identification and apportionment.
3. Investigate the impact of vehicle emissions on indoor and outdoor environments.

Project Methodology
A novel analytical methodology is required to enable enhanced identification and assessment of the environmental and health impacts associated with roadway emissions. Ambient particle samples will be collected from vehicle emission impacted environments and fractionated using a cascade impactor. Chemical analysis techniques based on high performance liquid chromatography (HPLC) coupled with a fluorescence detection will be developed and evaluated to determine the concentration of PAHs extracted from each of the collected particle size fractions. The project will involve laboratory and field-based experimentation as well as the statistical and chemometric analysis of collected data for the development of a multidimensional emission profile (i.e. a fingerprint) to allow source identification and apportionment.

Project Outcomes
The intended outcomes of this research will be to:
- Develop analytical techniques to characterize particulate matter and allow source identification and apportionment.
- Improve understanding of roadway emission impact on personal exposure in indoor and outdoor environments.
- Support the establishment of effective policies and management actions to minimise vehicle emission impacts.

Further Information on the project may be obtained from Prof Richard Stuetz (email: r.stuetz@unsw.edu.au). Applications (including a cover letter, academic transcript and CV) should be submitted to Prof Stuetz, UNSW Water Research Centre, University of New South Wales, Sydney NSW 2052.