

An Indian-Australian research partnership

Project Title: Diesel particulate matter around mining: Exposure characterization and risk assessment

Project Number IMURA0773

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IITB Department: Centre for Environmental Science & Engineering

Research Clusters:

Research Themes:

Highlight which of the Academy's CLUSTERS this project will address? <i>(Please nominate JUST <u>one</u>. For more information, see www.iitbmonash.org)</i>		Highlight which of the Academy's Theme(s) this project will address? <i>(Feel free to nominate more than one. For more information, see www.iitbmonash.org)</i>	
1	Material Science/Engineering (including Nano, Metallurgy)	1	Advanced computational engineering, simulation and manufacture
2	Energy, Green Chem, Chemistry, Catalysis, Reaction Eng	2	Infrastructure Engineering
3	Math, CFD, Modelling, Manufacturing	3	Clean Energy
4	CSE, IT, Optimisation, Data, Sensors, Systems, Signal Processing, Control	4	Water
5	Earth Sciences and Civil Engineering (Geo, Water, Climate)	5	Nanotechnology
6	Bio, Stem Cells, Bio Chem, Pharma, Food	6	Biotechnology and Stem Cell Research
7	Semi-Conductors, Optics, Photonics, Networks, Telecomm, Power Eng	7	Humanities and social sciences
8	HSS, Design, Management	8	Design

The research problem

Define the problem

The project will focus on quantifying the airborne particulate matter concentrations in communities around open-cast coal mines. Specific emphasis will be on assessing the environmental health risks due to exposure to diesel particulate matter coming from the hauling of diesel-powered trucks around coal mines. Impact of coal mines on water quality and loss of biodiversity has been well documented and there are a number of studies on occupational exposure to larger size dust and coal particles in the miners due to mining operations. However, data is sparse on coal mines' impact on fine particulate matter (including DPM) exposures and related risks in surrounding communities. These finer particles, such as diesel particulate matter (DPM), are of specific concern because (once emitted) they have higher residence time in atmosphere and can be carried longer distances away from the source of origin. Moreover, due to their small size and higher surface area they can penetrate deeper in lungs and can induce more cardio-respiratory damage. DPM which is a complex mixture of soot, organics and heavy metals of nano- to few micrometer size particles, has been classified as class 1 carcinogen. Hence a focused study is warranted on quantifying the PM_{2.5} (mass concentration of particles with diameter $\leq 2.5 \mu\text{m}$), its chemical composition, and subsequent risk to the exposed populations around coal mines. It is important to note that, though compared to India, the ambient urban air quality is way superior in Australia, the air pollution levels around coal mines are likely high and not well characterized. Hence a study to investigate the PM exposures in communities around coal mines, its chemical characterization and risk to exposed populations is relevant for India as well as in Australia and thus a comparative assessment is envisaged.

Project aims

Define the aims of the project

1. To quantify particulate matter levels in Indian and Australian communities living near coal mines
2. To study the chemical and oxidative properties of particulate matter, specifically DPM, around coal mines
3. To assess the environmental health risks of PM exposures in communities near coal mines in the two countries
4. To comparatively assess the air pollutant levels, its chemical properties, health risks, mining practices and control measures used, and regulatory policies between India and Australia

Expected outcomes

Highlight the expected outcomes of the project

1. Comprehensive assessment of PM and its toxic chemical constituents near coal mines in India and Australia
2. Increased understanding of the DPM exposures and the associated risk in communities around coal mines
3. Consolidation of regulatory policies, control measures, PM exposure levels and health risks in the two countries and options for risk mitigation measures

How will the project address the Goals of the above Themes?

Describe how the project will address the goals of one or more of the 6 Themes listed above.

The research area in PM exposures and risk assessment can be considered a sub-research area of nanotechnology. DPM primarily consists of particles of nanoscale sizes (with mass median diameter typically $\sim 100\text{-}300 \text{ nm}$) pose very high risk to humans via inhalation. While the nanotechnology research usually focusses on nanomaterial synthesis for development of light-weight, high-strength advanced materials, the health effects of nanoparticles are not much understood, including the adverse effects of environmental nanoparticles.

Capabilities and Degrees Required

List the ideal set of capabilities that a student should have for this project. Feel free to be as specific or as general as you like. These capabilities will be input into the online application form and students who opt for this project will be required to show that they can demonstrate these capabilities.

We are seeking for 1 Ph.D. student in this project. Candidates would be desirable with the following academic backgrounds:

1. M.Tech in Environmental Science & Engineering/ Analytical Chemistry/ Civil Engineering/ Mining Engineering
2. M.Sc. in Environmental Science/ Chemistry/ Atmospheric Science
3. B.Tech. in Civil Engineering/ Mining Engineering/ Environmental Engineering + 2 years of research experience in environmental monitoring and assessment

Potential Collaborators

Please visit the IITB website www.iitb.ac.in OR Monash Website www.monash.edu to highlight some potential collaborators that would be best suited for the area of research you are intending to float.

IITB: Prof. C. Venkataraman (ChE), Prof. Virendra Sethi (CESE)

Monash: A/Prof Victor Chang (Env Engg) & Prof Malcolm Sim

Select up to **(4)** keywords from the Academy's approved keyword list (**available at <http://www.iitbmonash.org/becoming-a-research-supervisor/>**) relating to this project to make it easier for the students to apply.

Nanotechnology, Transportation, Geo Science, Miscellaneous