Environmental Engineering & Sciences

Department of Civil and Environmental Engineering

Spring '24: CEE 595AG Seminar

Friday, February 16, 2024 | 10:00 – 10:50 a.m. CST | 3310 Yeh Center

Quantification of particle emission rates, oxidative potential and human exposure assessment for PM emissions from indoor sources

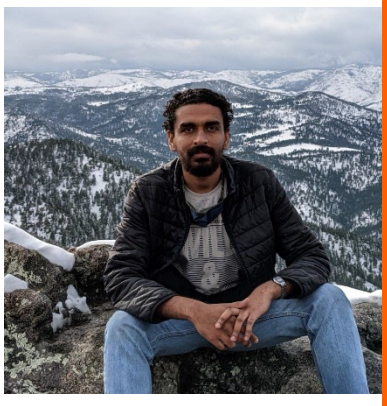
Numerous studies have shown that exposure to particulate matter (PM) or aerosols leads to respiratory and cardiovascular diseases. Airborne transmission via PM is also an important pathway in the spread of infectious diseases including COVID-19, influenza, and measles. Although ambient PM mass concentrations (PMC) are the currently used regulatory metric, several studies have found varying associations between PMC and adverse health effects, attributed to the inability of PMC to capture the complex chemical composition of PM. One of the proposed alternative metrics for PM-induced health effects is oxidative potential (OP), which is the ability of PM to induce oxidative stress. A vast proportion of infectious transmission (SARS-CoV-2) as well as exposure to PM is expected to occur indoors, as people spend over 85% of their times indoors. Quantifying the particle emission rates (PER) from humans and other indoor emission sources, can aid in the estimation of airborne transmission risk and human exposure to indoor generated PM, respectively. Although a few studies have quantified the respiratory PER from different human activities, the relative contribution of respiratory and non-respiratory sources (skin-shedding, clothing) towards total human-generated aerosol emissions is still unknown. Several studies have quantified the OP of ambient PM, but the OP of indoor origin PM is relatively unknown.

We first propose to evaluate the influence of human occupancy and activities on emissions of indoor particles from respiratory and non-respiratory sources using both controlled chamber as well as real-world environments. Results from this study demonstrate that human-generated aerosols predominantly constitute of emissions from non-respiratory sources (clothing + skin shedding; > 55%) compared to respiratory sources (< 10%), and that indoor particle and CO2 concentrations are driven by human occupancy. Next, we propose to quantify the OP and estimate the human exposure attributable to PM emissions from common household appliances using controlled chamber experiments. Results from this study reveals that mass-normalized OP as well as inhalable PM mass and OP exposure from indoor-origin sources exceed those of ambient origin PM in Midwest USA. Ensuing this, we propose to quantify both time and size resolved PER and OP of PM emissions from indoor sources, to estimate the lung deposited doses of PM and OP. Finally, we also propose to study the role of chemical composition as well as indoor intervention strategies such as HEPA filters etc. on OP of PM.

P.S. Ganesh Subramanian

PhD Candidate

Advisor: Vishal Verma



Biography

P. S. Ganesh Subramanian is a Ph.D. student in the Department of Civil and Environmental Engineering at the University of Illinois Urbana-Champaign. He received his bachelor's and master's degree in Earth and Environmental Sciences from the Indian Institute of Science. His current area of research is evaluating the particulate matter induced health effects, using acellular surrogates of toxicity. His hobbies include reading, cycling, gardening and yoga.