ABSTRACT

Coal is used widely for domestic cooking in many regions of India, which contributes significantly to the Carbon Monoxide (CO) and $PM_{2.5}$ levels indoors as well as in the ambient. The focus in this work was to investigate the emission factors (EFs) and mitigation of emissions from coal cookstoves. Two different types of cookstoves were deployed, with different coals and their carbonized forms, and $PM_{2.5}$ and CO emissions were measured for initial ignition, flaming and smoldering stages. EFs were estimated for CO and $PM_{2.5}$ for each stage. Elemental Carbon-Organic Carbon (EC-OC) analyses were carried out for the PM<2.5 μm using IMPROVE_A and DIN-19539 protocols. Carbonization of two coals were carried out in the laboratory at 200, 400 and 600°C, and results showed that PM emissions were reduced by as much as ~70% for coal carbonized to 600°C. Pyrolysis-GCMS was used to identify the species released for different temperature of carbonization, and compared well with differential thermogravimetric analysis and other reported data in literature. Solvent extraction followed by GC-MS was used for raw and carbonized coals to understand the removal of species at the various carbonization temperatures. Further, coal samples carbonized at 800 and 1000°C were found difficult to ignite. Thus an optimum level of coal volatile matter is required for reducing PM emissions while maintaining ignitability for domestic cookstoves. Ventilation options for kitchen were studied for reducing indoor air pollutant in a model kitchen using experimental and computational approaches. Carbon dioxide from a kerosene stove was used as a surrogate and the results compared well with the simulations. Choices of ventilation options were also found to depend on extreme temperature conditions in the ambient.