CARBONACEOUS AEROSOL EMISSIONS FROM BIOMASS BURNING COOK STOVES IN WESTERN INDIA

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In India, around 830 million populations are dependent on biomass for cooking activity (Pandey et al., 2014). Combustion of these biomass fuels emits carbonaceous aerosols such as Black carbon (BC), organic carbon (OC) and brown carbon (BrC) into the atmosphere. BC contributes to warming effect on the climate since it absorbs the radiation whereas the OC has light scattering property causing a cooling effect. Recently, BrC has also been observed to contribute towards warming effect (Kirchstetter et al., 2004).

Our aim is to determine the emission factors (EFs) of carbonaceous aerosols on regional scale from biomass burning cookstoves. Few studies have reported PM EFs 2-3 times higher from field studies as compared to laboratory studies.

Field measurements were conducted in rural villages of Western India using biomass in traditional cookstoves. Real time $PM_{2.5}$ and Black carbon (BC) concentration were measured using DustTrak (Model: 8530) and microAeth (Model: AE-51), respectively. Also, $PM_{2.5}$ concentration was measured gravimetrically using a Multi-stream sampler having Teflon and quartz filter substrates.

An eight armed radial stainless steel inlet probe was used to capture representative sample coming from the biomass burning cookstoves. The design was adopted from Roden et al, (2006) with modifications in the number and size of the sampling points. The experimental runs of 15 minutes were performed in different households while actual cooking was going on. We captured boiling and baking, the two major activities mostly observed in the Indian cooking practices. Traditional cookstoves with 2 pots were commonly used among the villagers with wood and crop residue as the primary fuel for cooking.

Gravimetric $PM_{2.5}$ concentration during different cooking activities varied from 1.6-8 mg/m^3. The BC/$PM_{2.5}$ ratio from real time data varied from 0.12-0.25. $PM_{2.5}$ concentration gradually increased as the cooking activity progressed, and as the flame progressed from gentle stage to vigorous stage (see Figure 1(a)). During the smoldering phase the concentration decreased gradually since there was no cooking activity between 18.10-18.30. Similar trend was observed for BC as well.

Figure 1 (b) shows that the $PM_{2.5}$ concentration gradually increased and then started to decrease as the smoldering phase started at the end of cooking process. BC variation was in sync with variation of $PM_{2.5}$ concentration.

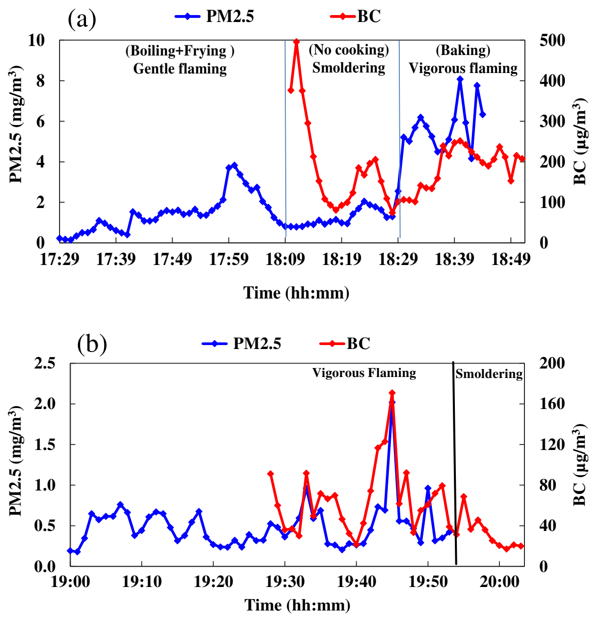

Figure 1. Real time $PM_{2.5}$ and BC concentration from fuel wood burning in traditional cookstoves a) with clogged chimney b) without chimney

The first results from our study shows higher concentrations of $PM_{2.5}$ and BC during the actual cooking conditions as compared to previous laboratory studies. It was observed that the concentrations of $PM_{2.5}$ and BC varies with type of cooking activity, burning conditions (flaming or smoldering), type of cookstoves and kitchen conditions. It is also affected by fuel characteristics such as fuel size, moisture content, burning rate, etc. Therefore, more field-based experimental runs with different stove/fuel combinations under different cooking and burning conditions are required to characterize the carbonaceous emissions.

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