Carbonyl and Phenol Emissions from Indoor Combustion Sources

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ABSTRACT

In many people's minds air pollution is associated with the contamination of urban air from automobile exhausts and industrial emissions. However, in developing countries, the problem of indoor air pollution far outweighs the ambient air pollution. This is because the pollutants generated from the indoor sources and the pollutants infiltrated from outdoors are entrapped into limited air volumes of the indoors. The risk associated with the indoor pollution is aggravated, because people spend much of their times in the indoor environment with limited air circulation.

Among the numerous indoor pollutant sources, combustion sources have been recognized as a major contributor for the indoor pollution. Apart from the indoor cooking activities, lifestyles (smoking), insect repelling (mosquito coil burning) and the religious practices (burning joss sticks and candles) have introduced additional burdens to the indoors. Though these pollutant sources can be completely eliminated or controlled, they have turned out to be prevalent pollutant sources in Sri Lankan households.

All these combustion products are known to emit volatile organic by products due to incomplete combustions. Among the VOC emissions our investigation was focused on selected carbonyl compounds and phenolic compounds. Both the source emission factors and the airborne levels were monitored to understand the indoor air burden. Mosquito coils, joss sticks, cigarettes, candles and beedies were smoldered in a laboratory set up simulating the indoor environments for the evaluation of emissions factors.

The formaldehyde emission factors ranged from 20.1 to 48.3 □g per g of combusted material and the emission factors for acetone ranged from 14.0 to 37.5 □g per g of combusted material. Other carbonyl compounds had very low emission factors that they could not be detected with sufficient accuracy and precision. The emission factors were greatest for cigarettes, beedies and joss sticks compared to candles and mosquito coils.

Several volatile phenolic compounds were found to emanate from the above sources. Both the emission factors and the types of phenolic compounds emitted were different from one combustion source to the other. Among the phenolic compounds, emission factors for cresols, nitrated phenols, halogenated phenols, amino phenols and naphthols were found to be in the ranges of 3.5 to 28.1 □g per g of combusted material. Candles and joss sticks emit lesser phenolic compounds compared to other three investigated indoor combustion sources.

Passive sampling onto coated filters from different indoor settings has revealed that these pollutants are ubiquitous in indoors. Samples collected onto filter papers were isolated and quantifies using chromatographic methods. The average airborne levels in a m^3 of indoor air over a period of one week was found to be in the range of 0.09 to 0.23 □g for formaldehyde, 0.14 to 0.30 □g for acetone and 0.10 to 0.34 □g for the monocyclic phenolic compounds. The average airborne levels were slightly higher for the indoors having multi-combustion sources and presumably peak concentrations during the combustion activities (often with closed doors during the over night) may exceed the threshold values.