Aerosol Processes in PAH Infiltration and Population Exposure in Rome

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Polycyclic aromatic hydrocarbons (PAHs) are known to be harmful to human health e.g. by causing lung cancer (Vineis *et al*, 2004). Spatial variability of the emissions, atmospheric dispersion, infiltration of the particles from outdoor to indoors, and population time-activity defines the exposures. Since the time spent indoors is typically 80-90%, exceeding times spent in traffic and outdoors, indoor exposures and thus particle infiltration from outdoors is a key issue (e.g. Hänninen *et al*, 2004).

Infiltration from outdoors to indoors, as well as lung deposition, is largely affected by particle size (Hänninen *et al*, 2012). Recently, accumulation mode particle deposition to alveolar region has been noticed to be the largest contributor to the PAH uptake (Zhang *et al*, 2012).

The aim of the work is to quantify the main aerosol processes that modify infiltration and respiratory tract deposition.

$PM_{2.5}$-bound PAH concentration measurements carried out in Rome, Italy, were used to evaluate the indoor-to-outdoor relationships of PAHs. A mass-balance model is used to estimate infiltration and indoor sources. Additional results regarding the indoor-outdoor behavior of PAH are presented in a parallel paper by Gatto *et al*.

High, up-to 30-40 fold differences in outdoor and indoor PAH concentrations were observed between non-heating and heating seasons. Indoor-to-outdoor ratios of PAH concentration between different microenvironments were noticed to vary much less, but between different seasons the variation of indoor-to-outdoor ratios for examined homes was significant. Indoor sources played only a minor role in PAH exposures.

As can be seen from Figure 2, accumulation mode particles, i.e. the particles of which demonstrate high infiltration rate indoors and the particles of which are able to penetrate alveolar parts of human lungs are also the particles consisting high mass concentrations.

Seasonal heating emissions contribute almost 90% of the PAH exposure yearly in Rome metropolitan area followed by traffic and waste incineration. The variation in the PAH indoor-outdoor relationship is significant between different seasons, but there is only little variations between different microenvironments. Majority of the PAH mass is in accumulation mode and ultrafine particle size ranges. The latter is affected more by infiltration.

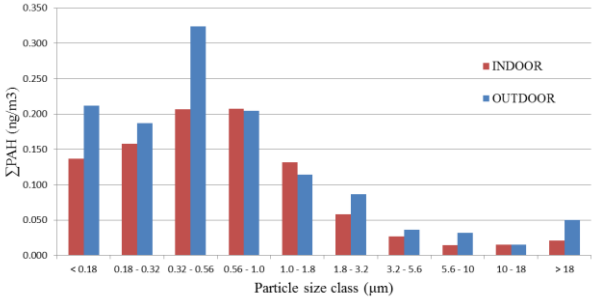

Figure 1. Measured Σ_{11}PAH concentration as a function of particle size distribution.

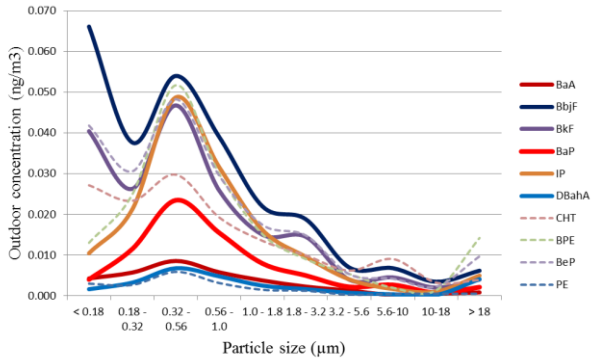

Figure 2. Outdoor concentration as a function of particle size distribution for all PAH compounds.

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