

Seasonal behavior of indoor and outdoor PAHs in different microenvironments of Rome, Italy

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Among Persistent Organic Pollutants (POP), Polycyclic Aromatic Hydrocarbons (PAHs) are a class of complex organic chemicals of increasing concern for their occurrence in the environment. They are ubiquitous in ambient air and have been identified as carcinogenic, benzo[a]pyrene (B[a]P), and some of them as probably and possibly carcinogenic. PAHs can be found in the atmosphere in both gaseous and particulate forms (PM_{2.5} and PM₁₀) depending on their volatility which is governed by their chemical structure. The best known PAH is the benzo[a]pyrene (B[a]P). To identify and to quantify population exposure among children and elderly people to PAHs content in particulate matter in highly urbanized areas and to assess the impact on human health, in order to support environmental policy and regulation in this field, EXPAH project has proposed an integrated approach based on measurements and modeling techniques (<http://www.ispesl.it/expah/>).

In the frame of this Life+ EXPAH project, particle-bound PAHs were monitored in the urban area of Rome in order to assess the actual human exposure in different living/working places (microenvironments).

The method was based on PM_{2.5} active sampling at low volume conditions on PTFE filters and GC/MS determination of non-volatile PAH congeners, characterized by higher carcinogenic and mutagenic potencies. According to the experimental design, two seasonal in-field campaigns (summer and winter) were performed by sampling both indoor and outdoor living/working microenvironments.

In each seasonal campaign, 17 locations were monitored including six schools, two offices and nine houses. The study was focused on seven "carcinogenic" PAHs (benz[a]anthracene, benzo[b]fluoranthene, benzo[j]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, indeno[1,2,3-cd]pyrene and dibenz[a,h]anthracene) and a mutagenic congener (benzo[ghi]perylene).

Results

Large differences between winter and summer indoor and outdoor PAH's values were found in the city of Rome (see Fig. 1). During the winter in-field campaign (December 2011-March 2012), the target PAHs ranged from 6.0 to 7.4 ng/m³ (indoor), and 8.4 to 13.2 ng/m³ (outdoor). The typical indoor/outdoor ratio was ca. 0.7. During the summer campaigns (lasted from May to July 2012), the target PAHs ranged 0.40÷1.35 ng/m³ (indoor), and 0.62÷1.52 ng/m³ (outdoor). Heating

and biomass burning during winter were presumably responsible of this finding.

The winter values were well above the guideline value for BaP (1 ng/m³) whereas the summer values were well below. During the winter the average BaP detected indoor ranged from 0.94 (offices) to 1.14 (schools) ng/m³, and the respective outdoor values ranged from 1.4 and 2.0 ng/m³; during the summer BaP ranged from 0.04 to 0.15 ng/m³ (indoor) and 0.06 to 0.19 ng/m³ (outdoor).

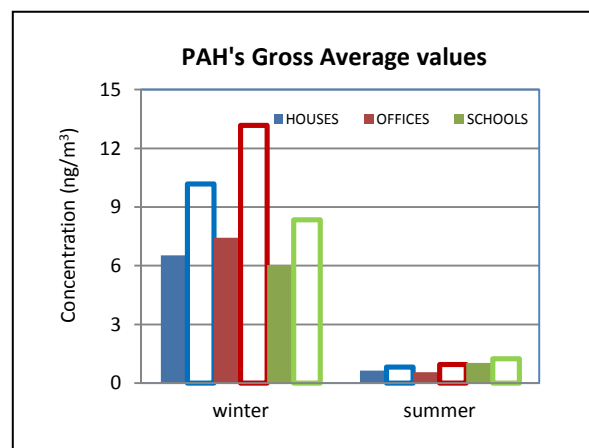


Fig. 1. Total PAHs in the investigated microenvironments: full bars refer to Indoor; empty bars refer to Outdoor

According to results, in the principal life environments humans seem to be exposed to PAH levels similar to those typical of outdoor air. In winter, these level can exceed the guideline values of ambient air quality.

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