Assessing the contribution of indoor particulate matter sources in residential homes in a northern province of Italy

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Many hazardous chemicals produced by different anthropogenic sources and emitted in the environment may cause adverse effects on human health (Kampa et al., 2008). Particulate matter (PM) effects on human health are well known. Because people spend most of their time indoors, indoor PM exposure is a relevant health concern. Indoor residences greatly contribute to total daily exposures because people spend 80 to 90% of their time in confined environments (Schweizer et al. 2007). The health effects are strictly correlated to the chemical composition since PM contains classes of compounds, such as PAHs, recognized as carcinogen by IARC.

Aim of this study was to assess the chemical composition of $PM_{2.5}$ and PM_{10} samples collected in residential homes in a Northern province of Italy (Lodi) in order to identify the main sources of indoor exposure and the contribution of outdoor particles. 24-h samples were collected in 29 homes by means of GK2.05 and GK2.69 samplers (Cattaneo et al. 2011) during both winter and summer. Characteristics of the buildings, including location (e.g. proximity to roads with high traffic) were recorded. Furthermore a time-activity diary containing each activity that could influence indoor PM levels (occupants number, heating system, ventilation, number of cigarettes smoked, time spent for cooking food, time spent on housework, etc.) was available.

The concentrations of 8 ions (Ca^{2+}, Mg^{2+}, K^{+}, NH_4^{+}, Na^{+}, SO_4^{2-}, NO_3^{-} and Cl^{-}) and 15 PAHs considered as "priority" for the U.S. EPA (naphthalene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo (a) anthracene, chrysene, benzo (b) fluoranthene, benzo (k) fluoranthene, benzo (a) pyrene, dibenzo (a, h) anthracene, benzo (g, h, i) perylene and indeno (1,2,3, cd) pyrene) were quantified.

The impacts of outdoor sources is attested by the high contribution of sulphate and nitrate during both seasons. This is confirmed by what reported for the regional emissions (INEMAR 2007) according to which traffic in Lodi province corresponds to approximately 47% of the total emissions of both $PM_{2.5}$ and PM_{10}. Therefore the traffic volume on neighboring roads heavily affects indoor PM levels.

It is worth noting that in Lodi province there is also a big impact of agricultural responsible for high ammonia emissions.

The concentrations of PAHs as sum of the 15 examined species were found, with few exceptions, to be below 5 ng m^{-3} and 2 ng m^{-3} in winter and summer respectively.

In order to identify possible PAHs sources, three different methodologies were applied:

1. diagnostic ratios of PAH isomers (Alves et al. 2012, Venkataraman, et al. 1994),
2. linear mixed models for repeated measurements (summer and winter) aimed at identifying main determinants (Urso et al., in press)
3. Chemical Mass Balance (Belis et al., 2011)

The characteristic of buildings and the activities was used to select the variables to be included in the tested models.

Preliminary results have shown that meat cooking represents an important source of indoor PAHs, in addition to gasoline and diesel combustion due to outdoor sources.

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