INTRODUCTION

Sensitive, selective, fast and reliable methodologies are needed to sample and analyse pollutants in ambient air. The sampling step is a critical part of ambient air analysis. Sampling strategies have to allow sample collection during a concrete period of time, giving the results as time-weighted average concentrations. In addition to that, the sampling strategy has to be easy and simple enough to permit a facile field sampling.

Both active and passive sampling strategies are suitable for determining low concentrations of pollutants in outdoor and indoor ambient air. Nowadays, passive sampling is being an increasingly used technique for ambient air measurement, especially in urban and rural areas. In addition to that, the easy operability and low cost of passive samplers make them an ideal tool for long-term averaged pollution concentration studies.

Good agreement correlations between passive and active samplings of pollutants have been found in several studies (Batterman et al., 2002; Yamamoto et al., 2002; McClenny et al., 2006; Strandberg et al., 2006). However, slight differences between concentrations have been found for some compounds (e.g., benzene, toluene and xylenes) due to atmospheric chemical reactions. Passive samples accumulate compounds during a large period of time (e.g. 7-10 days), whereas active sampling retains freshly emitted pollutants (Pilidis et al., 2005; Sunesson, 2007).

In the present study, a comparison between the performance of two types of sampling strategies, active (multi-sorbent bed (Carbotrap, Carbotrap X, Carboxen 569)) and passive (Radiello® diffusive sampler indicated for thermal desorption, filled with Carbotrap 4), is done.

RESULTS AND DISCUSSION

Multi-sorbent bed (Carbotrap, Carbotrap X, Carboxen 569)-Radiello® concentrations comparative

In Tables 2 and 3, the average concentrations for different periods both for multi-sorbent bed and radiello diffusive tubes are shown. Generally, only a few of the studied compounds do not show significant differences in the concentrations observed between the two different sampling methodologies, being higher the concentrations obtained with the Radiello® samplers (Figure 3). Daily variability of VOCs concentrations was observed through the multi-sorbent bed; hence, as Radiello® passive samplers represent the average concentration during a period of time, the daily variability may not be properly shown.

Table 2. Average ± standard deviation indoor air concentrations (µg m⁻³) for multi-sorbent bed tubes for each period sampled (n = 8 for 4 days periods; n = 6 for 5 days periods; n = 4 for 7 days periods and n = 3 for 14 days periods). Compounds are listed by elution order.

MATERIALS AND METHODS

Sampling

Daily duplicate 24 hour samples of multi-sorbent bed tubes were taken during a period of 14 days. On the other hand, during the same period of time, quadruplicate samples of Radiello® tubes were taken in 4 days, 3 days and 14 days samples. The sampling was done indoors during the months of February-March 2010 in Tarragona city. Active sampling was done connecting the multi-sorbent bed tubes to an air collector pump sampler specially designed in the LCMA-UPC laboratory. The flow sampling rate was 70 ml min⁻¹.

Desorption and analysis

The analysis of VOCs was performed by Automatic Thermal Desorption (ATD) coupled with capillary Gas Chromatography (GC)/Mass Spectrometry Detector (MSD), using a Perkin Elmer ATD 400 (Perkin Elmer, Boston, Massachusetts, USA) and a Thermo Quest Trace 2000 GC (ThermoQuest, San Jose, California, USA) fitted with a Thermo Quest Trace Finnigan MSD. VOCS standards were prepared in methanol and injected at 30°C on the tubes under an inert Helium gas flow (100 ml min⁻¹) using a conventional gas chromatograph packed column injector (Ribes et al., 2007). The instrumental settings and operating conditions are shown in Table 1.

Table 1. Instrumental settings and operating conditions.

<table>
<thead>
<tr>
<th>Description</th>
<th>Condition</th>
<th>Temperature (°C)</th>
<th>Mass</th>
<th>Flow (mL/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desorption temperature</td>
<td>300°C</td>
<td>200°C</td>
<td>120°C</td>
<td>10°C</td>
</tr>
<tr>
<td>Desorption time</td>
<td>24 h</td>
<td>1 h</td>
<td>1 h</td>
<td>1 h</td>
</tr>
<tr>
<td>Carrier gas</td>
<td>He</td>
<td>He</td>
<td>He</td>
<td>He</td>
</tr>
<tr>
<td>Gas flow</td>
<td>300 ± 20 mL/min</td>
<td>60 ± 2 mL/min</td>
<td>60 ± 2 mL/min</td>
<td>60 ± 2 mL/min</td>
</tr>
<tr>
<td>Mass range</td>
<td>50-700 Da</td>
<td>50-700 Da</td>
<td>50-700 Da</td>
<td>50-700 Da</td>
</tr>
</tbody>
</table>

For several compounds, the mass of compound (ng) summed from the samples of 4 and 3 days of exposure is significantly different than the mass of compound obtained by the samplers that stayed 7 consecutive days exposed, being generally higher the concentrations obtained in a longer sampling period (Figure 4).

Figure 4. Total amount of different compounds (ng sample) adsorbed on Radiello® cartridges exposed for a different number of days.

REFERENCES


McClenny, B. et al., 2006. J. Environ. Monit. 8, 263-269.


