**Indoor Air Sampling of VOCs: Long-Term Passive Diffusion Devices**

Study Challenge with Comparison to Active Method

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**OVERVIEW**

The purpose of the research is to compare the results from long duration sampling periods using a variety of passive diffusion samplers to the results from 24-hour sampling periods using sorbent tubes and low-flow pumps (EPA Method TO-17), which were collected throughout a 14-day study period. A controlled release in a large room of trichloroethylene (TCE) with one and two orders of magnitude daily concentration variability throughout the course of a two-week monitoring event provided the basis for the study. The daily concentration measurements by EPA Method TO-17 and the multi-day passive diffusion samplers were performed in triplicate.

The results from the 24-hour active samples were averaged and compared with the passive diffusion devices exposed to indoor air for 3, 7, 10, and 14 days in accordance with ASTM D6196-02. A specific uptake rate for each of the passive devices was calculated for each of the four exposure periods. The data consistency is of high quality.

**RESULTS**

An uptake rate was calculated for each of the passive devices for each of the four exposure periods. Samples were collected in triplicate. The uptake rate is based on the average TO-17 concentration, the average mass measured on the passive device, and the exposure period, which is expressed below:

\[
\text{Uptake Rate} = \frac{\text{Average Mass from Passive Device} \times \text{Average Concentration} \times \text{time}}{\text{Units} \text{ cm}^3/\text{min}}
\]

The following table is a summary of the uptake rates calculated for each of the four exposure periods (3, 7, 10, and 14 days). The uptake rates are fairly consistent over time and the concentration variability on a daily basis was large. The device with the lowest uptake rate was the PT (passive radial) sampler. The radially mounted configuration (PR) had the highest uptake rate by an order of magnitude. The BeSure Axial Sampler (BA) uptake rate was nearly identical to PT (same sorbent make-up); however, the BA CV was four times lower.

<table>
<thead>
<tr>
<th>Type/Days</th>
<th>3</th>
<th>7</th>
<th>10</th>
<th>14</th>
<th>Units</th>
<th>Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC</td>
<td>0.23</td>
<td>0.25</td>
<td>0.23</td>
<td>0.24</td>
<td>0.008</td>
<td>0.036</td>
</tr>
<tr>
<td>PT</td>
<td>0.21</td>
<td>0.15</td>
<td>0.14</td>
<td>0.15</td>
<td>0.044</td>
<td>0.300</td>
</tr>
<tr>
<td>BA</td>
<td>0.14</td>
<td>0.10</td>
<td>0.11</td>
<td>0.10</td>
<td>0.011</td>
<td>0.017</td>
</tr>
<tr>
<td>IR</td>
<td>1.57</td>
<td>1.08</td>
<td>1.85</td>
<td>2.61</td>
<td>2.02</td>
<td>0.543</td>
</tr>
</tbody>
</table>

The coefficient of variation (CV) was lowest for the single sorbent tube (PC) and highest for the multiple sorbent tube (PT). The radially mounted configuration (PR) had the highest uptake rate by an order of magnitude. The BeSure Axial Sampler (BA) uptake rate was nearly identical to PT (same sorbent make-up); however, the BA CV was four times lower.

**CONCLUSIONS**

A controlled release of TCE in an a large room to reflect real world conditions allowed for over two orders of magnitude daily concentration variability over the course of the two-week monitoring event.

The daily concentration measurements by EPA Method TO-17 and the passive diffusion samplers were done in triplicate and had excellent reproducibility. The device with the lowest uptake rate was the PT (passive radial) sampler. The radially mounted configuration (PR) had the highest uptake rate by an order of magnitude. The BeSure Axial Sampler (BA) uptake rate was nearly identical to PT (same sorbent make-up); however, the BA CV was four times lower at 0.074.

The TCE uptake rate for the PC configuration is approximately half of that reported in a previous laboratory study (MDHS80) for shorter duration sampling and may be more representative of real world conditions with longer duration sampling periods. The performance of all the passive diffusion devices was analyzed in this study for large fluctuations of TCE concentrations. The average concentration for all of the exposure periods could be reliably predicted using the established uptake rates and without the need for pumps or vacuums for the PC and BA devices. The PT and PR devices' coefficients of variation were above 0.30 and did not produce reliable concentration estimates.

Contact Beacon Environmental Services, Inc. at www.beacon-usa.com or 1-410-838-8780 for further information.