

An Evaluation of Indoor Air Sampling Procedures: Short Duration vs. Long Duration Sampling

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OBJECTIVES

- To compare longer sampling times using passive diffusion samplers (ISO 16017-2 and ASTM D6196-03) and to compare these results to shorter-term testing periods using sorbent tubes and low-flow pumps (EPA Method TO-17) at great frequency for TCE in indoor air.
- To examine the results of daily tests with passive diffusion devices exposed to indoor air for 3, 7, 10 and 14 days.
- To obtain passive device uptake rates at the different periods and to evaluate the statistical significance of the entire data set.

METHODOLOGY

- Shown below is the overall layout of the sampling stations for the monitoring of the controlled release of TCE in the room. Three sampling stations were set up and are denoted as Sampling Stations A, B and C.

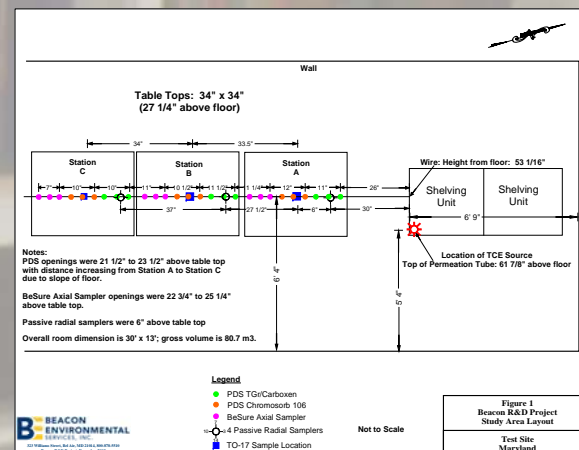


- The next photograph is an overhead shot of Sampling Station A. Note the active sampling pump with the cord and the passive devices both strung on the wire above the table and on the table itself right of the pump.



SAMPLE COLLECTION

- The TO-17 sampling events occurred daily for 14 days and three tubes were collected every morning. The pumping rate was ~20 mL/min and was measured at the beginning and end of each daily sampling event.
- Shown below is the study area layout. Note the location of the source of TCE with respect to the three sampling stations.



- The passive devices were all deployed the first morning in triplicate and remained for four sampling durations. Four types of passive collection devices (three axial and one radial) were used and are summarized below:
 - TenaxGR/Carboxen Passive Diffusion Sampler-PT
 - Chromosorb 106 Passive Diffusion Sampler-PC
 - BeSure Axial Sampler-BA
 - Passive Radial Sampler-PR

RESULTS

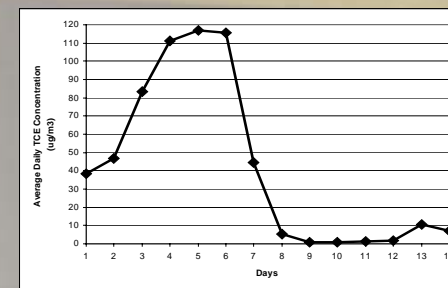
- The following table is a summary of the uptake rates calculated from the average of daily TO-17 values and the average mass from each of the passive diffusion devices at 3, 7, 10 and 14 days.
- The uptake rates are fairly consistent over time even though the concentration variability on a daily basis was large.
- The daily TO-17 measurements and the passive devices were done in triplicate.* The data consistency was excellent.
- The coefficient of variation (COV) was lowest for the single sorbent tube (PC) and highest for the multiple sorbent tube (PT). The radial sorbent configuration (PR) had the highest uptake rate. The BeSure Axial Sampler (BA) uptake rate was nearly identical to PT (same sorbent make-up), however, the BA coefficient of variation was four times lower.

Type	Average Uptake Rate cm ³ /min	Standard Deviation cm ³ /min	Coefficient of Variation
PC	0.237	0.008	0.036
PT	0.148	0.044	0.300
BA	0.149	0.011	0.074
PR	2.024	0.543	0.268

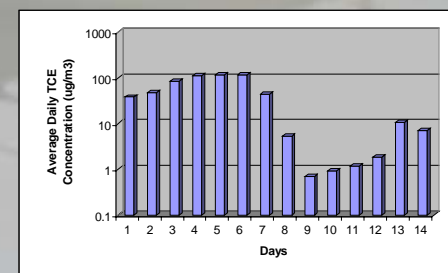
* On two of the fourteen days there was a pump interruption. One those two days, there were duplicate samples.

Time History of Daily TCE Concentrations

- The following graph shows there is a wide variability over the course of the sampling period. The first three days were an exponential growth (to Day 3), the next four days a flattening out followed by a quick drop (to Day 7), the next three days continuing drop to very low levels (to Day 10) and the last four days another, much lower spike (to Day 14).

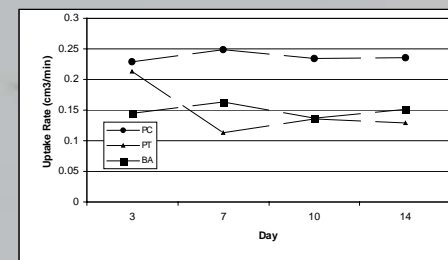


- The following plot demonstrates over two orders of magnitude daily average concentrations.



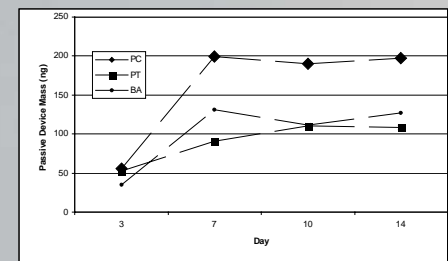
Uptake Rates from Axial Devices

- The following graph shows the time varying, calculated uptake rates of the three axial devices. The data consistency is of high quality.



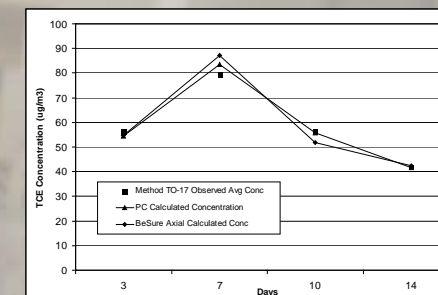
Passive Mass Collected from Axial Devices

- The following graph shows the average mass of TCE collected in the three axial devices. The dynamics of the daily TCE concentration variability are reflected with the passive data.



Projections from Established Uptake Rates

- The following graph shows the projected concentration of TCE from the mass collected on the PC and BA passive devices with the measured average concentrations. A COV of less than 0.10 allows reliable tracking of the magnitude and trends for all sampling periods. The uptake rates for the PT and PR devices were not as reliable for the COVs were 0.300 and 0.258, respectively.



CONCLUSIONS

- A controlled release of TCE in an indoor air environment 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 coefficient of variation of the uptake rate was lowest for the single sorbent tube (PC) and highest for multiple sorbent tube (PT). The radial sorbent configuration (PR) had the highest uptake rate. The BeSure Axial Sampler (BA) uptake rate was nearly identical to PT (same sorbent make-up), however, the BA coefficient of variation 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.

- 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 with no pump/active air flow/vacuum for the PC and BA devices. The PT and PR devices' coefficients of variability were above 0.10 and did not produce reliable concentration estimates.

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