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Air Sampling of VOCs Using New SPME Portable Field Sampler

R. Shirey, V. Mani, and W. Betz, Sample Handling, Supelco, Bellefonte, PA, USA

With the development of two new products, the solid phase microextraction (SPME)* technology now can be applied to air sampling and monitoring. These products—an SPME portable field sampler and an SPME fiber coated with 75 μ m of Carboxen™/polydimethylsiloxane (PDMS) – allow analysis of volatile organic compounds (VOCs) at trace levels.

- The SPME portable field sampler eliminates the need to ship samples from the field to the lab. When the needle containing the fiber is sealed by the self-contained septum, there is no loss of analytes from the fiber prior to desorption. Consequently, the fiber need not be desorbed immediately after extraction.
- The Carboxen/PDMS fiber efficiently extracts and retains VOCs at trace levels, yielding good linearity. The pore structure of the Carboxen material enables the fiber to extract a variety of analytes in a complex mixture, with minimal displacement.

Using a mixture of 9 VOCs, we attempted to determine the capacity of the Carboxen/PDMS fiber, and to determine whether analytes with low distribution constants would be displaced by analytes with higher distribution constants. The analytes were obtained from a 1ppm gas stream and spiked into a 125mL bulb with a final concentration ranging from 400ppt to 400ppb. Using an SPME portable field sampler containing a Carboxen/PDMS fiber, the analytes were extracted for 10 minutes at ambient conditions. Figure A shows the analytes at 10ppb.

Figure B shows the concentration plots for three analytes. Excellent linearity is indicated by the correlation coefficients of 0.98 or higher. Of the 9 VOCs, only 1,2-dichloroethane yielded a value less than 0.98 (Table 1). Vinyl chloride and 1,3-butadiene had the lowest distribution constants, while tetrachloroethene and trichloroethene had the highest.

Classical adsorption mechanism theory suggests that, due to limited adsorption sites, the lighter analytes will be displaced by the heavier analytes as concentration increases. At concentrations above 400ppt, the amount of analyte extracted would level off. However, the unique pore structure of Carboxen-1006[■] material enables

Figure A. VOCs in Air at 10ppb

Sample: VOCs in air at 10ppb, 125mL bulb
 SPME Fiber: Carboxen/PDMS, 75 μ m film
 Cat. No.: 57318
 Extraction: headspace, 10 min
 Desorption: 5 min, 300°C
 Column: SPB™-1 SULFUR, 30m x 0.32mm ID, 4.0 μ m film
 Cat. No.: 24158
 Oven: 40°C (2 min) to 150°C at 8°C/min
 Carrier: helium, 35cm/sec
 Inj.: splitless (closed 2 min), 0.75mm ID liner
 Det.: GC/MS ion trap, m/z = 45 - 260

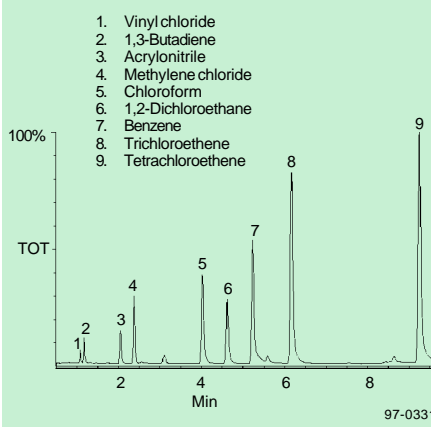


Figure B. Linear Analyte Response Using Carboxen/PDMS Fiber

10 min extraction

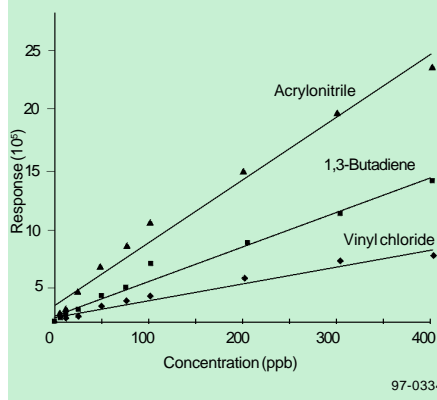


Table 1. Correl. Coef. for VOCs

Analyte	R ²
Vinyl chloride	0.980
1,3-Butadiene	0.990
Acrylonitrile	0.980
Methylene chloride	0.986
Chloroform	0.984
1,2-Dichloroethane	0.953
Benzene	0.995
Trichloroethene	0.982
Tetrachloroethene	0.990

extraction of all analytes without displacement of the lighter analytes.

The portable field sampler and the Carboxen/PDMS fiber are an ideal combination for monitoring air samples. The ability to collect both air and water samples in the lab or field with the sampler and analyze at a later time is convenient, simple, and reliable for trace level analyses.

Ordering Information:

Description	Cat. No.
SPME Portable Field Sampler, pk. of 2 Permanent 75 μ m Carboxen/PDMS fiber**	504831
SPME Fiber Assembly, pk. of 3 75 μ m Carboxen/PDMS	57318
SPME Holder for Manual Sampling Order fiber assemblies separately.	57330-U
Thermogreen™ LB-2 Septa, 5mm pk. of 100	20638
SPME Septum Tool	504858
SPB-1 SULFUR Capillary GC Column 30m x 0.32mm ID, 4.0 μ m film	24158

*Solid phase microextraction technology licensed exclusively to Supelco. US patent #5,691,206; European patent #0523092.

**Note: Our original SPME unit and replaceable Carboxen/PDMS fibers can be used for this application if the analytes are analyzed immediately after the extraction.

Fused silica columns manufactured under HP US Pat. No. 4,293,415.

■US Pat. No. 4,839,331.

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