TORION TECHNOLOGIES INC.

Accelerated Trace Level Detection of Selected VOCs in Air, Using a Needle Trap Device with a Portable GC-MS

Needle Trapping (NT) Devices provide a simple, low cost methodology to collect and introduce samples to an analytical instrument. The low cost and convenience of NTs allow analytical chemists to use the technique to deploy multiple samplers simultaneously. When coupled with the TRIDION®-9 high speed, high resolution GC-MS, samples covering a wide boiling point range can be analyzed in as little as 3 minutes per run. Methods are easily optimized for detection limits and compounds of interest.

Introduction

There is a demonstrated need to perform air monitoring for hazardous volatile compounds in a variety of environments. U.S. EPA Method TO-14A, 15, and 17 provide guidance for such applications. Sample concentrations can vary greatly from locations in or near industrial environments to surrounding residential environments that are in close proximity. Samplers based on NTDs can be setup to cover a wide area, and sampling times adjusted based on anticipated concentrations. In this application note the detection capabilities of the field portable TRIDION-9 GC-MS using CUSTODION®-NT sampling devices are demonstrated for a number of TO-15/17 analytes.

Experimental Conditions

A 5-liter Tedlar™ bag was spiked with a mixture of volatile organic compounds at 1 ppm (see Table 1). Dilutions were made to generate known vapor concentrations for the analytes at 100 and 500 ppb. The analytes were extracted from the bags at ambient temperature, collecting various volumes from 300-500 mL into a CUSTODION-NT. The CUSTODION-NT had a three-layer bed; Tenax TA (1 mg), Carboxen 1016 (1.5 mg) and Carboxen 1003 (1.5 mg) were loaded in the needle for analyte trapping.

Following sample extraction, the CUSTODION-NT was inserted into the TRIDION-9 GC-MS injection port where the target analytes were desorbed (20 sec) into a split-splitless injector (270°C) coupled with a low thermal mass, metal-clad, capillary GC column (MXT-5, 5 m x 0.1 mm, 0.4 µm df). After an initial 10 sec hold at 50°C, the GC temperature was increased at 2°C/sec to 270°C for a total run time of 90 sec. The capillary GC is coupled to a toroidal ion trap mass spectrometer (TMS) detector having a mass range of 45-500 m/z.

Results

Table 1. List of Target Compounds with retention times (n=3)

Compound	Avg. Retention Time (s)	RSD (%)
Dichlorodifluoromethane	8.98	0.55%
1,2-Dichlorotetrafluoroethane	8.28	0.47%
Vinyl chloride	8.76	0.49%
Bromomethane	9.66	0.38%
Trichlorofluoromethane	11.79	9.11%
1,1-Dichloroethene	12.90	2.45%
Methylene Chloride	13.89	1.95%
Trans-1,2-Dichloroethene	13.65	0.99%
1,1 Dichloroethane	16.60	0.60%
Cis-1,2-dichloroethylene	19.00	1.39%
1,1,1-Trichloroethane	21.68	2.05%
1,2-Dichloroethane	22.36	1.78%
Benzene	23.19	1.52%
1,2-Dichloropropane	26.38	1.20%
Trichloroethene	26.43	1.02%
cis-1,3-Dichloropropene	30.23	0.64%
trans-1,3-Dichloropropene	32.75	0.34%
Toluene	32.69	0.48%
1,1,2-Trichloroethane	33.58	0.60%
1,2-Dibromoethane	37.08	0.12%
Perchloroethylene	36.95	0.25%
Chlorobenzene	40.88	0.17%
Ethylbenzene	41.99	0.17%
m&p-Xylene	42.82	0.06%
Styrene	45.14	0.07%
o-Xylene	45.19	0.03%
1,1,2,2-Tetrachloroethane	47.89	0.00%
1,3,5-Trimethylbenzene	52.09	0.08%
1,2,4-Trimethylbenzene	54.49	0.04%
1,3-Dichlorobenzene	56.15	0.03%
1,4-Dichlorobenzene	56.75	0.11%
1,2-Dichlorobenzene	58.96	0.01%
1,2,4-Trichlorobenzene	70.97	0.01%
Hexachlorobutadiene	73.07	0.01%

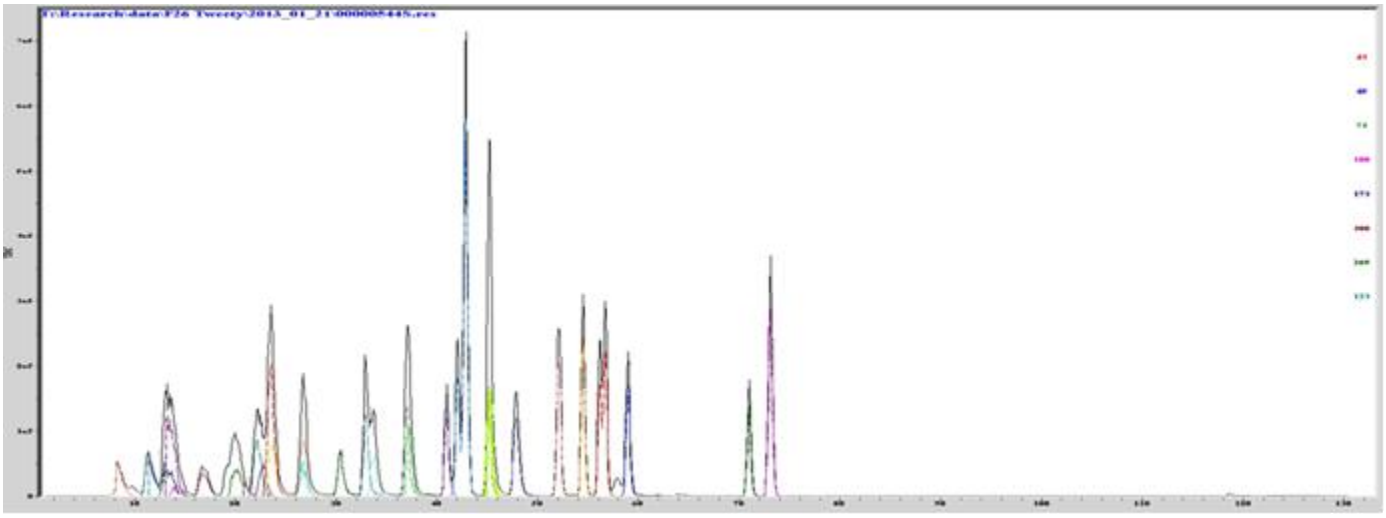

Figure 1 – *Total ion chromatogram of the calibration mix as given in Table 1 showing the deconvolution of coeluting peaks. (Reconstructed chromatograms are shown in different colors).*

Table 1 shows the retention time reproducibility for 3 replicate injections. This table shows the results for 34 compounds from the calibration mix and demonstrates the excellent performance of the CUSTODION-NT and TRIDION-9 GC-MS for retention time reproducibility, essential for accurate quantitation and identification of VOCs in air.

Figure 1 shows a total ion chromatogram of the calibration mixture demonstrating the deconvolution of coeluting peaks. The advanced proprietary peak deconvolution and customized peak identification algorithms offered by CHROMION® software coupled with highly reproducible retention times achieved with the TRIDION-9 GC-MS provide unique compound identification and quantification capabilities. Figure 2 demonstrates the quantitative capabilities of the CUSTODION-NT combined with the TRIDION-9 GC-MS. These results were obtained from a 100 ppb standard made by diluting the calibration mix with lab air in a Tedlar bag. The sample was collected for 2 minutes at 50 mL/min using a CUSTODION-NT. Based on these results, the method detection limit for these compounds is estimated to be in the 10-50 ppb range (depending on compound). If lower detection limits are needed, then longer sampling times can be employed.

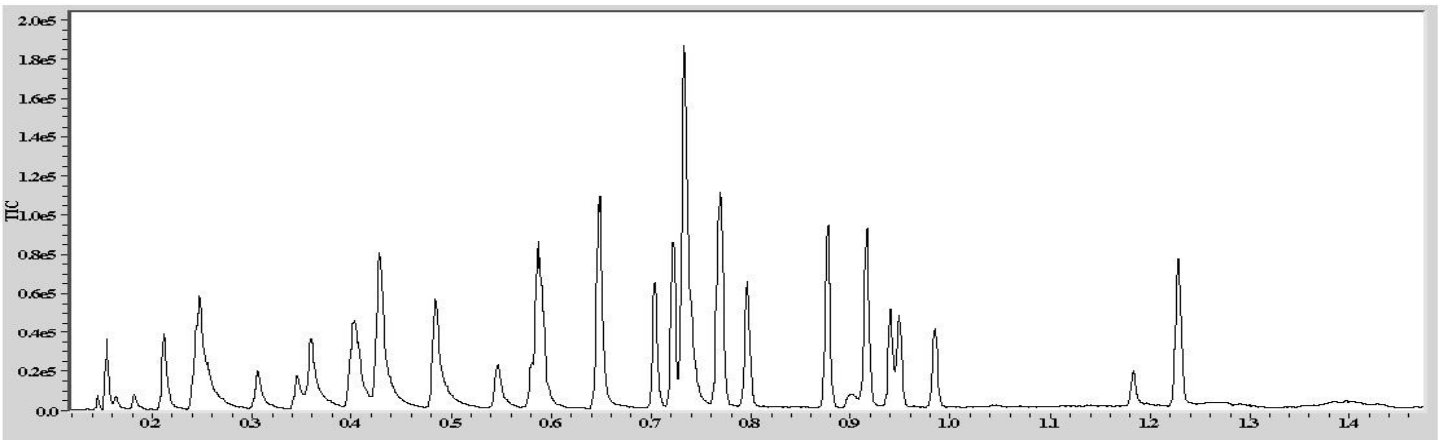

Figure 1 – *Total ion chromatogram of a 100 ppb sample of the calibration mix as given in Table 1*

Conclusions

The CUSTODION-NT and TRIDION-9 GC-MS are uniquely suited for rapid onsite analysis. The combination of ease of use, low cost of the CUSTODION-NT, and the high speed analysis possible with the TRIDION-9 GC-MS allow for an unprecedented number of samples to be processed. This high speed analytical capability provides the information when and where it is needed to make in-field decisions. Wide concentration ranges can be accommodated with CUSTODION-NT by simply adjusting the sampling time and gas flow rate during sampling.

We invite you to talk with a Torion Scientist to help you discover you onsite solution today. Please call 801-705-6600.

Acknowledgements

TRIDION®, CUSTODION® and CHROMION® are registered trademarks of Torion Technologies Inc. The TRIDION-9, CUSTODION-NT, and CHROMION operating software are manufactured and sold under U.S. Patents and Applications 7,075,070, 7,075,064, 11/639,373, 11/379,716 and/or any division, continuations, revisions or foreign filings thereof. SPME fibers are also sold under license from SUPELCO under U.S. Patent 5,691,206, and/or any divisions, continuations, or revisions thereof.

This data represents typical results. For further technical assistance or purchasing information, contact:

Torion Technologies Inc.
796 East Utah Valley Drive, Suite 200
American Fork, UT 84003
Web: http://www.torion.com
Email: information@torion.com
Phone: 801-705-6600
Fax: 801-705-6649

