



Using Needle Trap Device (NTD) with the TRIDION™-9 GC-MS for Trace Level Detection of Selected VOCs in Air

Needle Trapping Devices (NTDs) provide a simple, low cost methodology to collect and introduce samples to an analytical instrument. The low cost and convenience of NTDs allow the analytical chemist 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 Brief 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 gas phase at ambient temperature by passing sample from the bag using a pump flowing at 50 ml/min for 1-5 min into a CUS-TODION-NT with a three-layer bed. Tenax TA (1 mg), Carbox-en 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 second 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%

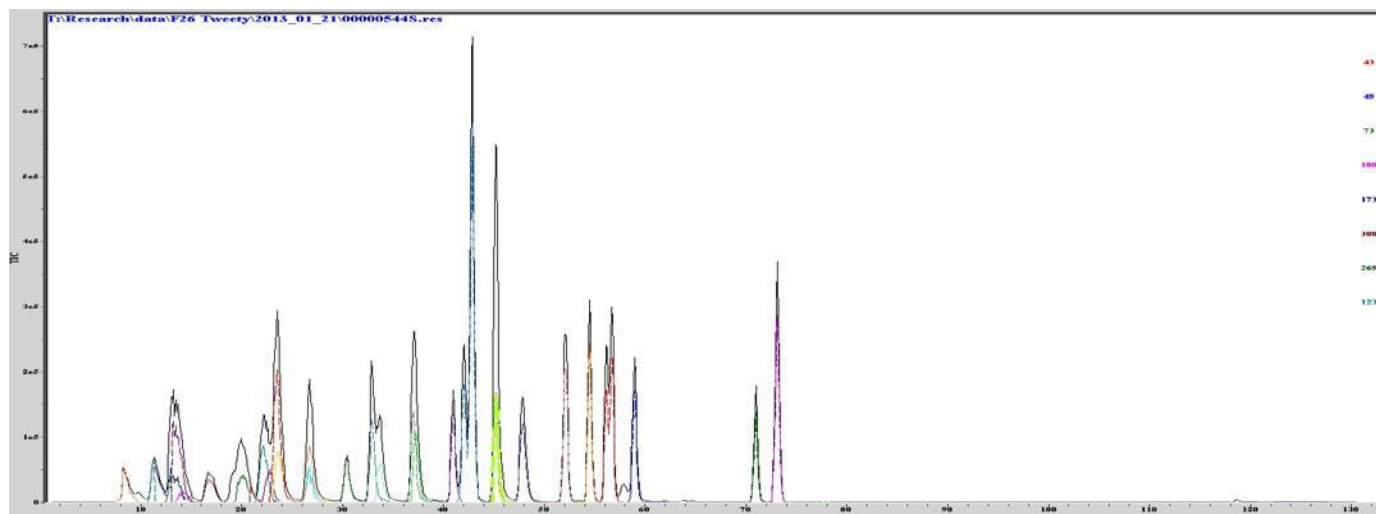


Figure 1 – Total ion chromatogram of the calibration mix as given in Table 1 showing the deconvolution of coeluting peaks. (Reconstructed chromatograms are shown in different colors.)

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 good 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.

Conclusions

The CUSTODION-NT and TRIDION-9 GC-MS are uniquely suited for rapid onsite analysis. The combination of the 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

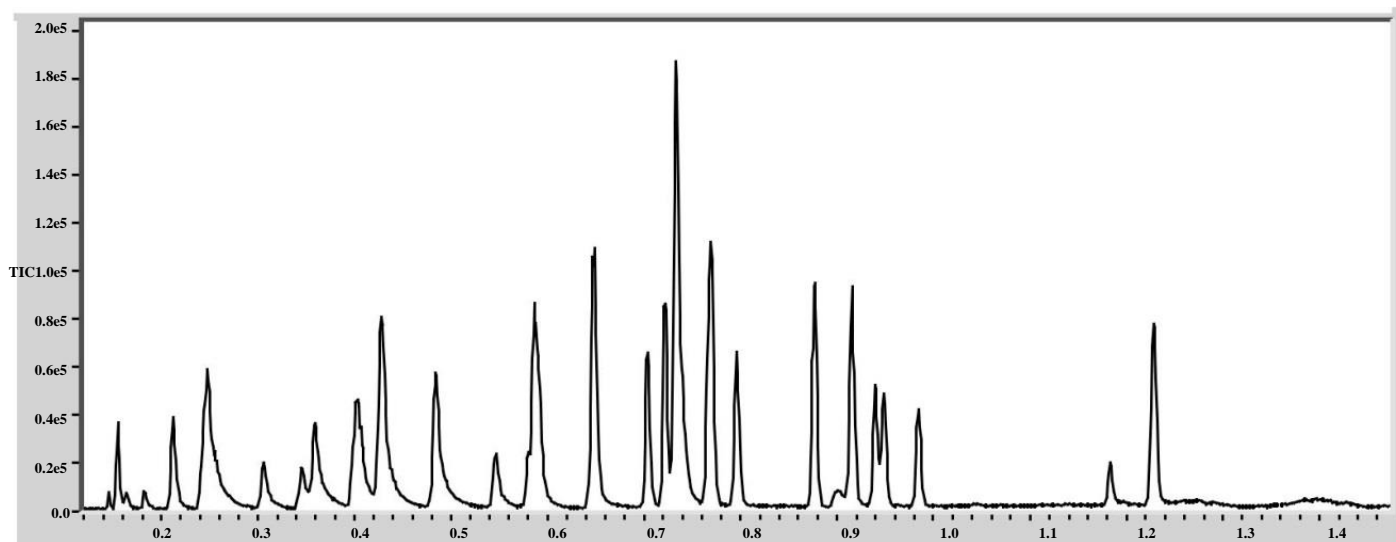


Figure 2 – Total ion chromatogram of a 100 ppb sample of the calibration mix as given in Table 1.

simply adjusting the sampling time and gas flow rate during sampling.

Acknowledgements

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



Abacus Analytical Systems GmbH
 Bottroper Weg 2
 13507 Berlin, Germany
 Tel: +49(0)30 5130132-0
torion@abacus-lab.de