Developing a Consensus Test Method for Measuring Volatile Organic Compounds (VOCs) in Water utilizing Headspace Analysis with Gas Chromatography and Mass Spectrometry (Headspace GC/MS)

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2018 Environmental Measurement Symposium

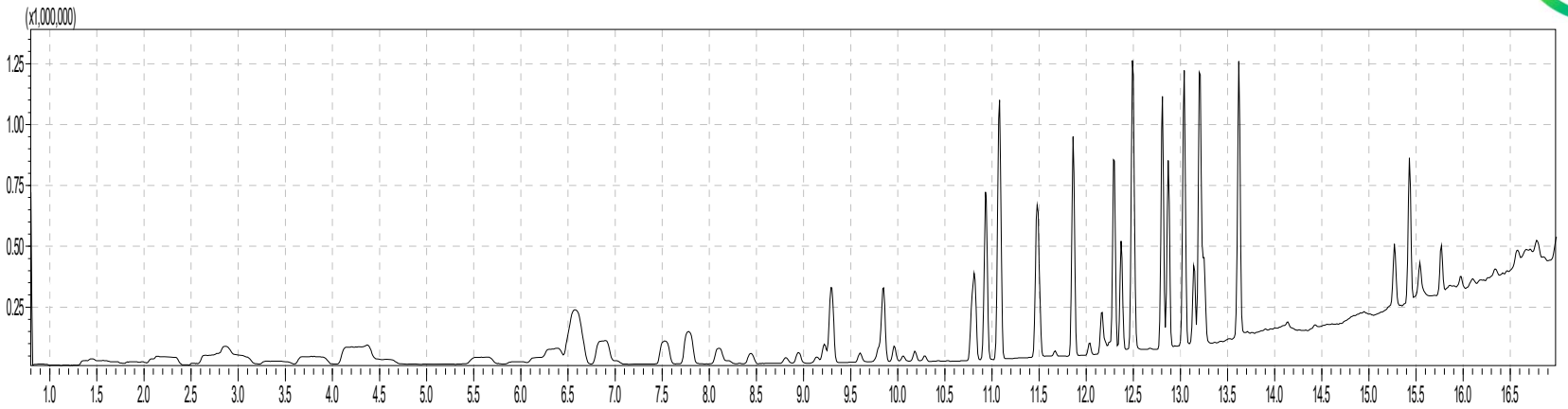
Headspace Cold Trap sampling introduction for the extraction of VOCs in water is an alternative to the use of a Purge and Trap aqueous extraction system.

Headspace Equipment Sample Introduction Configuration Options.

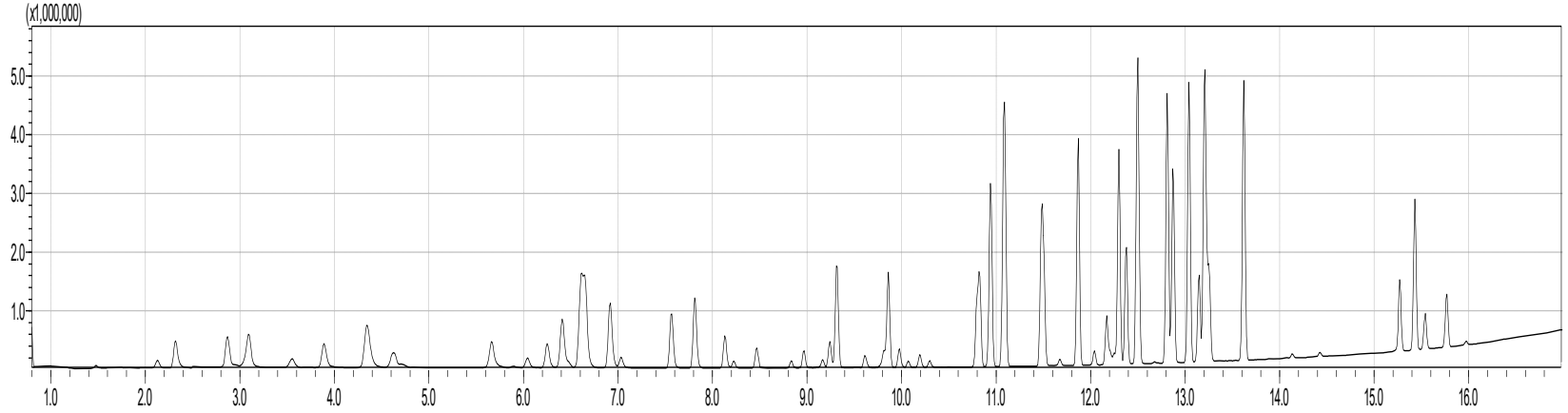
- Sample Loop - A Fixed volume of sample headspace introduced directly to GCMS system.

- Cold Trap - A portion of the sample headspace is concentrated on to the trap, and then is introduced to the GCMS system.

40 ppb Total Ion Chromatogram Standard with Sample Loop Introduction



40 ppb Total Ion Chromatogram Standard with Sample Cold Trap Introduction



Cold Trap Advantages over Loop

- Allows for lower detection limits in a similar range to a purge and trap system.
- Allows for sharper analyte peak separation.

Compounds Evaluated

Dichlorodifluoromethane
Chloromethane
Vinyl chloride
Bromomethane
Chloroethane
Trichlorofluoromethane
1,1-dichloroethene
Carbon disulfide
Acetone
Methylene chloride
Acrylonitrile
trans-1,2-Dichloroethene
Vinyl Acetate
n-Hexane
1,1-dichloroethane
2-Butanone
2,2-dichloropropane
cis-1,2-Dichloroethene
Bromochloromethane
Chloroform

Dibromofluoromethane (SUR)
Carbon Tetrachloride
1,1,1-trichloroethane
Pentafluorobenzene (IS)
1,1-dichloropropene
Benzene
1,2-Dichloroethane
1,4-difluorobenzene (SUR)
Trichloroethene
1,2-Dichloropropane
Dibromomethane
Bromodichloromethane
2-chloroethylvinyl ether
cis-1,3-dichloropropene
4-methyl-2-pentanone
Toluene-D8 (SUR)
Toluene
trans-1,3-Dichloropropene
1,1,2-trichloroethane
Tetrachloroethene

1,3-dichloropropane
2-Hexanone
Dibromochloromethane
1,2-Dibromoethane
Chlorobenzene
Chlorobenzene-d5 (IS)
Ethylbenzene
1,1,1,2-Tetrachloroethane
m p-Xylene
o-Xylene
Bromoform
Styrene
Isopropylbenzene
4-Bromofluorobenzene (SUR)
1,1,2,2-Tetrachloroethane
Bromobenzene
1,2,3-Trichloropropane
n-Propylbenzene
2-Chlorotoluene
4-Chlorotoluene

tert-Butylbenzene
1,3,5-Trimethylbenzene
1,2,4-Trimethylbenzene
1,3-Dichlorobenzene
p-Isopropyltoluene
1,4-Dichlorobenzene-D4 (IS)
1,4-Dichlorobenzene
n-Butyllbenzene
sec-Butylbenzene
1,2-Dichlorobenzene
1,2-Dibromo-3-chloropropane
1,2,4-Trichlorobenzene
Hexachlorobutadiene
Naphthalene
1,2,3-Trichlorobenzene

Equipment and Consumables

Equipment:

- Shimadzu GC-2010 Plus/MS-QP2020
- Shimadzu HS-20 series equipped with cold trap

Consumables

- GC Column - RXI-624Sil MS 20 m x 0.18 x 1 um
- Headspace Trap – Carboxen® adsorbent /Carbosieve® adsorbent

Carboxen, Carbosieve and Carbopack are trademarks of Sigma-Aldrich Co.

Method Parameters

Head space Parameter		GC Parameters		Mass Spec Parameters	
Collection mode loop/Trap:	Trap	Flow Control:	Linear velocity	Ion Source Temp:	200 °C
Oven temperature:	65 °C	Pressure:	9.8 psi	Interface Temp:	230 °C
Sample Line Temperature:	75 °C	Total flow:	5.5 mL/min	Solvent Cut Time:	0.8 min
Transfer Line Temperature:	120 °C	Column Flow:	0.5 mL/min	Microscan width:	0 u
Trap Cooling Temperature:	- 28 °C	Linear Velocity:	31.1 cm/sec	Detector Voltage:	0 relative to tuning report
Trap Desorb Temperature:	250 °C	Split Ratio:	1:10	Scan Mode	SIM
Trap Equilibrium Temperature:	- 28 °C	Purge Flow:	0		
Shaking Level:	3	Oven Ramp:	35 °C hold 5 min		
Multiinjection Count:	1		35 °C to 240 °C		
			15 °C/min hold 0.5 min		
Pressurizing Gas Pressure:	48 psi	Total Run Time:	19.17 min		
Dry Purge Gas Pressure:	7.3 psi				
Equilibrating Time:	30 min				
Pressurizing Time:	2.00 min				
Pressure Equilibration Time:	0.10 min				
Load Time:	5.00 min				
Load Equilibration Time:	0.10 min				
Dry Purge Time:	0.50 min				
Injection Time:	6.00 min				
Needle Flush Time:	3.00 min				
GC Cycle Time:	30 minutes				

Results

Calibration levels and Curve Fit

	std 1	std 2	std 3	std 4	std 5	std 6	std 7	std 8	std 9	std 10	std 11	Curve	R2 or RF(% RSD)
	* 0.5 ppb	* 1 ppb	* 1.5 ppb	* 2(ppb	* 5 ppb	* 7 ppb	* 10 ppb	* 15 ppb	* 20 ppb	* 30 ppb	* 40 ppb	Fit	
	calculated (ppb)	calculated (ppb)	calculated (ppb)	calculated (ppb)	calculated (ppb)	calculated (ppb)	calculated (ppb)	calculated (ppb)	calculated (ppb)	calculated (ppb)	calculated (ppb)		
Dichlorodifluoromethane	0.53	1.04	1.55	2.06	4.75	6.24						Mean RF	6.44
Chloromethane	0.45	1.25	1.59	2.18	5.27	6.78	9.42	15.4				Quadratic	0.99
Vinyl chloride		1.16	1.65	2.10	5.00	6.31	8.51					Quadratic	0.99
Bromomethane	0.46	1.03	1.65	2.47	5.18	6.66	9.14	14.1	17.7			Mean RF	11.3
Chloroethane	0.49	1.05	1.59	2.05	5.31	7.15	9.94	14.5	20.2	28.0	36.1	Mean RF	5.16
Trichlorofluoromethane	0.48	1.01	1.55	2.01	5.22	7.19	10.0	14.9	20.5	29	37.5	Mean RF	3.42
1,1-dichloroethene	0.58	1.09	1.59	2.02	5.04	6.86	9.56	14.2	19.5	27.6	36.1	Mean RF	7.69
Carbon disulfide	0.60	1.09	1.60	2.04	4.99	6.78	9.45	14.1	19.3	27.3	36.0	Mean RF	8.94
Acetone	0.41	1.15	1.56	1.80	4.83	6.95	10.1	15.7	21.0	29.6	39.5	Linear	0.99
Methylene chloride	0.61	1.07	1.6	2.08	5.03	6.73	9.61	14.3	18.8	26.7	36.0	Mean RF	9.38
Acrylonitrile	0.51	0.98	1.44	1.88	4.68	7.66	8.54	15.6	22.3	32.8	39.0	Mean RF	8.06
trans-1,2-Dichloroethene	0.57	1.07	1.58	2.02	4.98	6.9	9.41	14.5	19.7	27.6	37.3	Mean RF	6.52
Vinyl Acetate	0.49	1.12	1.36	2.11	4.80	6.36						Mean RF	8.49
n-Hexane			1.63	1.95	4.91	6.83	9.6	14.5	20.8	30.2	40.4	Mean RF	4.12
1,1-dichloroethane	0.42	0.95	1.49	1.97	5.31	7.20	10.2	15.5	21.1	30.2	40.9	Mean RF	6.03
2-Butanone	0.62	1.17	1.61	1.96	4.94	6.31	9.07	13.9	18.8	27.0	38.6	Mean RF	11.7
2,2-dichloropropane	0.54	1.21	1.61	2.16	5.17	6.83	9.39	13.9	18.2	26.2	36.3	Mean RF	10.3
cis-1,2-Dichloroethene	0.53	1.05	1.55	2.00	4.98	6.81	9.65	14.7	19.9	28.7	39.4	Mean RF	3.51
Bromochloromethane	0.56	1.06	1.59	2.01	5.08	6.76	9.67	14.6	19.4	27.8	37.9	Mean RF	5.80
Chloroform	0.47	1.01	1.54	2.02	5.08	6.99	9.81	15.1	20.6	29.6	40.3	Mean RF	2.70
Dibromofluoromethane (SUR) 30 ppb	31.5	31.5	30.0	31.2	30.5	29.8	27.9	30.9	29.0	29.5	29.8	Mean RF	3.80
Carbon Tetrachloride	0.62	1.05	1.49	2.02	5.08	7.00	9.69	14.8	20.4	29.7	40.1	Linear	0.99

*Calibration level concentrations with the exception of internal standards, surrogates, and m p-Xylene ** concentrations double since results are m-xylene and p-xylene combined.

Calibration levels and Curve Fit

	std 1	std 2	std 3	std 4	std 5	std 6	std 7	std 8	std 9	std 10	std 11	Curve	R2 or RF(% RSD)
	* 0.5 ppb	* 1 ppb	* 1.5 ppb	* 2(ppb	* 5 ppb	* 7 ppb	* 10 ppb	* 15 ppb	* 20 ppb	* 30 ppb	* 40 ppb	Fit	
	calculated (ppb)	calculated (ppb)	calculated (ppb)	calculated (ppb)	calculated (ppb)	calculated (ppb)	calculated (ppb)	calculated (ppb)	calculated (ppb)	calculated (ppb)	calculated (ppb)		
1,1,1-trichloroethane	0.47	0.99	1.53	1.98	5.13	7.06	9.85	15.0	20.8	29.9	40.5	Mean RF	**2.80**
Pentafluorobenzene (IS) 30 ppb	30	30	30	30	30	30	30	30	30	30	30		
1,1-dichloropropene	0.63	1.11	1.64	2.07	5.02	6.89	9.61	14.6	20.6			Linear	**0.99**
Benzene	0.60	1.10	1.60	2.00	4.87	6.55	9.27	14.1	19.4	28.0	38.7	Mean RF	**8.56**
1,2-Dichloroethane	0.47	1.03	1.51	2.04	5.18	6.94	10.0	15.2	20.4	28.8	39.1	Mean RF	**3.00**
1,4-difluorobenzene (SUR) 30 ppb	30.7	30.6	30.6	30.8	30.5	30.1	30.4	30.1	29.6	29.3	29.4	Mean RF	**2.68**
Trichloroethene	0.59	1.05	1.62	1.93	4.85	6.65	10.5	13.4	19.9	27.7	38.0	Mean RF	**8.34**
1,2-Dichloropropane	0.5	1.01	1.54	2	5.11	6.90	9.79	15.0	20.4	29.0	40.0	Mean RF	**1.82**
Dibromomethane	0.53	1.08	1.57	2.04	5.07	6.76	9.73	14.6	19.7	28.1	38.1	Mean RF	**4.56**
Bromodichloromethane	0.47	1.00	1.52	1.99	5.13	6.88	9.86	15.1	20.6	29.8	40.9	Mean RF	**2.50**
2-chloroethylvinyl ether	0.43	0.95	1.51	1.93	5.39	7.30	11.0	16.4				Mean RF	**8.06**
cis-1,3-dichloropropene	0.45	0.97	1.48	1.94	5.03	6.85	9.92	15.3	21.0	31.2	44.1	Mean RF	**5.42**
4-methyl-2-pentanone	0.44	0.91	1.38	1.86	4.93	6.8	9.56	15.4	21.9	34.1	47.1	Mean RF	**9.81**
Toluene-D8 (SUR) 10 ppb	9.85	9.91	9.92	9.92	9.93	10.0	10.0	10.1	10.2	10.2	10.1	Mean RF	**0.99**
Toluene	0.54	1.06	1.59	1.94	4.99	6.94	9.75	15.2				Linear	0.99
trans-1,3-Dichloropropene	0.44	0.95	1.45	1.92	5.04	7.00	9.87	15.3	21.3	31.5	44.0	Mean RF	**5.97**
1,1,2-trichloroethane	0.54	1.07	1.59	2.00	4.96	6.78	9.5	14.4	19.9	28.5	38.9	Mean RF	**4.93**
Tetrachloroethene	0.57	1.06	1.52	1.90	4.69	6.60	9.13	14.1	20.5	30.7	42.3	Mean RF	**6.84**
1,3-dichloropropane	0.44	0.99	1.45	1.96	5.01	6.95	9.85	15.3	21.4	31.0	43.0	Mean RF	**5.21**
2-Hexanone	0.49	0.92	1.28	1.85	4.78	6.64	9.48	14.8	21.7	35.1	49.1	Mean RF	**11.4**
Dibromochloromethane	0.46	1.02	1.51	1.95	4.97	6.91	9.72	15.1	21.0	30.6	41.8	Mean RF	**3.67**
1,2-Dibromoethane	0.47	0.99	1.51	1.97	5.07	6.95	9.77	15.2	20.9	30.4	41.3	Mean RF	**2.97**
Chlorobenzene	0.65	1.16	1.64	2.05	5.01	6.79	9.49	14.7	20.6			Linear	0.99
Chlorobenzene-d5 (IS) 30 ppb	30	30	30	30	30	30	30	30	30	30	30		
Ethylbenzene	0.48	0.94	1.39	1.80	4.74	6.75	9.6	15.3	22.1	33.5	46.5	Mean RF	**8.82**
1,1,1,2-Tetrachloroethane	0.51	1.08	1.61	2.04	5.09	6.96	9.43	14.4	20.0	28.4	38.1	Mean RF	**4.78**
m p-Xylene **	0.98	1.95	2.95	3.88	10.13	14.3	19.8	30.5	42.4	59.9	79.2	Mean RF	**2.61**

*Calibration level concentrations with the exception of internal standards, surrogates, and m p-Xylene ** concentrations double since results are m-xylene and p-xylene combined.

Calibration levels and Curve Fit

	std 1	std 2	std 3	std 4	std 5	std 6	std 7	std 8	std 9	std 10	std 11	Curve	R2 or RF(% RSD)
	* 0.5 ppb	* 1 ppb	* 1.5 ppb	* 2(ppb	* 5 ppb	* 7 ppb	* 10 ppb	* 15 ppb	* 20 ppb	* 30 ppb	* 40 ppb	Fit	
	calculated (ppb)	calculated (ppb)	calculated (ppb)	calculated (ppb)	calculated (ppb)	calculated (ppb)	calculated (ppb)	calculated (ppb)	calculated (ppb)	calculated (ppb)	calculated (ppb)		
o-Xylene	0.50	0.98	1.49	1.98	5.05	7.04	9.87	15.2	20.9	29.6	39.0	Mean RF	**1.94**
Bromoform	0.61	1.12	1.63	2.11	5.15	6.87	9.35	14.1	18.9	25.8	33.2	Mean RF	**11.5**
Styrene	0.48	0.96	1.44	1.89	5.11	7.20	10.2	15.8	21.5	30.2	39.5	Mean RF	**4.24**
Isopropylbenzene	0.47	0.93	1.43	1.86	5.14	7.29	10.1	15.7	22.0	30.9	40.1	Mean RF	**5.76**
4-Bromofluorobenzene (SUR) 10 ppb	11.2	10.9	10.9	10.9	10.7	10.6	10.4	10.1	9.7	9.17	8.66	Mean RF	**13.0**
1,1,2,2-Tetrachloroethane	0.43	1.22	1.51	2.22	5.39	7.20	7.6	16.5	19.9	30.1	39.9	Linear	0.99
Bromobenzene	0.65	1.17	1.68	2.09	5.00	6.78	9.19	13.8	18.2	25.1	32.6	Mean RF	14.7
1,2,3-Trichloropropane	0.55	1.14	1.63	2.05	5.21	6.86	9.67	14.4	19.2	26.1	34.5	Mean RF	**9.11**
2-Chlorotoluene	0.51	1.03	1.55	2.00	5.18	7.10	9.85	14.9	20.3	28.3	36.8	Mean RF	**3.84**
4-Chlorotoluene	0.47	0.96	1.48	1.92	5.13	7.15	9.91	15.4	21.3	30.3	40.5	Mean RF	**3.72**
tert-Butylbenzene	0.44	0.91	1.4	1.83	5.11	7.27	10.1	15.7	22.3	32.1	42.3	Mean RF	**7.68**
1,3,5-Trimethylbenzene	0.43	0.91	1.39	1.83	5.06	7.20	10.1	16.0	22.4	32.4	42.6	Mean RF	**8.46**
1,2,4-Trimethylbenzene	0.46	0.92	1.43	1.89	5.21	7.36	10.2	15.7	21.7	30.5	39.5	Mean RF	**5.56**
1,3-Dichlorobenzene	0.42	0.96	1.48	1.94	5.23	7.42	10.2	15.7	21.8	30.0	39.1	Mean RF	**6.66**
p-Isopropyltoluene	0.43	0.89	1.37	1.80	5.06	7.24	10.2	16.0	22.8	32.6	42.7	Mean RF	**9.22**
1,4-Dichlorobenzene-D4 (IS) 30 ppb	30	30	30	30	30	30	30	30	30	30	30		
1,4-Dichlorobenzene	0.55	1.1	1.57	2.03	5.05	6.88	9.57	14.5	19.6	27.6	36.8	Mean RF	**6.34**
n-Butyllbenzene	0.47	0.91	1.37	1.77	4.96	7.13	9.94	15.5	22.4	33.0	43.8	Mean RF	**8.22**
sec-Butylbenzene	0.44	0.91	1.41	1.86	5.17	7.38	10.2	15.8	22.3	32.0	40.0	Mean RF	**7.55**
1,2-Dichlorobenzene	0.57	1.04	1.51	1.91	4.82	6.66	9.48	14.6	20.5	29.7	40.6	Mean RF	**5.65**
1,2-Dibromo-3-chloropropane	0.49	0.96	1.27	1.76	5.24	7.05	9.85	15.4	21.0	29.8	39.5	Linear	0.99
1,2,4-Trichlorobenzene	0.61	1.15	1.60	2.00	4.90	6.68	9.27	14.1	19.3	27.0	36.0	Mean RF	**10.5**
Hexachlorobutadiene	0.54	1.07	1.60	1.98	5.02	6.96	9.36	14.2	20.1	29.0	37.8	Mean RF	**5.10**
Naphthalene	0.66	1.15	1.54	1.90	4.91	6.77	9.68	15.0	20.7	29.6	40.1	Linear	0.99
1,2,3-Trichlorobenzene	0.60	1.13	1.61	2.01	4.93	6.78	9.42	14.1	19.4	26.9	35.5	Mean RF	**9.78**

* Calibration level concentrations with the exception of internal standards, surrogates, and m p-Xylene ** concentrations double since results are m-xylene and p-xylene combined.

MDLs

	MDL 1	MDL 2	MDL 3	MDL 4	MDL 5	MDL 6	MDL 7	MDL 8	MDL 9	Mean	Mean Recovery	**STDEV**	**RSD**	MDL
	* 2 ppb	* 2 ppb	* 2 ppb	* 2 ppb	* 2 ppb	* 2 ppb	* 2 ppb	* 2 ppb	* 2 ppb	ppb	%		%	ppb
Dichlorodifluoromethane	1.96	2.22	2.47	2.42	2.34	2.41	2.33	2.47	2.45	2.34	117	0.164	7.02	0.516
Chloromethane	1.85	2.00	3.45	2.19	1.91	2.16	1.84	2.10	1.89	2.15	108	0.503	23.4	1.581
Vinyl chloride	2.29	2.95	3.01	3.39	3.08	3.21	3.19	3.18	2.94	3.03	151	0.311	10.3	0.977
Bromomethane	2.20	2.02	2.36	2.52	2.34	2.37	2.24	2.29	2.27	2.29	115	0.137	5.99	0.431
Chloroethane	2.01	1.97	2.06	2.03	2.01	2.05	2.09	2.09	2.13	2.05	102	0.050	2.42	0.156
Trichlorofluoromethane	1.73	1.86	1.97	1.92	1.91	1.95	1.99	2.03	2.06	1.94	96.8	0.099	5.09	0.309
1,1-dichloroethene	1.83	1.89	1.98	1.93	1.93	1.97	2.01	2.04	2.07	1.96	98.1	0.075	3.83	0.236
Carbon disulfide	1.88	1.89	1.97	1.92	1.89	1.92	1.97	1.98	2.02	1.94	96.9	0.049	2.53	0.154
Acetone	1.81	1.83	1.90	2.14	1.90	1.90	1.67	1.66	1.73	1.84	91.9	0.148	8.05	0.465
Methylene chloride	2.26	1.99	2.12	2.01	2.02	2.02	2.09	2.12	2.16	2.09	104	0.088	4.21	0.276
Acrylonitrile	1.95	2.27	2.43	2.35	2.31	2.30	2.38	2.40	2.42	2.31	116	0.147	6.35	0.461
trans-1,2-Dichloroethene	1.99	1.93	1.98	1.94	1.89	1.90	1.96	1.99	2.02	1.96	97.8	0.044	2.25	0.138
Vinyl Acetate	3.08	2.63	2.76	2.54	2.51	2.27	2.49	2.52	2.56	2.60	130	0.223	8.59	0.700
n-Hexane	1.49	1.60	1.66	1.61	1.59	1.61	1.64	1.65	1.67	1.61	80.7	0.054	3.35	0.170
1,1-dichloroethane	2.26	2.02	2.09	2.01	1.98	2.06	2.04	2.05	2.09	2.07	103	0.081	3.92	0.254
2-Butanone	2.31	1.93	2.03	1.91	1.86	1.80	1.87	1.95	1.98	1.96	98.0	0.148	7.55	0.464
2,2-dichloropropane	3.51	3.01	3.02	2.91	2.81	2.63	2.79	2.67	2.64	2.89	144	0.276	9.57	0.868
cis-1,2-Dichloroethene	2.21	1.97	2.04	1.97	1.93	1.92	1.97	1.98	2.02	2.00	100	0.087	4.35	0.273
Bromochloromethane	2.35	2.00	2.07	2.01	2.03	1.97	2.07	2.05	1.98	2.06	103	0.115	5.59	0.361
Chloroform	2.30	2.08	2.16	2.10	2.06	2.08	2.13	2.13	2.17	2.13	107	0.072	3.40	0.228
Dibromofluoromethane (SUR) 30 ppb	35.7	30.5	30.6	30.8	31.0	29.8	30.4	30.6	30.9	31.1	104	1.73	5.56	
Carbon Tetrachloride	2.03	2.02	2.19	2.07	2.09	2.03	1.97	2.17	2.15	2.08	104	0.076	3.65	0.238
1,1,1-trichloroethane	2.05	1.99	2.07	2.01	1.99	1.99	2.05	2.06	2.07	2.03	102	0.036	1.75	0.112
Pentafluorobenzene (IS) 30 ppb	30	30	30	30	30	30	30	30	30					

*Calibration level concentrations with the exception of internal standards, surrogates, and m p-Xylene ** concentrations double since results are m-xylene and p-xylene combined.

MDLs

	MDL 1	MDL 2	MDL 3	MDL 4	MDL 5	MDL 6	MDL 7	MDL 8	MDL 9	Mean	Mean Recovery	STDEV	RSD	MDL
	* 2 ppb	* 2 ppb	* 2 ppb	* 2 ppb	* 2 ppb	* 2 ppb	* 2 ppb	* 2 ppb	* 2 ppb	ppb	%		%	ppb
1,1-dichloropropene	2.11	2.14	2.21	2.14	2.08	2.09	2.12	2.12	2.16	2.13	107	0.039	1.83	0.123
Benzene	2.17	2.00	2.04	1.99	1.93	1.96	2.01	2.02	2.05	2.02	101	0.068	3.36	0.213
1,2-Dichloroethane	2.44	2.00	2.10	2.06	1.99	1.98	2.05	2.08	2.13	2.09	105	0.140	6.69	0.440
1,4-difluorobenzene (SUR) 30 ppb	33.3	30.5	30.2	30.3	30.5	30.1	30.1	30.3	30.2	30.6	102	1.02	3.32	
Trichloroethene	2.00	1.98	1.95	1.89	1.86	1.93	1.97	1.97	2.00	1.95	97.5	0.048	2.49	0.152
1,2-Dichloropropane	2.30	2.03	2.04	2.01	1.97	2.00	2.01	2.04	2.07	2.05	103	0.097	4.74	0.305
Dibromomethane	2.36	1.98	2.03	2.03	1.97	1.94	2.02	2.05	2.04	2.05	102	0.123	6.01	0.386
Bromodichloromethane	2.41	2.13	2.14	2.11	2.04	2.07	2.12	2.11	2.14	2.14	107	0.106	4.96	0.333
2-chloroethylvinyl ether	2.96	2.15	2.20	1.92	2.27	2.05	2.14	2.09	1.93	2.19	110	0.311	14.2	0.976
cis-1,3-dichloropropene	2.63	2.24	2.25	2.18	2.13	2.11	2.18	2.18	2.18	2.23	112	0.156	7.00	0.490
4-methyl-2-pentanone	2.10	1.97	2.02	1.84	1.90	1.84	1.91	1.91	1.88	1.93	96.5	0.086	4.45	0.270
Toluene-D8 (SUR) 10 ppb	9.39	9.78	9.81	9.82	9.82	9.8	9.74	9.83	9.81	9.76	32.5	0.140	1.43	
Toluene	1.65	1.78	1.86	1.85	1.76	1.81	1.86	1.87	1.86	1.81	90.6	0.072	3.99	0.227
trans-1,3-Dichloropropene	2.35	2.22	2.29	2.24	2.18	2.16	2.19	2.15	2.19	2.22	111	0.065	2.94	0.205
1,1,2-trichloroethane	2.1	1.97	2.04	2.02	1.93	1.94	2.02	1.97	2.08	2.01	100	0.060	2.98	0.188
Tetrachloroethene	1.69	1.93	1.99	1.95	1.91	1.95	1.97	2.00	1.98	1.93	96.5	0.094	4.89	0.297
1,3-dichloropropane	2.12	2	2.06	2.03	1.95	1.99	2.01	2.00	2.05	2.02	101	0.049	2.42	0.154
2-Hexanone	2.16	2.03	1.96	1.81	1.99	1.75	1.91	1.89	1.82	1.92	96.2	0.127	6.57	0.397
Dibromochloromethane	2.12	1.98	2.09	2.01	1.97	2.05	2.03	2.07	2.08	2.04	102	0.051	2.50	0.160
1,2-Dibromoethane	2.08	2.00	1.99	1.91	1.95	1.96	2.01	2.00	1.98	1.99	99.3	0.047	2.36	0.147
Chlorobenzene	2.09	2.1	2.19	2.14	2.08	2.12	2.13	2.13	2.16	2.13	106	0.035	1.63	0.109
Chlorobenzene-d5 (IS) 30 ppb	30	30	30	30	30	30	30	30	30					
Ethylbenzene	1.67	1.8	1.89	1.82	1.79	1.84	1.86	1.87	1.88	1.82	91.2	0.068	3.71	0.212
1,1,1,2-Tetrachloroethane	2.09	2.13	2.17	2.12	2.07	2.1	2.18	2.14	2.21	2.13	107	0.046	2.14	0.143
m p-Xylene **	3.61	3.97	4.07	3.93	3.89	3.95	4.10	4.03	4.07	3.96	98.9	0.149	3.76	0.467

* Calibration level concentrations with the exception of internal standards, surrogates, and m p-Xylene ** concentrations double since results are m xylene and p-xylene combined.

MDLs

	MDL 1	MDL 2	MDL 3	MDL 4	MDL 5	MDL 6	MDL 7	MDL 8	MDL 9	Mean	Mean Recovery	STDEV	RSD	MDL
	* 2 ppb	* 2 ppb	* 2 ppb	* 2 ppb	* 2 ppb	* 2 ppb	* 2 ppb	* 2 ppb	* 2 ppb	ppb	%		%	ppb
o-Xylene	1.91	2.02	2.06	2.02	1.97	1.99	2.05	2.07	2.13	2.02	101	0.064	3.14	0.200
Bromoform	2.37	2.23	2.31	2.21	2.17	2.26	2.29	2.24	2.3	2.26	113	0.060	2.65	0.188
Styrene	1.95	1.95	1.98	1.96	1.92	1.97	1.97	2.02	2.05	1.97	98.7	0.039	1.98	0.123
Isopropylbenzene	1.73	1.94	2.01	1.96	1.93	1.98	2.02	2.01	2.05	1.96	97.9	0.094	4.82	0.296
4-Bromofluorobenzene (SUR) 10 ppb	11.1	10.9	10.8	10.9	10.9	10.8	10.9	10.8	10.8	10.9	36.3	0.082	0.75	
1,1,2,2-Tetrachloroethane	2.63	2.35	2.52	2.44	2.39	2.24	2.42	2.38	2.41	2.42	121	0.109	4.49	0.341
Bromobenzene	2.09	2.13	2.16	2.13	2.03	2.11	2.17	2.15	2.17	2.13	106	0.045	2.13	0.142
1,2,3-Trichloropropane	2.42	2.2	2.24	2.22	2.14	2.19	2.29	2.2	2.22	2.24	112	0.080	3.58	0.251
2-Chlorotoluene	1.96	2.04	2.11	2.06	2.01	2.06	2.1	2.09	2.13	2.06	103	0.053	2.59	0.167
4-Chlorotoluene	1.89	1.98	2.04	2	1.96	1.99	2.04	2.02	2.06	2.00	100	0.052	2.59	0.162
tert-Butylbenzene	1.65	1.9	1.98	1.92	1.89	1.94	1.98	1.97	1.99	1.91	95.7	0.105	5.51	0.331
1,3,5-Trimethylbenzene	1.71	1.89	1.97	1.92	1.9	1.93	1.97	1.94	1.99	1.91	95.7	0.083	4.35	0.261
1,2,4-Trimethylbenzene	1.81	1.96	2.04	1.98	1.94	1.97	2.02	2.01	2.04	1.97	98.7	0.071	3.60	0.223
1,3-Dichlorobenzene	1.71	2.01	2.1	2.08	2.1	2.05	2.11	2.05	2.15	2.04	102	0.130	6.39	0.409
p-Isopropyltoluene	1.65	1.9	1.97	1.92	1.89	1.94	1.96	1.97	1.99	1.91	95.5	0.103	5.40	0.324
1,4-Dichlorobenzene-D4 (IS) 30 ppb	30	30	30	30	30	30	30	30	30					
1,4-Dichlorobenzene	2.04	2.08	2.14	2.11	2.05	2.08	2.14	2.12	2.16	2.10	105	0.042	2.00	0.132
n-Butyllbenzene	1.61	1.86	1.95	1.89	1.85	1.9	1.94	1.93	1.94	1.87	93.7	0.105	5.63	0.331
sec-Butylbenzene	1.66	1.94	2.02	1.97	1.93	1.99	2.02	2.03	2.04	1.96	97.8	0.118	6.01	0.369
1,2-Dichlorobenzene	1.96	1.95	2.02	1.97	1.92	1.95	1.99	1.98	2.02	1.97	98.7	0.033	1.68	0.104
1,2-Dibromo-3-chloropropane	2.10	1.83	1.87	1.89	1.84	1.99	1.77	1.84	1.79	1.88	94.0	0.104	5.53	0.327
1,2,4-Trichlorobenzene	2.26	2.17	2.18	2.13	2.07	2.11	2.16	2.11	2.15	2.15	107	0.054	2.52	0.170
Hexachlorobutadiene	1.75	2.09	2.17	2.13	2.09	2.14	2.15	2.16	2.18	2.10	105	0.133	6.37	0.419
Naphthalene	2.60	2.14	2.03	1.97	1.91	1.89	1.97	1.96	1.99	2.05	103	0.218	10.6	0.685
1,2,3-Trichlorobenzene	2.49	2.21	2.19	2.13	2.07	2.11	2.15	2.11	2.17	2.18	109	0.124	5.67	0.389

* Calibration level concentrations with the exception of internal standards, surrogates, and m,p-Xylene ** Concentrations double since results are m-xylene and p-xylene combined.

Conclusions

- A GCMS-HS trap system utylizing SIM and a higher temperature limit RXI-624Sil MS column is capable of allowing for the detection and identification of 75 volatile organic compounds within 17 minutes.

- Dynamic analytical ranges between 0.5 ppb to 40 ppb can be obtained for the majority of analytes.

- A precision of < 15 % RSD for the majority of analytes.

Path Forward

- Experiment with improving retention of early eluting compounds with a cold trap packed with Carboxen® adsorbent and Carbopack™ adsorbent to improve retention of early eluting compounds.

- Analyze and spike samples with various matrixes.

Questions?

Acknowledgements

William Lipps, Eurofins Eaton Analytical, LLC

Brahm Prakash, Shimadzu Scientific Instruments, Inc.