

Routine analysis of volatile organic compounds in drinking water with ISQ 7000 GC-MS

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Goal

Demonstration of a routine analytical method that meets the requirements outlined in U.S. EPA Method 524.2 for the quantitation of volatile organic compounds (VOCs) in drinking water, using a purge and trap (P&T) system coupled to a single quadrupole GC-MS. Method detection limit (MDL), linearity, precision, and accuracy were assessed to evaluate method performance.

Introduction

U.S. EPA Method 524.2 is widely used in routine environmental analysis laboratories to test water samples for VOCs.¹ The method tests for a wide range of VOCs, including the four trihalomethane disinfection by-products that have sufficiently high volatility and low water solubility, to be removed from water samples with P&T procedures. Routine drinking water monitoring regulatory standards require contract testing labs to analyze for the presence of VOCs due to the potentially negative health effects associated with public water source contamination. It is



extremely important that routine laboratories ensure both accurate and rapid detection and quantitation of VOCs to ensure public safety.

There are several challenges that routine analysis laboratories face when performing U.S. EPA Method 524.2. Initially, laboratories must demonstrate achievement of method acceptance criteria including detection limit requirements for an assortment of compounds over a wide range of concentrations. The analytical method must be robust and reproducible to ensure consistent results are reported. Another significant challenge is the management of the moisture when analyzing water samples. Analysis of water samples can introduce moisture into the GC analytical column and cause damage if not properly managed. The resulting unplanned downtime of an analytical instrument can disrupt or delay sample reporting, which could in turn jeopardize the safety of a public water system.

The following evaluation describes the use of the Thermo Scientific™ ISQ™ 7000 MS system coupled to the Teledyne Tekmar Atomx XYZ purge and trap (P&T) system for U.S. EPA Method 524.2.

Experimental

Sample preparation

A 25 µg/mL (parts per million or ppm) calibration working standard was prepared in methanol from the following Restek® standards: Drinking Water VOA MegaMix®, Ketone Mix, and 502.2 Calibration Mix. In total, the standards contained 80 compounds.

The calibration curve was prepared from 0.05 µg/L to 50 µg/L (parts per billion or ppb) for all compounds. The

relative response factor (RRF) was calculated for each compound using one internal standard: fluorobenzene. Surrogate standards consisted of 4-bromofluorobenzene and 1,2-dichlorobenzene-D₄. Internal and surrogate standards were prepared in methanol from Restek standards at a concentration of 25 ppm, after which 5 µL was then mixed with each 5 mL sample for a resulting concentration of 25 ppb.

A quantity of seven 0.5 ppb standards were prepared in deionized water to calculate the MDL and precision for all compounds. Also, seven 5 ppb standards were prepared to determine the accuracy and precision of recovery of each compound. All calibration, MDL, and recovery standards were analyzed with the Atomx XYZ conditions in Table 1.

Table 1. Teledyne Tekmar Atomx XYZ water method conditions

Standby	Variable	Desorb	Variable
Valve Oven Temp	140 °C	Methanol Needle Rinse	Off
Transfer Line Temp	140 °C	Methanol Needle Rinse Volume	0.00 mL
Sample Mount Temp	90 °C	Water Needle Rinse Volume	7.00 mL
Transfer Line Temp	140 °C	Methanol Needle Rinse Volume	0.00 mL
Sample Vial Temp	20 °C	Desorb Preheat Temp	245 °C
Soil Valve Temp	100 °C	GC Start Signal	Begin Desorb
Standby Flow	10 mL/min	Desorb Time	4.00 min
Condensate Ready Temp	45 °C	Drain Flow	300 mL/min
Purge Ready Temp	40 °C	Desorb Temp	250 °C
Purge	Variable	Bake	Variable
Sample Equilibrate Time	0.00 min	Methanol Glass Rinse	Off
Pre-sweep Time	0.25 min	Number of Methanol Glass Rinses	0
Prime Sample Fill Volume	3.00 mL	Methanol Glass Rinse Volume	0.00 mL
Sample Volume	5.00 mL	Water Bake Rinses	1
Sweep Sample Time	0.25 min	Water Bake Rinse Volume	7.00 mL
Sweep Sample Flow	100 mL/min	Bake Rinse Sweep Time	0.25 min
Sparge Vessel Heater	Off	Bake Rinse Sweep Flow	100 mL/min
Sparge Vessel Temp	20 °C	Bake Rinse Drain Time	0.40 min
Pre-purge Time	0.00 min	Bake Time	2.00 min
Pre-purge Flow	0 mL/min	Bake Flow	200 mL/min
Purge Time	11.00 min	Bake Temp	280 °C
Purge Flow	40 mL/min	Condensate Bake Temp	180 °C
Purge Temp	20 °C		
Condensate Purge Temp	20 °C		
Dry Purge Time	1.00 min	Trap	K
Dry Purge Flow	100 mL/min	Chiller Tray	Off
Dry Purge Temp	20 °C	Purge Gas	Nitrogen

GC-MS conditions

A Thermo Scientific™ TRACE™ 1310 Gas Chromatograph (GC) was coupled to the ISQ 7000 system equipped with the Thermo Scientific™ NeverVent™ Vacuum probe interlock (VPI) and a Thermo Scientific™ ExtractaBrite™ ion source. An Rtx® VMS column (20 m, 0.18 mm, 1 µm film) from Restek, which is equivalent to the Thermo Scientific™ TraceGOLD TG-VMS 20 m, 0.18 mm, 1 µm film (P/N 26080-4950), was used for compounds separation, with a run time under 15 minutes. The TRACE 1310 GC was equipped with an iConnect SSL injector operating in split mode. The ISQ 7000 MS system was operated in full scan mode, offering sufficient sensitivity to achieve the required limits of detection. Note: The instrument can also be operated in Selected Ion Monitoring (SIM) mode to increase selectivity. This is particularly useful in samples such as sludge that have matrix interferences. Expanded method parameters for the ISQ 7000 MS system are displayed in Table 2. The data were acquired, processed, and reported using Thermo Scientific™ Chromeleon™ Chromatography Data System (CDS) software.

Results and discussion

Chromatography

Using the GC conditions described in Table 2, all compounds of interest were well resolved chromatographically.

Table 2. GC-MS conditions

Thermo Scientific TRACE 1310 GC conditions	
Column	Rtx® VMS, 20 m × 0.18 mm 1 µm film
Carrier gas	Helium – 0.8 mL/min constant flow
Oven temperature	35 °C, 3 min 12 °C/min to 85 °C 25 °C/min to 225 °C 2 min Hold Run time 14.767 min
Inlet temperature and injection mode	SSL, 200 °C, 50:1 split
Thermo Scientific ISQ 7000 MS conditions	
Transfer line temperature	230 °C
Ion source temperature	280 °C
Acquisition mode	Full scan 35 <i>m/z</i> to 260 <i>m/z</i> Solvent delay 0.50 min Dwell time 0.15 s
Emission current	25 µA Gain 1.00E+005

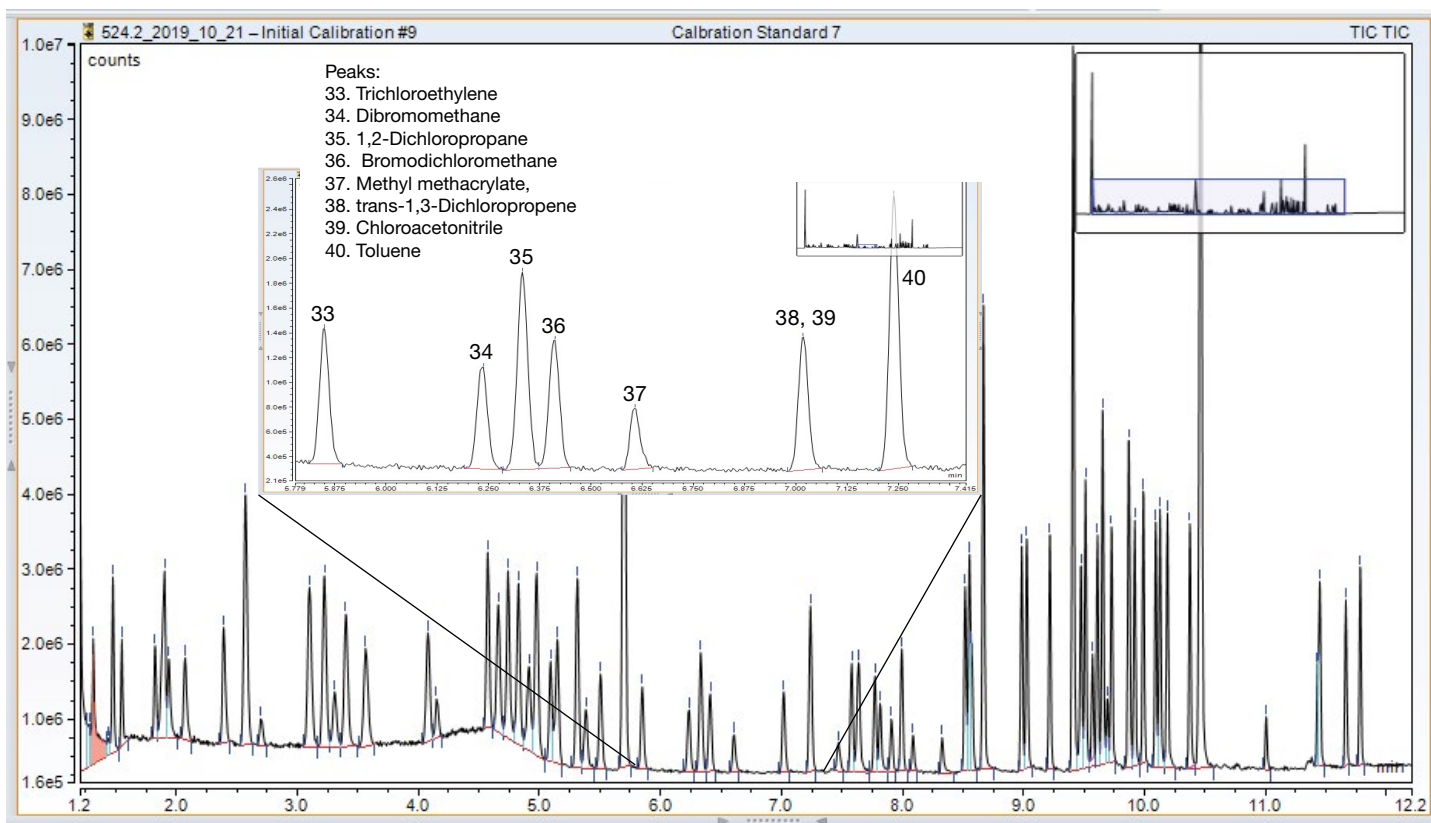


Figure 1. Total ion chromatogram (TIC) of a 5 ppb VOC standard (analyzed using the water method) with an inset indicating consistent peak shapes and separation with minimal water interference

It is evident that there is minimal water transfer compared with traditional purge and trap analysis as there were no detrimental effects to peak shape due to moisture entering the analytical column. This resulted in optimized chromatography that was maintained in lower concentration samples. Figure 1 displays consistent peak shape and separation of a 5 ppb VOC standard with minimal water interference.

Linearity and sensitivity

The calibration range of 0.05 ppb to 50 ppb was assessed for all compounds. Figure 2 shows a summary of the data for the calculated concentration for a 0.5 ppb standard for seven injections and the calculated MDLs for seven compounds over the chromatographic range.

Table 3 displays the relative standard deviation (%RSD) of the response factors (RFs), which were <20% for all compounds, except for iodomethane, which used a linear calibration and achieved $R^2=0.997$. The table also shows the MDL for each analyte is <0.25 ppb along with the accuracy and precision data. Figure 3 demonstrates the quantitation of 1,4-dichlorobenzene at 5 ppb in a VOC standard with excellent library spectral matching and calibration curve. Figure 4 displays several 0.05 ppb (the lowest calibration standard) VOC standards exhibiting excellent peak shape. In U.S. EPA Method 524.2 the lowest calibration point is typically 0.2 ppb. This method demonstrates that all compounds can be detected below the normal lowest calibration point.

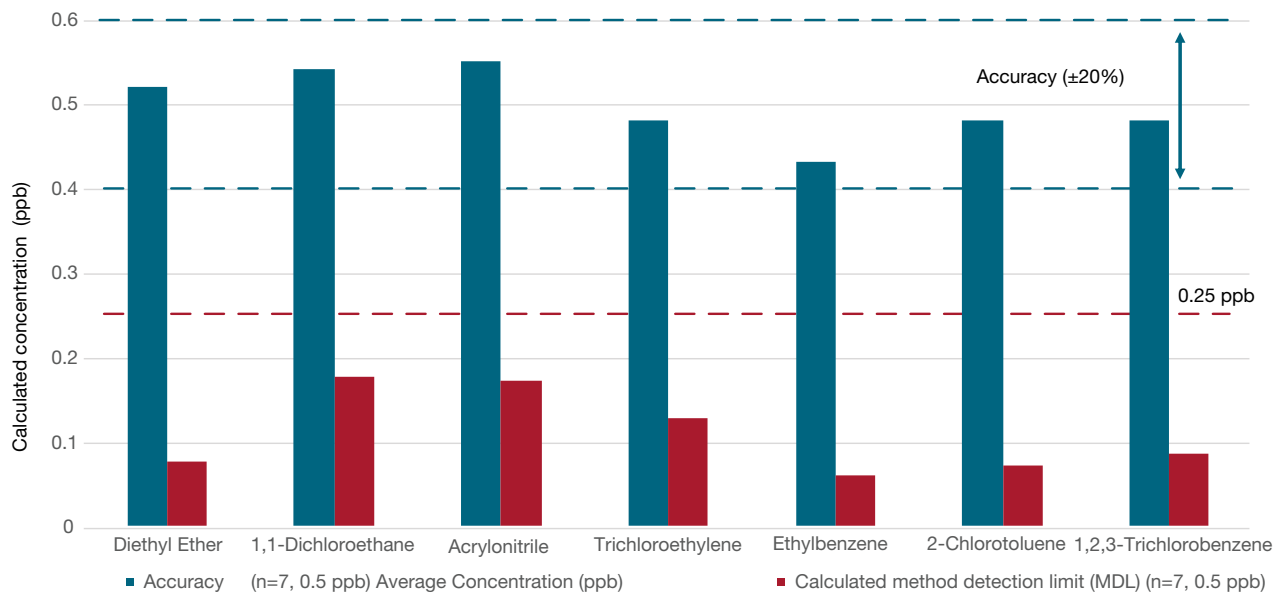


Figure 2. Calculated concentration for standard at 0.5 ppb for seven injections with calculated MDL of less than 0.25 ppb for all compounds

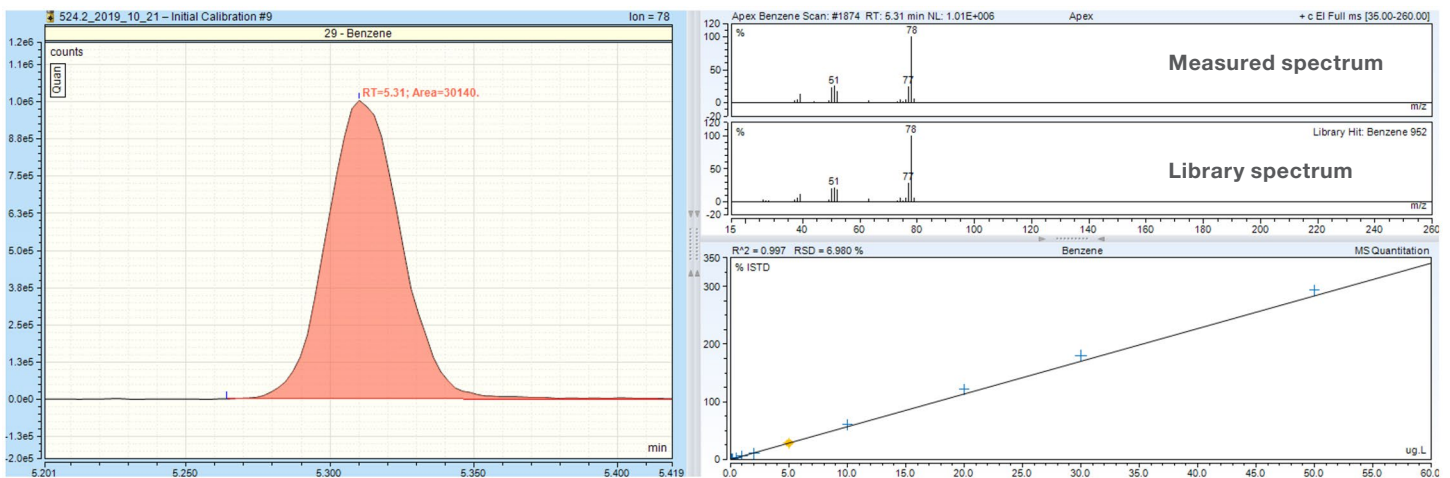


Figure 3. Chromleon results browser showing extracted ion chromatogram for benzene (m/z 78), as well as NIST library results and a linear calibration range of 0.05 ppb to 50 ppb

Table 3 (part 1). U.S. EPA Method 524.2 calibration, accuracy, and precision data

Compound	Calibration			Accuracy and precision (n=7, 0.5 ppb)			Analyte recovery (n=7, 5 ppb)	
	Retention time	Linearity (RF %RSD)	Average RF	Average conc. (ppb)	MDL (ppb)	Precision ($\leq 20\%$)	Accuracy ($\pm 20\%$)	Precision ($\leq 20\%$)
Dichlorodifluoromethane	1.31	14.7	0.46	0.52	0.15	8.9	111	7.6
Chloromethane ¹	1.48	19.1	1.28	0.56	0.17	9.5	102	4.2
Vinyl Chloride	1.55	15.2	0.64	0.52	0.21	13.0	109	5.7
Bromomethane	1.83	19.2	0.52	0.68	0.21	9.7	107	9.1
Chloroethane	1.94	10.0	0.56	0.52	0.13	7.8	106	4.5
Trichlorofluoromethane	2.07	18.6	0.57	0.54	0.19	11.2	114	6.4
Diethyl Ether	2.4	8.2	0.58	0.52	0.08	4.6	110	2.6
1,1-Dichloroethene	2.57	9.6	0.47	0.51	0.16	9.9	103	6.8
Carbon Disulfide ²	2.58	9.1	1.99	0.56	0.17	9.4	104	6.1
Iodomethane ^{3,5}	2.71	n.a.	0.37	0.28	0.05	5.9	71	19.7
Allyl Chloride	3.09	9.7	0.33	0.55	0.15	8.8	109	5.6
Methylene Chloride	3.22	12.3	1.47	0.57	0.17	9.3	107	4.7
trans-1,2-Dichloroethene	3.4	8.9	0.93	0.56	0.15	8.7	110	4.0
Methyl-t-Butyl Ether	3.57	14.3	0.91	0.49	0.08	4.9	113	1.6
1,1-Dichloroethane	4.08	11.7	1.29	0.54	0.18	10.3	110	5.1
Acrylonitrile	4.15	15.0	0.34	0.55	0.17	10.0	106	3.6
Propionitrile	4.16	14.2	0.34	0.57	0.17	9.3	107	3.6
cis-1,2-Dichloroethene	4.57	9.6	0.98	0.57	0.18	10.2	114	3.8
2,2-Dichloropropane	5.66	8.6	0.62	0.51	0.14	8.8	98	6.7
Bromochloromethane ³	4.74	18.5	1.09	0.58	0.12	6.4	108	3.7
Chloroform	4.82	10.1	1.04	0.57	0.16	9.1	111	5.3
Carbon Tetrachloride	4.91	11.5	0.37	0.49	0.13	8.4	116	7.3
Methyl Acrylate	4.97	5.7	0.37	0.5	0.14	9.1	107	3.7
1,1,1-Trichloroethane	4.98	7.8	0.56	0.53	0.15	9.1	116	5.7
Tetrahydrofuran ⁴	4.99	11.3	0.37	0.62	0.10	4.9	111	4.3
1,1-Dichloropropene	5.09	14.0	0.43	0.44	0.11	7.6	98	4.1
2-Butanone	5.14	11.7	0.06	0.96	0.26	8.7	108	5.6
1-Chlorobutane ³	5.14	14.0	0.67	0.46	0.12	8.2	103	6.1
Benzene	5.31	7.0	1.42	0.46	0.09	6.3	102	4.2
Methacrylonitrile	5.39	9.8	0.16	0.49	0.15	9.5	94	3.5
1,2-Dichloroethane	5.5	7.4	0.64	0.54	0.11	6.6	112	1.5
Fluorobenzene (IS)	5.7							
Trichloroethylene	5.85	10.6	0.28	0.48	0.13	8.4	106	4.9
Dibromomethane	6.23	8.0	0.29	0.54	0.09	5.4	108	3.4
1,2-Dichloropropane	6.33	6.8	0.43	0.47	0.06	3.8	104	1.3
Bromodichloromethane	6.41	5.8	0.49	0.48	0.07	4.6	110	1.6
Methyl Methacrylate	6.62	9.1	0.13	0.48	0.15	10.2	92	2.5
trans-1,3-Dichloropropene	7.01	16.3	0.41	0.44	0.04	3.2	100	1.7
Chloroacetonitrile	7.03	6.6	0.02	0.48	0.09	10.1	103	8.9
Toluene	7.24	8.8	1.10	0.44	0.15	6.4	98	4.7
2-Nitropropane ²	7.47	8.5	0.31	0.47	0.10	7.0	97	2.8
Tetrachloroethene	7.58	12.5	0.20	0.52	0.20	11.8	111	9.8
4-Methyl-2-pentanone	7.62	14.1	0.38	0.53	0.05	3.1	110	3.7
cis-1,3-Dichloropropene	7.65	12.8	0.36	0.42	0.06	4.5	95	3.7
1,1,2-Trichloroethane	7.78	12.5	0.24	0.49	0.08	5.4	112	2.6
Ethyl Methacrylate	7.82	10.7	0.28	0.43	0.04	3.0	94	3.8

1. Compounds were linearly regressed.

2. Calibration curve 0.1 ppb–50 ppb.

3. Calibration curve 0.2 ppb–50 ppb.

4. Calibration curve 0.5 ppb–50 ppb

5. Compound is a poor purger. Analyte recovery is out of method range.

Table 3 (part 2). U.S. EPA Method 524.2 calibration, accuracy, and precision data

Compound	Calibration			Accuracy and precision (n=7, 0.5 ppb)			Analyte recovery (n=7, 5 ppb)	
	Retention time	Linearity (RF %RSD)	Average RF	Average conc. (ppb)	MDL (ppb)	Precision ($\leq 20\%$)	Accuracy ($\pm 20\%$)	Precision ($\leq 20\%$)
Dibromochloromethane	7.91	7.5	0.21	0.47	0.09	6.2	105	2.5
1,3-Dichloropropane	7.99	15.2	0.46	0.49	0.09	5.8	108	1.7
1,2-Dibromoethane	8.09	8.3	0.22	0.46	0.07	5.0	104	2.8
2-Hexanone	8.32	12.4	0.29	0.5	0.12	7.9	97	3.3
Chlorobenzene	8.52	13.7	0.63	0.49	0.11	7.3	102	3.0
Ethylbenzene	8.55	13.4	1.08	0.43	0.06	4.4	92	4.4
1,1,1,2-Tetrachloroethane	8.57	10.0	0.16	0.48	0.12	8.1	108	2.8
m-,p-Xylene	8.67	18.1	0.42	0.83	0.21	8.2	94	2.9
o-Xylene	8.99	9.7	0.39	0.44	0.14	10.3	92	3.6
Styrene	9.03	16.0	0.66	0.4	0.11	8.7	91	4.4
Bromoform	9.04	12.7	0.12	0.43	0.09	6.9	99	1.6
Isopropylbenzene	9.22	15.8	0.87	0.41	0.11	8.4	95	5.4
4-Bromofluorobenzene (SURR)	9.41	7.1	0.42	25		5.7	97	4.5
Bromobenzene	9.48	8.1	0.70	0.58	0.15	8.2	111	4.1
n-Propylbenzene	9.51	17.4	1.39	0.46	0.15	10.1	102	5.2
1,1,2,2-Tetrachloroethane	9.57	7.8	0.45	0.48	0.06	3.8	102	3.5
2-Chlorotoluene	9.61	6.0	0.93	0.48	0.07	4.9	101	3.4
1,2,3-Trichloropropane	9.65	9.3	0.36	0.48	0.08	5.4	109	4.3
1,2,4-Trimethylbenzene ³	9.66	19.3	0.92	0.39	0.13	10.5	95	3.4
trans-1,4-Dichloro-2-butene ²	9.69	8.3	0.11	0.47	0.12	8.4	99	4.9
4-Chlorotoluene	9.73	11.7	0.99	0.42	0.10	8.0	100	3.6
tert-Butylbenzene ⁴	9.87	10.1	0.79	0.39	0.11	9.2	81	5.1
1,3,5-Trimethylbenzene ³	9.92	20.0	0.92	0.37	0.10	8.5	95	3.4
sec-Butylbenzene ⁴	9.99	19.6	1.13	0.35	0.10	8.6	95	5.8
p-Isopropyltoluene ³	10.09	19.8	0.73	0.36	0.11	9.4	92	4.2
1,3-Dichlorobenzene	10.13	12.1	0.61	0.47	0.09	6.2	111	3.6
1,4-Dichlorobenzene	10.19	11.4	0.58	0.47	0.10	6.7	108	3.5
n-Butylbenzene	10.37	16.7	0.93	0.43	0.11	8.3	97	5.2
Hexachloroethane	10.45	15.0	0.09	0.5	0.24	15.2	104	8.5
1,2-Dichlorobenzene-d ₄ (SURR)	10.46	5.7	0.37	24.1		5.4	103	3.6
1,2-Dichlorobenzene	10.47	8.9	0.65	0.49	0.11	6.9	106	3.1
1,2-Dibromo-3-Chloropropane	11.01	12.4	0.10	0.57	0.15	8.2	114	5.9
Nitrobenzene ⁴	11.38	13.7	0.03	0.45	0.16	11.0	110	6.4
Hexachlorobutadiene ³	11.43	12.4	0.03	0.62	0.20	10.0	120	4.9
1,2,4-Trichlorobenzene	11.45	11.4	0.28	0.57	0.17	9.4	100	2.0
Naphthalene	11.67	6.2	0.79	0.48	0.09	5.8	94	4.3
1,2,3-Trichlorobenzene	11.79	9.2	0.33	0.48	0.09	5.7	93	4.4

1. Compounds were linear regressed.
2. Calibration curve 0.1 ppb–50 ppb.
3. Calibration curve 0.2 ppb–50 ppb.
4. Calibration curve 0.5 ppb–50 ppb
5. Compound is a poor purger. Analyte recovery is out of method range.

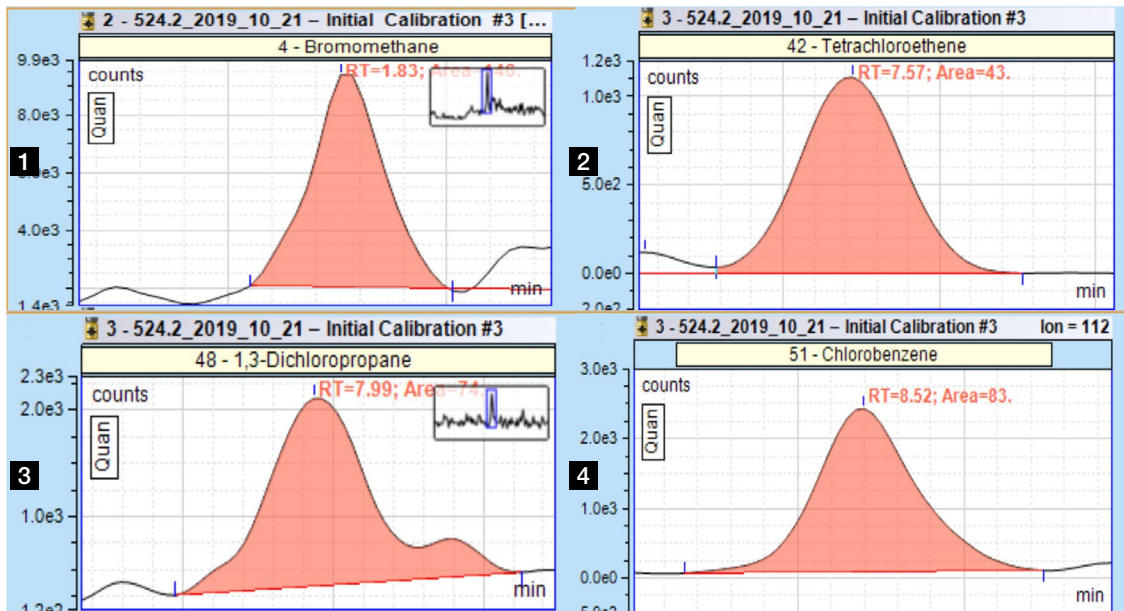


Figure 4. Example of chromatography (full scan, EI) from the lowest calibration level at 0.05 ppb: 1, bromomethane; 2, tetrachloroethene; 3, 1,3-dichloropropane; 4, chlorobenzene

Method robustness

To assess the stability of the method, 5 ppb calibration check standards were injected at intervals over a 75-sample injection sequence. No maintenance was performed on any part of the system during this extended test. Figure 5 shows the repeatability of five of the

compounds over 75 injections with excellent percentage RSDs. Table 4 displays the accuracy and precision of ten 5 ppb calibration check standards for all compounds. Figure 6 shows the accuracy and precision for ten injections of a 5 ppb standard for a selection of compounds over the chromatographic range.

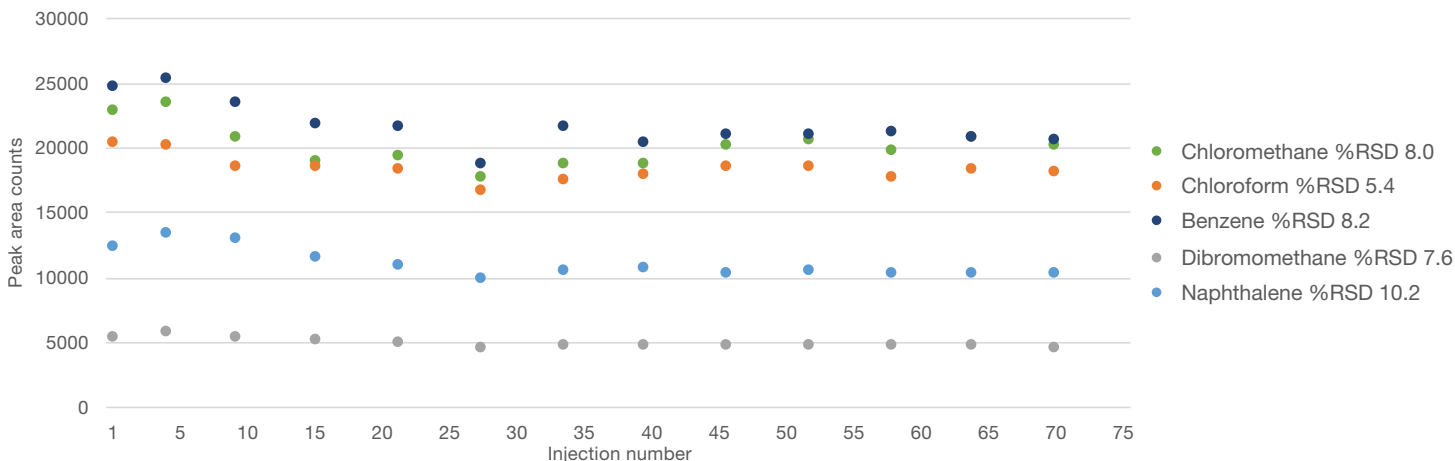


Figure 5. Repeatability of a 5 ppb VOC standard (as absolute peak area counts) assessed over n=75 consecutive injections

Table 4. U.S. EPA Method 524.2 accuracy and precision data for 5 ppb calibration check standards

Compound	Analyte recovery (n=10, 5 ppb)			
	Quantitation ion	Average conc. (ppb)	Accuracy (±20%)	Precision (≤20%)
Dichlorodifluoromethane	85	5.6	111	12.9
Chloromethane	50	5.2	103	9.7
Vinyl Chloride	62	5.3	105	10.0
Bromomethane	94	5.1	102	5.6
Chloroethane	64	5.3	105	8.5
Trichlorofluoromethane	101	5.6	112	10.8
Diethyl Ether	45	5.6	112	3.4
1,1-Dichloroethene	96	5.0	100	10.5
Carbon Disulfide	76	5.0	101	9.8
Iodomethane	142	3.9	77	18.1
Allyl Chloride	76	5.2	104	7.9
Methylene Chloride	49	5.5	110	5.7
trans-1,2-Dichloroethene	61	5.6	112	8.4
Methyl-t-Butyl Ether	73	5.5	109	2.4
1,1-Dichloroethane	63	5.7	113	7.2
Acrylonitrile	53	5.4	109	4.3
Propionitrile	53	5.5	110	4.3
cis-1,2-Dichloroethene	61	5.9	118	7.0
2,2-Dichloropropane	77	3.7	73	6.4
Bromochloromethane	49	5.8	115	5.1
Chloroform	83	5.8	116	7.2
Carbon Tetrachloride	117	5.8	116	9.4
Methyl Acrylate	55	5.2	105	3.2
1,1,1-Trichloroethane	97	5.8	116	9.0
Tetrahydrofuran	42	5.8	115	5.4
1,1-Dichloropropene	75	4.6	92	8.5
2-Butanone	72	5.4	108	7.1
1-Chlorobutane	56	4.8	97	8.9
Benzene	78	5.0	99	5.3
Methacrylonitrile	67	4.5	89	2.1
1,2-Dichloroethane	62	5.9	118	3.6
Fluorobenzene (IS)	96			
Trichloroethylene	95	5.1	102	8.0
Dibromomethane	93	5.6	111	3.6
1,2-Dichloropropane	63	5.2	104	3.9
Bromodichloromethane	83	5.6	111	3.9
Methyl Methacrylate	69	4.5	90	3.7
trans-1,3-Dichloropropene	75	4.6	91	2.0
Chloroacetonitrile	48	4.8	95	7.8
Toluene	91	4.7	94	7.1
2-Nitropropane	43	4.6	92	7.4
Tetrachloroethene	164	5.9	118	15.8
4-Methyl-2-pentanone	43	5.5	111	3.7

Compound	Analyte recovery (n=10, 5 ppb)			
	Quantitation ion	Average conc. (ppb)	Accuracy (±20%)	Precision (≤20%)
cis-1,3-Dichloropropene	75	4.3	86	2.9
1,1,2-Trichloroethane	83	5.6	112	3.3
Ethyl Methacrylate	69	4.6	92	4.2
Dibromochloromethane	129	5.2	104	2.8
1,3-Dichloropropane	76	5.5	109	2.3
1,2-Dibromoethane	107	5.2	104	3.4
2-Hexanone	43	4.8	97	6.5
Chlorobenzene	112	5.0	100	5.4
Ethylbenzene	91	4.4	87	7.2
1,1,1,2-Tetrachloroethane	131	5.4	109	4.3
m-,p-Xylene	106	8.7	87	7.4
o-Xylene	106	4.4	89	5.5
Styrene	104	4.2	83	7.3
Bromoform	173	4.7	94	4.5
Isopropylbenzene	105	4.4	88	7.3
4-Bromofluorobenzene (SURR)	95	25.0	100	5.6
Bromobenzene	77	5.4	109	4.7
n-Propylbenzene	91	4.8	96	7.6
1,1,1,2-Tetrachloroethane	83	4.9	98	4.8
2-Chlorotoluene	91	4.8	95	7.0
1,2,3-Trichloropropane	75	5.6	111	2.9
1,2,4-Trimethylbenzene	105	4.3	87	7.3
trans-1,4-Dichloro-2-butene	53	4.7	93	8.2
4-Chlorotoluene	91	4.6	92	5.6
tert-Butylbenzene	119	4.2	84	5.5
1,3,5-Trimethylbenzene	105	4.3	86	7.7
sec-Butylbenzene	105	4.3	86	8.2
p-Isopropyltoluene	119	4.1	83	8.5
1,3-Dichlorobenzene	146	5.3	106	6.0
1,4-Dichlorobenzene	146	5.1	102	4.4
n-Butylbenzene	91	4.5	90	8.8
Hexachloroethane	201	5.1	101	8.8
1,2-Dichlorobenzene-d ₄ (SURR)	152	27.0	108	5.2
1,2-Dichlorobenzene	146	5.2	104	5.4
1,2-Dibromo-3-Chloropropane	75	5.9	118	5.0
Nitrobenzene	51	5.5	109	7.0
Hexachlorobutadiene	225	6.0	119	10.7
1,2,4-Trichlorobenzene	180	4.7	95	7.5
Naphthalene	128	4.5	90	4.0
1,2,3-Trichlorobenzene	180	4.5	90	4.8

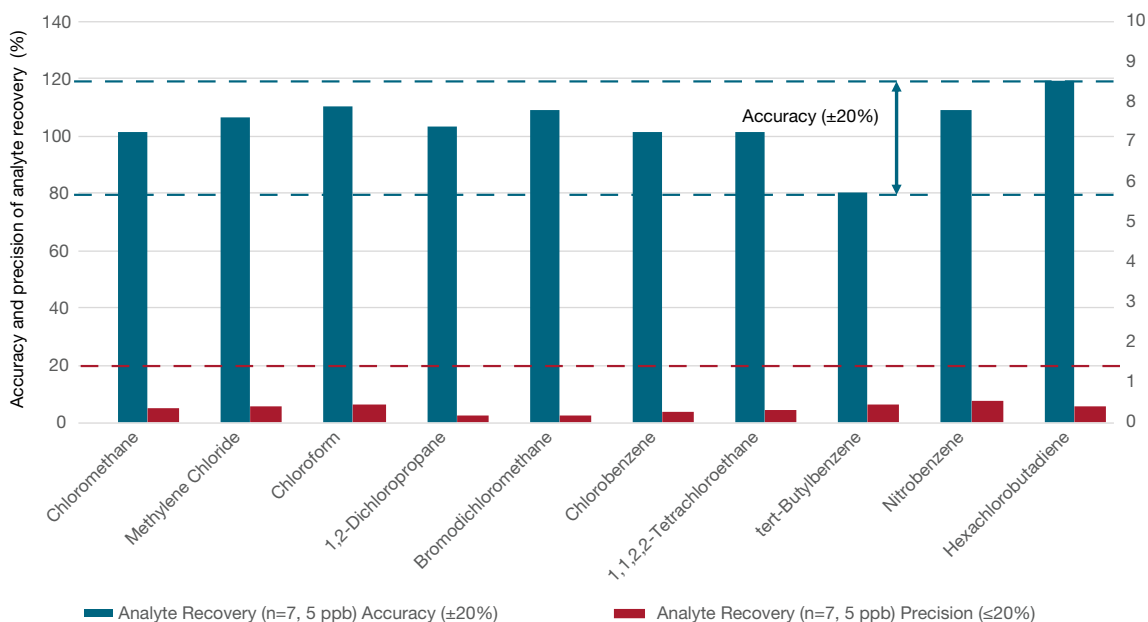


Figure 6. Accuracy and precision for ten injections of a 5 ppb standard for a selection of compounds

Conclusion

The combined analytical solution with the TRACE 1310 GC coupled to the ISQ 7000 MS system and the Atomx XYZ P&T system provides clear advantages for U.S. EPA Method 524.2.

- The Thermo Scientific ISQ 7000 VPI coupled with the Teledyne Tekmar Atomx XYZ P&T meets and exceeds all the requirements outlined in EPA method 524.2 for analysis of VOCs in water.
- Excellent linearity for all compounds was demonstrated with the %RSD of the calibration response factors passing all method requirements.
- MDL, precision, and accuracy for seven 0.5 ppb ($\mu\text{g/L}$) standards showed no interference from excessive water and delivered very reproducible results.

The Atomx XYZ concentrator's efficient trap cooling design reduces sample cycle time, allowing for more soil or water samples to be processed in a 12-hour period. The system

also utilizes a moisture control system that improves water vapor removal, thereby, reducing peak interference and increasing GC column life span.

The robust performance and design of the ISQ 7000 VPI and ExtractaBrite ion source allows users to exchange ionization sources and analytical columns without venting the instrument significantly reducing instrument downtime and minimizing sample analysis interruptions.

Combined, these complementary technologies effectively address the challenges of routine VOC analysis and provide a robust, sensitive solution needed for ensuring maximized instrument output and routine regulatory method compliance.

Reference

1. U.S. Environmental Protection Agency. Method 524.2. Measurement of Purgeable Organic Compounds in Water by Capillary Column Gas Chromatography/Mass Spectrometry (<https://www.epa.gov/sites/production/files/2015-06/documents/epa-524.2.pdf>)

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