US EPA Method 8260 with the Teledyne Tekmar Atomx XYZ and the Thermo Scientific™ TRACE™ 1310 GC and ISQ™ 7000 MS with Advanced Electron Ionization (AEI) Source

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Abstract

US EPA Method 8260, in conjunction with Methods 5030 and 5035, was used to determine the concentration of volatile organic compounds (VOCs) in water and soil matrices. For this study, a Teledyne Tekmar Atomx XYZ purge and trap (P&T) system and Thermo Scientific TRACE 1310 Gas Chromatograph (GC)/ISQ 7000 Mass Spectrometer (MS) with Advanced Electron Ionization (AEI) Source was used to create a working linear calibration curve and method detection limits (MDLs) for target compounds.

Introduction

The Atomx XYZ is Teledyne Tekmar's second-generation, multi-matrix P&T system and is based on the time-tested Atomx instrument platform. The concentrator's efficient trap cooling design reduces sample cycle time by as much as 14% over the previous model. Combined with its 84-position soil and water autosampler, the result is more samples tested per 12-hour period. An innovative moisture control system (MCS) improves water vapor removal by as much as 60%, thereby reducing peak interference and increasing GC column lifespan. In addition to other refinements, the Atomx XYZ incorporates a precision-machined valve manifold block to reduce potential leak sources and ensure the system is both reliable and robust. A reduced footprint of 13 cm (5"), compared to the previous generation, provides more bench space for laboratory tasks.

Sample Preparation

A working 50 ppm calibration standard was prepared in methanol from Restek® standards: 8260B MegaMix®, 8260B Acetate, California Oxygenates, VOA (Ketones), 502.2 Calibration Mix, Hexachloroethane, and 2-Chloroethyl Vinyl Ether. In total, the standard contained 97 compounds.

The water calibration curve was prepared from 0.5 ppb to 200 ppb for all compounds, while the soil calibration curve was prepared from 1 ppb to 200 ppb. The relative response factor (RF) was calculated for each compound using one of four internal standards: Pentafluorobenzene, 1,4-Difluorobenzene, Chlorobenzene-d5, and 1,4-Dichlorobenzene-d4. Surrogate standards consisted of: Dibromofluoromethane, 1,2-Dichloroethane-d4, Toluene-d8, and 4-Bromofluorobenzene. Internal and surrogate standards were prepared together 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.

Ten 1 ppb standards for the water method and ten 2 ppb standards for the soil method were prepared for MDL and accuracy and precision calculations. All calibration and MDL samples were analyzed using the Atomx XYZ conditions in Table I (water method) and Table II (soil method). GC/MS conditions are shown in Table III.

Experimental Instrument Conditions

Table I Teledyne Tekmar Atomx XYZ Water Method Conditions			
Purge	**Variable**	**Desorb**	**Variable**
Valve Oven Temp	140 ºC	Methanol Needle Rinse	Off
Transfer Line Temp	140 ºC	Methanol Needle Rinse Volume	0.00 mL
Sample Mount Temp	90 ºC	Water Needle Rinse Volume	7.00 mL
Water Heater Temp	90 ºC	Sweep Needle Time	0.25 min
Sample Vial Temp	20 ºC	Dry Purge Temp	20 ºC
Soil Valve Temp	100 ºC	Desorb Preheat Temp	245 ºC
Standby Flow	10 mL/min	GC Start Signal	Begin Desorb
Condensate Ready Temp	45 ºC	Desorb Time	2.00 min
Purge Ready Temp	40 ºC	Drain Flow	300 mL/min
Purge	**Variable**	Desorb Temp	250 ºC
Sample Equilibrate Time	0.00 min	**Bake**	**Variable**
Pre-sweep Time	0.25 min	Methanol Glass Rinse	Off
Prime Sample Fill Volume	3.00 mL	Number of Methanol Glass Rinses	0
Sample Volume	5.00 mL	Methanol Glass Rinse Volume	0.00 mL
Sweep Sample Time	0.25 min	Water Bake Rinses	1
Sweep Sample Flow	100 mL/min	Water Bake Rinse Volume	7.00 mL
Sparge Vessel Heater	Off	Bake Rinse Sweep Time	0.25 min
Sparge Vessel Temp	20 ºC	Bake Rinse Sweep Flow	100 mL/min
Pre-purge Time	0.00 min	Bake Rinse Drain Time	0.40 min
Pre-purge Flow	0 mL/min	Bake Time	2.00 min
Purge Time	11.00 min	Bake Flow	200 mL/min
Purge Flow	40 mL/min	Bake Temp	260 ºC
Purge Temp	20 ºC	Condensate Bake Temp	200 ºC
Condensate Purge Temp	20 ºC		
Dry Purge Time	2.00 min	**Trap**	#9
Dry Purge Flow	100 mL/min	**Purge Gas**	Helium

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Table II Teledyne Tekmar Atomx XYZ Soil Method Conditions			
Purge	**Variable**	**Purge**	**Variable**
Valve Oven Temp	140 ºC	Purge Temp	20 ºC
Transfer Line Temp	140 ºC	Condensate Purge Temp	20 ºC
Sample Mount Temp	90 ºC	Dry Purge Time	2.00 min
Water Heater Temp	90 ºC	Dry Purge Flow	100 mL/min
Sample Vial Temp	40 ºC	Dry Purge Temp	20 ºC
Soil Valve Temp	100 ºC	**Desorb**	**Variable**
Standby Flow	10 mL/min	Methanol Needle Rinse	Off
Condensate Ready Temp	45 ºC	Methanol Needle Rinse Volume	0.00 mL
Purge Ready Temp	40 ºC	Water Needle Rinse Volume	7.00 mL
Purge	**Variable**	Sweep Needle Time	0.25 min
Pre-purge Time	0.00 min	Desorb Preheat Temp	245 ºC
Pre-Purge Flow	0 mL/min	GC Start Signal	Begin Desorb
Pre-heat Mix Speed	Slow	Desorb Time	2.00 min
Sample Pre-heat Time	0.00 min	Drain Flow	300 mL/min
Pre-sweep Time	0.25 min	Desorb Temp	250 ºC
Water Volume	10.00 mL	**Bake**	**Variable**
Sweep Water Time	0.25 min	Bake Time	2.00 min
Sweep Water Flow	100 mL/min	Bake Flow	400 mL/min
Sparge Vessel Heater	Off	Bake Temp	280 ºC
Purge Mix Speed	Medium	Condensate Bake Temp	200 ºC
Purge Time	11.00 min	**Trap**	#9
Purge Flow	40 mL/min	**Purge Gas**	Helium

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Table III Thermo Scientific TRACE 1310 GC and ISQ 7000 MS System Conditions	
Thermo Scientific TRACE 1310 GC Conditions	
Column	Rtx®-VMS, 20 m x 0.18 mm, 1µm Film, Helium – 0.8 mL/min
Oven Profile	35 ºC, 2 min, 12ºC/min to 85 ºC, 20ºC/min to 225 ºC, 2 min Hold, Run Time 15.167 min
Inlet	200 ºC, 50:1 Split
Thermo Scientific ISQ 7000 MS Conditions	
Temp	Transfer Line 300 ºC; Ion Source 280 ºC
Scan	Range 35 *amu* to 260 *amu*, Solvent Delay 0.10 min, Normal Scanning
Current	Emission Current 25 µA, Gain 3.00E+005

Results

The relative standard deviation (%RSD) of the RFs for the calibration curve, MDL, and accuracy and precision data are shown in Table IV (water) and Table V (soil). Figure 1 (water) and Figure 2 (soil) display a 100 ppb standard, indicating excellent peak resolution with no water inference for all VOCs.

Table IV US EPA Method 8260 Water Calibration and Accuracy and Precision Data

Compound	Retention Time	Calibration			Accuracy and Precision (n=10, 1 ppb)[1]		
		Linearity RF (≤20% RSD)	MDL (ppb)	Average RF	Average Conc. (ppb)	Accuracy (70-130%)	Precision (≤20% RSD)
Dichlorodifluoromethane	1.37	10.9	0.19	7.92	1.11	111	6.17
Chloromethane	1.54	15.7	0.16	17.3	1.03	103	5.53
Vinyl Chloride	1.61	11.1	0.22	9.39	1.07	107	7.44
Bromomethane[2]	1.89	0.999	0.13	15.9	1.21	121	3.74
Chloroethane	2.01	14.2	0.20	11.3	1.25	125	5.57
Trichlorofluoromethane	2.12	9.09	0.18	22.9	1.29	129	4.88
Diethyl Ether	2.44	10.1	0.16	18.0	1.24	124	4.70
1,1-Dichloroethene	2.51	14.8	0.14	50.8	1.22	122	4.05
Carbon Disulfide	2.51	14.7	0.14	50.8	1.22	122	4.14
1,1,2-Trichlorotrifluoroethane	2.55	15.4	0.19	12.5	1.27	127	5.38
Iodomethane[2]	2.61	0.996	0.24	0.626	0.978	98	8.74
Allyl Chloride	2.86	8.81	0.28	9.46	1.21	121	8.30
Methylene Chloride	2.94	14.5	0.10	34.2	1.25	125	2.92
trans-1,2-Dichloroethene	3.06	10.9	0.17	8.29	1.24	124	4.93
1,1-Dichloroethane	3.06	14.7	0.23	23.9	1.08	108	7.49
Acetone[2]	3.08	0.995	0.18	12.0	1.25	125	5.06
Methyl Acetate	3.16	6.87	0.24	36.9	1.30	130	6.40
Methyl-tert-butyl Ether (MTBE)	3.25	7.28	0.11	2.47	1.07	107	3.51
Acetonitrile[2]	3.39	0.999	0.33	4.12	1.27	127	9.10
tert-Butyl Alcohol (TBA)	3.44	6.57	0.15	8.09	1.11	111	4.91
Diisopropyl Ether	3.52	7.79	0.11	67.9	1.03	103	3.89
Acrylonitrile	3.61	6.09	0.13	0.009	1.13	113	4.18

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Table IV US EPA Method 8260 Water Calibration and Accuracy and Precision Data							
Compound	Retention Time	Calibration			Accuracy and Precision (n=10, 1 ppb)[1]		
		Linearity RF (≤20% RSD)	MDL (ppb)	Average RF	Average Conc. (ppb)	Accuracy (70-130%)	Precision (≤20% RSD)
Propionitrile	3.61	17.5	0.42	5.73	1.30	130	11.4
Chloroprene	3.61	6.48	0.11	5.76	1.12	112	3.42
Vinyl Acetate[2]	3.77	0.997	0.29	1.77	1.22	122	8.47
Ethyl-tert-butyl- Ether (ETBE)	3.80	8.04	0.10	40.1	0.983	98	3.51
cis-1,2-Dichloroethene	3.93	10.3	0.14	0.513	1.05	105	4.78
2,2-Dichloropropane	4.01	9.49	0.18	16.6	0.917	98	6.96
Bromochloromethane	4.06	9.61	0.10	5.11	0.969	97	3.77
Chloroform	4.15	8.18	0.14	21.7	1.11	111	4.32
Carbon Tetrachloride[2]	4.24	0.995	0.11	11.9	0.864	86	4.57
Dibromofluoromethane (SURR)	4.29	6.50		0.580	24.7		3.08
1,1,1-Trichloroethane	4.30	9.98	0.15	16.9	1.14	114	4.63
Methyl Acrylate	4.33	10.4	0.11	12.6	0.926	93	4.29
Ethyl Acetate	4.36	16.7	0.22	0.896	0.925	93	8.49
1,1-Dichloropropene	4.40	10.1	0.14	15.1	1.11	111	4.53
Tetrahydrofuran	4.42	9.43	0.19	1.93	1.20	120	5.71
2-Butanone (MEK)	4.51	11.0	0.34	11.9	1.04	104	11.5
Benzene	4.60	8.82	0.16	45.5	1.10	110	5.08
Pentafluorobenzene (IS)	4.69						
Methacrylonitrile	4.70	7.26	0.10	0.650	1.04	104	3.47
1,2-Dichloroethane-d4 (SURR)	4.71	5.17		0.043	25.0	100	6.43
1,2-Dichloroethane	4.77	9.45	0.11	0.989	1.06	106	3.61
tert-Amyl Methyl Ether (TAME)	4.81	6.62	0.19	1.53	1.09	109	6.32
Isobutanol	4.81	6.97	0.13	34.8	1.05	105	4.43
Trichloroethene	5.08	13.4	0.13	0.583	1.21	121	3.84
Isopropyl Acetate	5.10	15.9	0.27	2.17	1.13	113	8.37
1,4-Diflourobenzene (IS)	5.13						
Dibromomethane	5.43	9.33	0.13	0.359	0.932	93	5.04
1,2-Dichloropropane	5.53	7.90	0.13	0.573	1.01	101	4.42
Bromodichloromethane	5.58	13.7	0.07	0.671	0.856	86	3.02
Methyl Methacrylate	5.82	7.75	0.07	0.377	0.924	92	2.59
Propyl Acetate	5.98	13.1	0.45	1.59	1.13	113	14.0
2-Chloroethyl Vinyl Ether	6.13	9.52	0.13	7.29	1.02	102	4.42
cis-1,3-Dichloropropene	6.15	11.3	0.11	0.728	0.879	88	4.61
Toluene	6.25	10.5	0.12	2.02	1.01	101	4.33
Toluene-d8 (SURR)	6.36	2.61		2.10	24.2		0.826
2-Nitropropane	6.60	16.3	0.41	0.269	0.981	98	14.8
Tetrachloroethene	6.69	16.9	0.15	0.946	1.22	122	4.37
trans-1,3-Dichloropropene	6.74	10.1	0.09	0.722	0.863	86	3.50
4-Methyl-2-Pentanone	6.80	5.65	0.26	1.07	1.17	117	7.85
1,1,2-Trichloroethane	6.87	7.76	0.10	0.429	0.963	96	3.66
Ethyl Methacrylate	6.96	10.5	0.08	0.704	0.895	90	3.06
Dibromochloromethane	7.01	17.0	0.08	0.451	0.761	76	3.73
1,3-Dichloropropane	7.10	7.73	0.11	0.829	0.986	99	4.07

Table IV US EPA Method 8260 Water Calibration and Accuracy and Precision Data

Compound	Retention Time	Calibration			Accuracy and Precision (n=10, 1 ppb)[1]		
		Linearity RF (≤20% RSD)	MDL (ppb)	Average RF	Average Conc. (ppb)	Accuracy (70-130%)	Precision (≤20% RSD)
1,2-Dibromoethane	7.20	7.90	0.09	0.496	0.974	97	3.45
Butyl Acetate	7.43	8.88	0.32	1.78	1.22	122	9.34
2-Hexanone	7.51	11.8	0.39	0.808	1.18	118	11.8
Chlorobenzene-d5 (IS)	7.63						
Chlorobenzene	7.65	7.91	0.13	1.29	0.994	99	4.75
Ethylbenzene	7.68	13.0	0.15	2.24	1.01	101	5.40
1,1,1,2-Tetrachloroethane	7.71	10.5	0.09	9.83	0.951	95	3.46
m-,p-Xylene	7.81	13.2	0.31	0.609	2.05	102	5.36
o-Xylene	8.16	10.2	0.16	0.617	1.02	102	5.53
Styrene	8.20	12.4	0.3	0.980	1.24	124	9.80
Bromoform	8.20	17.6	0.11	0.288	0.781	78	4.92
Isopropylbenzene	8.41	14.6	0.17	1.50	1.06	106	5.84
Amyl Acetate	8.59	15.4	0.32	1.52	1.06	106	10.8
4-Bromofluorobenzene (SURR)	8.62	1.38		1.02	25.3		1.82
Bromobenzene	8.70	12.4	0.13	1.46	1.04	104	4.44
1,2,3-Trichloropropane	8.70	14.6	0.23	0.375	1.01	101	7.90
n-Propylbenzene	8.74	14.2	0.18	3.01	1.05	105	5.94
1,1,2,2-Tetrachloroethane	8.80	15.3	0.35	0.576	0.912	91	13.5
2-Chlorotoluene	8.86	14.3	0.23	1.83	1.17	117	7.00
1,3,5-Trimethylbenzene	8.91	12.9	0.19	2.18	1.24	124	5.51
trans-1,4-dichloro-2-butene	8.95	12.8	0.27	0.242	1.11	111	7.56
cis-1,4-Dichloro-2-Butene	8.95	14.7	0.13	0.207	1.00	100	4.62
4-Chlorotoluene	8.99	15.2	0.30	2.06	1.09	109	9.78
tert-Butylbenzene	9.15	15.0	0.15	1.76	1.01	101	5.21
1,2,4-Trimethylbenzene	9.21	16.7	0.15	2.23	1.01	101	5.24
sec-Butylbenzene	9.30	14.2	0.18	2.58	1.06	106	5.98
p-Isopropyltoluene	9.42	17.3	0.19	1.99	1.05	105	6.53
1,3-Dichlorobenzene	9.45	12.4	0.17	1.48	1.04	104	5.87
1,4-Dichlorobenzene-d4 (IS)	9.52						
1,4-Dichlorobenzene	9.53	12.5	0.18	1.48	1.08	108	5.76
n-Butylbenzene	9.75	13.7	0.19	2.34	1.04	104	6.47
Pentachloroethane	9.84	15.8	0.34	0.008	1.11	111	11.0
Hexachloroethane	9.84	12.6	0.32	0.358	1.05	105	10.8
1,2-Dichlorobenzene	9.86	12.8	0.16	1.47	1.05	105	5.47
1,2-Dibromo-3-Chloropropane	10.50	12.5	0.18	0.175	0.934	93	6.85
Hexachlorobutadiene	10.90	17.3	0.37	0.001	1.01	101	13.0
Nitrobenzene	10.96	15.0	0.46	0.014	1.25	125	12.9
1,2,4-Trichlorobenzene	11.03	14.0	0.16	0.939	0.963	96	5.92
Naphthalene	11.30	17.2	0.16	1.99	0.934	93	6.23
1,2,3-Trichlorobenzene	11.44	16.7	0.28	0.928	1.00	100	10.0

1. Data from ten 1 ppb samples.
2. Compounds were linear regressed.

Table V US EPA Method 8260 Soil Calibration and Accuracy and Precision Data							
Compound	Retention Time	Calibration			Accuracy and Precision (n=10, 2 ppb)[3]		
		Linearity RF (≤20% RSD)	MDL (ppb)	Average RF	Average Conc. (ppb)	Accuracy (70-130%)	Precision (≤20% RSD)
Dichlorodifluoromethane	1.39	18.5	0.23	9.72	1.79	90	4.47
Chloromethane	1.55	13.9	0.37	20.2	1.97	98	6.60
Vinyl Chloride	1.63	9.02	0.21	12.8	1.95	98	3. 83
Bromomethane	1.92	9.05	0.19	29.0	1.75	88	3.79
Chloroethane	2.04	10.4	0.21	15.1	1.79	89	4.22
Trichlorofluoromethane	2.14	16.6	0.20	37.8	1.69	84	4.29
Diethyl Ether	2.46	8.80	0.25	22.9	1.80	90	4.95
Carbon Disulfide	2.49	16.9	0.20	18.0	1.68	84	4.31
1,1,2-Trichlorotrifluoroethane[4]	2.53	1.00	0.21	117.3	1.74	87	4.20
1,1-Dichloroethene	2.58	16.1	0.24	104.2	1.99	100	4.24
Iodomethane	2.60	16.7	0.70	0.799	2.46	123	10.0
Allyl Chloride	2.87	9.47	0.22	15.4	1.77	89	4.49
Methylene Chloride	2.95	9.31	0.19	49.0	1.76	88	3.76
trans-1,2-Dichloroethene	3.06	11.5	0.19	40.4	1.68	94	4.04
Acetone	3.19	13.0	0.48	24.7	1.97	99	8.70
Methyl Acetate	3.28	12.7	0.44	42.0	1.81	91	8.61
Methyl-tert-butyl Ether (MTBE)	3.28	12.9	0.21	2.86	1.75	87	4.33
Acetonitrile[4]	3.44	0.995	0.74	9.03	2.31	115	11.4
Chloroprene	3.51	11.3	0.38	0.010	2.00	100	6.73
1,1-Dichloroethane	3.53	11.4	0.21	31.6	1.64	82	4.54
tert-Butyl Alcohol (TBA)	3.54	9.36	0.26	32.1	2.19	110	4.13
Diisopropyl Ether	3.55	11.0	0.36	82.8	1.97	99	6.50
Acrylonitrile	3.64	14.1	0.21	6.69	1.79	90	4.18
Propionitrile	3.64	18.4	0.29	5.94	1.80	90	5.63
Vinyl Acetate	3.79	13.3	0.28	72.8	1.82	91	5.46
Ethyl-tert-butyl- Ether (ETBE)	3.83	11.2	0.31	2.05	2.09	105	5.32
cis-1,2-Dichloroethene	3.95	13.0	0.22	0.665	2.03	102	3.89
2,2-Dichloropropane	4.03	13.0	0.22	25.7	1.97	99	3.96
Bromochloromethane	4.10	12.3	0.26	6.64	2.11	105	4.36
Chloroform	4.16	12.7	0.30	28.9	2.21	110	4.88
Carbon Tetrachloride	4.25	11.6	0.63	21.3	2.34	117	9.59
Dibromofluoromethane (SURR)	4.31	6.24		0.619	24.8	99	4.19
1,1,1-Trichloroethane	4.31	12.3	0.16	24.7	2.12	106	2.65
Methyl Acrylate	4.36	11.1	0.10	14.5	1.99	99	1.74
Ethyl Acetate	4.38	9.16	0.25	1.35	1.88	94	4.74
1,1-Dichloropropene	4.41	12.8	0.17	24.1	1.98	99	3.01
Tetrahydrofuran	4.45	11.6	0.20	2.33	1.70	85	4.24
2-Butanone (MEK)	4.54	16.1	0.29	16.4	2.02	101	5.15
Benzene	4.61	13.9	0.19	61.8	2.15	107	3.12
1,2-Dichloroethane-d4 (SURR)	4.70	3.42		0.136	27.0	108	1.75
Pentafluorobenzene (IS)	4.70						
Methacrylonitrile	4.72	9.11	0.29	0.630	1.89	94	5.51
1,2-Dichloroethane	4.79	13.3	0.27	1.10	2.05	102	4.69

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Table V US EPA Method 8260 Soil Calibration and Accuracy and Precision Data							
Compound	Retention Time	Calibration			Accuracy and Precision (n=10, 2 ppb)[3]		
		Linearity RF (≤20% RSD)	MDL (ppb)	Average RF	Average Conc. (ppb)	Accuracy (70-130%)	Precision (≤20% RSD)
tert-Amyl Methyl Ether (TAME)	4.83	11.7	0.33	1.79	1.95	98	6.07
Trichloroethene	5.09	11.4	0.39	0.763	1.83	91	7.62
Isobutanol	5.13	15.8	0.41	60.6	1.91	96	7.54
Isopropyl Acetate	5.13	12.7	0.35	2.53	2.06	103	6.04
1,4-Diflourobenzene (IS)	5.14						
Dibromomethane	5.45	11.1	0.67	0.424	1.92	96	12.4
1,2-Dichloropropane	5.54	10.5	0.30	0.705	2.07	104	5.11
Bromodichloromethane	5.60	10.0	0.35	0.888	2.07	103	5.96
Methyl Methacrylate	5.83	8.42	0.31	0.402	1.99	99	5.60
Propyl Acetate	5.99	13.2	0.24	1.92	2.02	101	4.27
2-Chloroethyl Vinyl Ether	6.14	8.24	0.36	8.09	1.88	94	6.86
cis-1,3-Dichloropropene	6.17	9.14	0.27	1.02	1.94	97	4.86
Toluene-d8 (SURR)	6.33	1.95		2.01	22.8	91	1.42
Toluene	6.37	8.60	0.26	3.15	1.83	91	5.13
2-Nitropropane[4]	6.61	0.997	0.98	0.789	1.97	98	17.6
Tetrachloroethene	6.70	9.74	0.23	1.35	1.99	99	4.16
trans-1,3-Dichloropropene	6.75	10.3	0.40	1.01	2.03	101	6.95
4-Methyl-2-Pentanone	6.82	10.0	0.54	1.23	1.97	98	9.81
1,1,2-Trichloroethane	6.88	7.86	0.30	0.474	2.04	102	5.18
Ethyl Methacrylate	6.97	8.69	0.15	0.756	1.91	95	2.84
Dibromochloromethane	7.02	7.97	0.22	0.559	2.00	100	3.92
1,3-Dichloropropane	7.11	9.02	0.30	0.913	2.01	100	5.38
1,2-Dibromoethane	7.21	9.35	0.28	0.548	1.84	92	5.50
Butyl Acetate	7.45	10.7	0.23	2.05	1.72	86	4.68
2-Hexanone	7.52	11.0	0.21	1.13	1.73	87	4.32
Chlorobenzene-d5 (IS)	7.64						
Chlorobenzene	7.65	9.65	0.24	1.73	2.05	102	4.07
Ethylbenzene	7.69	9.48	0.37	3.16	2.07	103	6.29
1,1,1,2-Tetrachloroethane	7.72	7.55	0.41	13.2	1.78	89	8.16
m-,p-Xylene	7.81	13.1	0.27	0.894	4.17	104	2.27
o-Xylene	8.16	8.60	0.19	0.867	1.69	84	3.91
Styrene	8.20	8.34	0.37	1.39	1.96	98	6.73
Bromoform	8.21	9.58	0.13	0.357	1.71	86	2.79
Isopropylbenzene	8.41	14.1	0.44	2.24	1.75	88	8.87
Amyl Acetate	8.60	10.2	0.37	1.63	1.74	87	7.49
4-Bromofluorobenzene (SURR)	8.64	1.88		1.06	24.4	97	1.88
1,2,3-Trichloropropane	8.70	12.0	0.32	2.13	1.93	96	5.89
Bromobenzene	8.71	13.3	0.49	0.440	1.75	88	9.89
n-Propylbenzene	8.75	12.4	0.25	5.00	1.95	98	4.51
1,1,2,2-Tetrachloroethane	8.81	11.1	0.21	0.779	1.66	83	4.45
2-Chlorotoluene	8.86	14.5	0.40	2.80	1.78	89	7.94
1,3,5-Trimethylbenzene	8.91	16.0	0.29	3.35	1.75	88	5.79
cis-1,4-Dichloro-2-Butene	8.96	11.5	0.20	0.322	1.68	94	4.18

Table V US EPA Method 8260 Soil Calibration and Accuracy and Precision Data

Compound	Retention Time	Calibration			Accuracy and Precision (n=10, 2 ppb)[3]		
		Linearity RF (≤20% RSD)	MDL (ppb)	Average RF	Average Conc. (ppb)	Accuracy (70-130%)	Precision (≤20% RSD)
trans-1,4-dichloro-2-butene	8.96	11.2	0.20	0.326	1.96	98	3.69
4-Chlorotoluene	9.00	10.3	0.42	3.50	1.90	95	7.89
tert-Butylbenzene	9.16	12.1	0.26	2.85	1.98	99	4.67
1,2,4-Trimethylbenzene	9.22	16.4	0.52	3.41	1.84	92	10.0
sec-Butylbenzene	9.30	11.0	0.43	4.33	1.97	99	7.77
p-Isopropyltoluene	9.42	16.4	0.24	3.32	1.83	91	4.70
1,3-Dichlorobenzene	9.46	11.5	0.49	2.52	1.86	93	9.31
1,4-Dichlorobenzene-d4 (IS)	9.52						
1,4-Dichlorobenzene	9.53	7.52	0.29	2.81	1.90	95	5.38
n-Butylbenzene	9.75	12.2	0.29	4.54	1.87	94	5.46
Pentachloroethane	9.84	14.0	0.41	0.504	1.92	96	7.53
Hexachloroethane	9.84	8.68	0.27	0.012	1.92	96	5.00
1,2-Dichlorobenzene	9.86	11.6	0.37	2.19	1.76	88	7.46
1,2-Dibromo-3-Chloropropane	10.50	9.62	0.34	0.279	1.75	88	6.87
Hexachlorobutadiene[4]	10.90	0.999	0.34	0.002	1.83	92	6.59
Nitrobenzene[4]	10.96	0.995	0.37	0.046	2.02	101	6.43
1,2,4-Trichlorobenzene	11.03	16.4	0.58	1.72	1.91	96	10.7
Naphthalene	11.30	19.0	0.28	2.97	1.95	97	5.14
1,2,3-Trichlorobenzene	11.44	13.8	0.46	1.66	1.78	89	9.14

3. Data from ten 2 ppb samples.
4. Compounds were linear regressed.

Figure 1 Total Ion Chromatogram of a Water Method 100 ppb VOC Standard Indicating Consistent Peak Shapes for all Compounds with Minimal Water Interference.

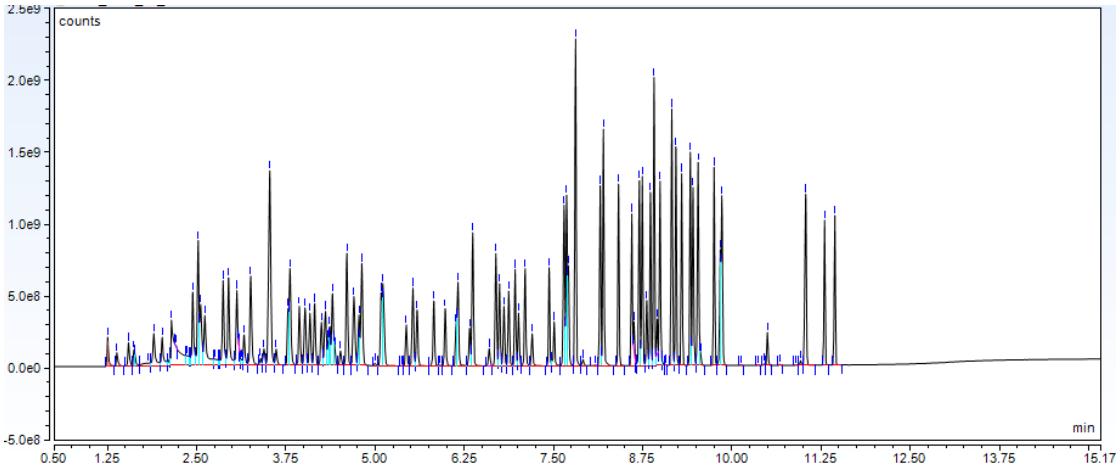

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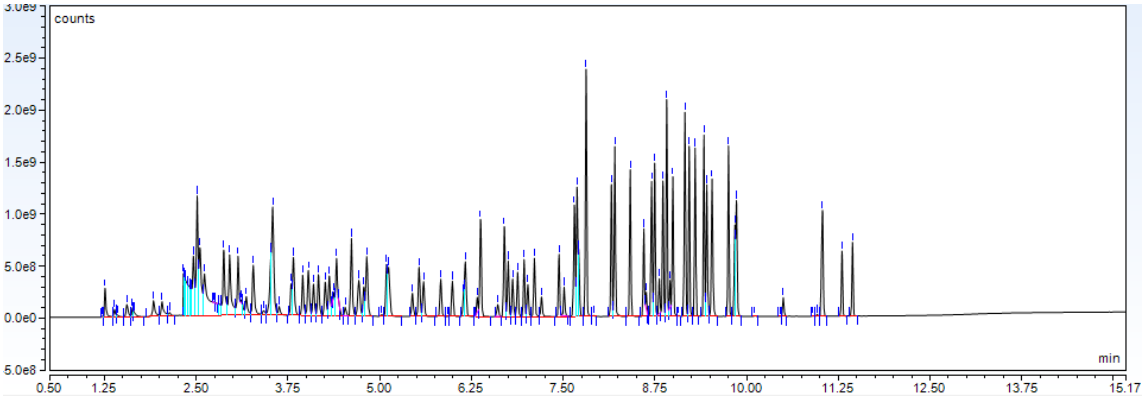
Figure 2 Total Ion Chromatogram of a Soil Method 100 ppb VOC Standard Indicating Consistent Peak Shapes for all Compounds with Minimal Water Interference.



Conclusion

This study demonstrates the capability of the Teledyne Tekmar Atomx XYZ P&T system to process VOCs in water and soil samples following US EPA Method 8260 in conjunction with Methods 5030 and 5035 with detection by a Thermo Scientific TRACE 1310 GC/ISQ 7000 MS with an AEI Source. The %RSD of the calibration curve passed all method requirements. Furthermore, MDL and precision and accuracy for ten 1 ppb standards for the water method and ten 2 ppb standards for the soil method showed no interference from excessive water.

By making additional, appropriate changes to the GC oven temperature program, the GC/MS cycle time may also be reduced, increasing laboratory throughput in a 12-hour period.

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