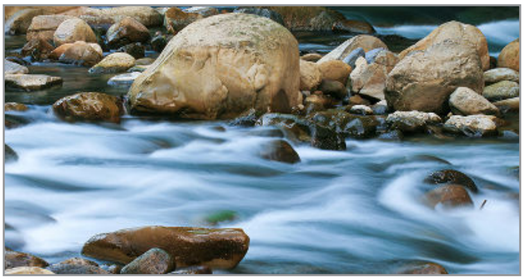
Comprehensive Trace-Level GC-MS/MS Semivolatiles Method (EPA Method 8270E)

Maintain Data Quality While Lowering Detection Limits with an RMX-5Sil MS Column

By Erica Pack, Jason Hoisington, Chris English, Ramkumar Dhandapani, Colton Myers

Key Highlights

- Next-generation TriMax deactivation creates a robust and exceptionally neutral sample flow path.
- Maximum inertness improves peak shape for a wide range of semivolatiles, allowing lower calibration ranges and picogram-level sensitivity.
- Maximum column performance supports expanded analyte lists and scaled down sample extraction volumes.



Related Products

- *RMX-5Sil MS column 30 m, 0.25 mm ID, 0.25 µm (cat.# 17323)*
- *Topaz 4 mm Precision inlet liner with wool (cat.# 23267)*
- *Restek electronic leak detector (cat.# 28500)*
- *SVOC MegaMix 150 (cat.# 31907)*
- *GC-MS Tuning Mix (cat.# 31615)*
- *Acid Surrogate Mix (4/89 SOW) (cat.# 31025)*
- *Base Neutral Surrogate Mix (4/89 SOW) (cat.# 31024)*
- *Revised SV Internal Standard Mix (cat.# 31886)*

Abstract

This study explores the impact of groundbreaking TriMax deactivation on the GC-MS/MS analysis of semivolatiles by EPA Method 8270E. The performance of four commonly used analytical columns was compared using peak asymmetry, calibration linearity, recovery, and repeatability tests across a wide range of compound chemistries. Results show that RMX-5Sil MS columns, built with a new TriMax deactivation technology, have a significantly more inert surface that meets performance criteria across acidic, basic, and neutral semivolatiles whereas other columns met criteria only for certain classes of compounds. Competitive performance across a wide range of semivolatiles at low levels allows labs to streamline operations through microextraction sample preparation (e.g., EPA Method 3511) or method consolidation. The TriMax deactivation technology used on RMX-5Sil MS columns has overcome activity issues that are demonstrated to affect overall quantitative performance of competitor columns.

Introduction

Semivolatile organic compounds (SVOCs) are monitored in the environment globally due to their prevalence and the risks they pose to human health. GC-MS is a common approach for analyzing semivolatiles when following methods, such as U.S. EPA Method 8270, which covers the analysis of extracts from many types of environmental matrices, including solid waste, soil, air sampling media, and water samples. The latest revision, EPA Method 8270E [1], allows either GC-MS or GC-MS/MS to be used, and with the higher sensitivity of MS/MS detection, labs can meet lower detection limits and realize solvent and time savings by scaling down sample extraction volumes via microextractions. Microextraction methods, such as EPA Method 3511 [2], are generally simpler and use less solvent (e.g., dichloromethane) than standard extraction methods. However, the extracts are less concentrated, which is driving the adoption of GC-MS/MS in laboratories seeking to reduce solvent consumption while maintaining method performance capabilities.

Semivolatiles comprise a wide range of compound chemistries, some of which are known to interact with active sites (e.g., silanols) in the sample flow path, which makes reliable low-level detection difficult. To overcome these challenging interactions, labs may use different GC columns for different target analytes. Midpolarity “5” or “5sil” type columns are commonly used, but as labs seek to lower detection limits and push the sensitivity of their columns, the drawbacks of the different manufacturing processes for each “5-type” column become more apparent. While neutral compounds are not typically affected by the active sites left behind on the GC column surface, acidic and basic compounds can be sensitive to even the most subtle differences in surfaces. With basic (benzidine) and acidic (pentachlorophenol) compounds included in system suitability checks, in addition to demand for increasingly sensitive calibrations, active sites on the GC column surface are coming under intense scrutiny. GC columns with a broadly effective deactivation are highly desired because by producing better results for acidic, basic, and neutral semivolatiles, they can allow labs to improve productivity and profitability through lower solvent consumption, better instrument performance, and more opportunity to consolidate methods.

In this study, we compared the performance of several GC columns that are widely used for semivolatiles analysis to the performance of RMX-5Sil MS columns. RMX-5Sil MS columns undergo a unique column surface deactivation featuring TriMax technology that produces a robust polymer deposition, eliminating active sites and resulting in an exceptionally inert sample flow path. The RMX-5Sil MS column uses a traditional 5sil polymer, so it is a direct 5sil replacement, while the highly neutral surface improves peak shape and performance for a wide variety of compounds to help lower calibration curves while still meeting data quality requirements.

Experimental

Standard and Sample Preparation

Calibration standards containing acidic, basic, and neutral semivolatiles were prepared in dichloromethane across a range of 0.5-5000 ppb to determine the lowest linear calibration range for each analyte. Fresh calibration standards were prepared for each column. Mid-range recovery test standards were also prepared at 50 ppb.

Instrument Conditions

Samples were run on four types of columns (RMX-5Sil MS, two premium competitor columns, and one traditional competitor column) in 30 m, 0.25 mm ID, 0.25 µm formats. A Thermo TRACE 1310 GC paired with a TSQ 8000 mass spectrometer was used for semivolatiles analysis under the conditions listed below. The conditions used are simplified to allow for standardization and direct comparison of the columns that were tested. Routine work may use different inlet, oven, or detector settings to further improve chromatographic results. Optimized conditions are demonstrated in a separate low-level study that included an expanded list of 150 commonly analyzed semivolatiles [3].

Injection volume: 1 µL
Liner: Topaz 4 mm Precision inlet liner with wool (cat.# 23267)
Injection port: 250 °C; 5:1 split; 1.2 mL/min
Carrier gas: helium
Oven: 40 °C (hold 1 min) to 280 °C at 12.4 °C/min to 315 °C at 3.3 °C/min (hold 1 min)
Detector: MS/MS; SRM mode; 280 °C transfer line temp; 330 °C source (see Figure 1 for SRM transitions)

Data Quality Evaluation

Data quality was assessed based on asymmetry, linearity, recovery, and repeatability, and general performance for each metric was categorized according to the criteria in Table I. Asymmetry was evaluated for each compound as a measurement of inertness. Linearity was assessed using both R^2 and %RSD. Percent recovery was determined for each analyte at the lowest calibration point (LCP) and at 50 ppb, which was used as a midpoint recovery test. Repeatability of recovery was also determined at 50 ppb. Note that while linearity %RSD, R^2, LCP recovery, and 50 ppb recovery were evaluated based on compliance with EPA Method 8270E criteria, recovery %RSD does not have a method-based compliance metric and asymmetry does not for most compounds, so data quality criteria were based on similar metrics in the method.

Table I: I Data Quality Classifications

	Ideal	Acceptable	Poor
Asymmetry	0.9-1.2	0.5-0.9 or 1.2-2	<0.5, >2
Linearity (R^2)	>0.995	0.990-0.995	<0.990
Linearity (%RSD)	<10%	11-20%	>20%
Recovery (LCP)	70-130%	50-69% or 131-200%	<50%, >200%
Recovery (50 ppb)	70-130%	50-69% or 131-200%	<50%, >200%
Repeatability (%RSD at 50 ppb)	<10%	11-20%	>20%

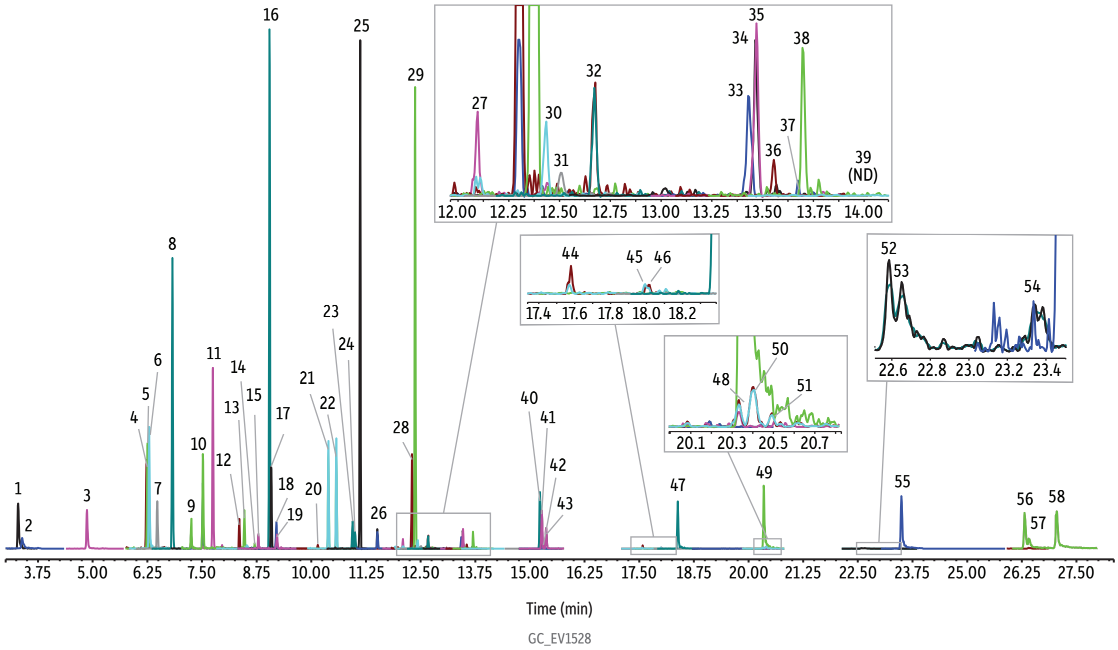
Results and Discussion

Chromatographic Performance

Silanols are a common source of active sites on the fused silica surface of GC columns, so column manufacturers use different deactivation treatments to reduce their impact. However, if the deactivation is not thoroughly effective, an analyte's interaction with silanols can cause inconsistent or delayed partitioning from the stationary phase, which results in peak tailing and subsequent issues, such as retention time shifts and poor sensitivity. Acidic compounds, particularly phenols, can be retained by silanols through hydrogen bonding, while basic compounds, such as benzidines, may bond to the surface through an acid-base interaction. One of the challenges with analyzing semivolatiles is that they include a wide range of compound classes that interact through different mechanisms and severities, so the column deactivation must be broadly effective.

To better combat silanol activity, Restek has developed next-generation TriMax deactivation for all RMX columns, which minimizes surface silanol activity though a strong polymer-fused silica interface, preventing analyte-silanol interactions. As shown in Figure 1, this results in excellent chromatographic performance and sharp, symmetric peaks for a wide range of semivolatiles, including well-known challenging compounds, such as 2,4-dinitrophenol (2,4-DNP); pentachlorophenol; and benzidine.

Figure 1: Excellent peak shape was obtained for a wide range of semivolatiles on an RMX-5Sil MS column under the standardized conditions used for comparative analysis. (For optimized conditions, see our low-level method for 150 semivolatiles [3].)



Column	RMX-5Sil MS, 30 m, 0.25 mm ID, 0.25 µm (cat.# 17323)
Standard/Sample	
	8270 Calibration mix #1 (cat.# 31618) 8270 Calibration mix #2 (cat.# 31619) 8270 Calibration mix #5 (cat.# 31995) Base neutral surrogate mix (4/89 SOW) (cat.# 31024) Acid surrogate mix (4/89 SOW) (cat.# 31025) Revised SV internal standard mix (cat.# 31886)
Diluent:	Dichloromethane
Conc.:	50 ppb (100 ppb internal standards)
Injection	
Inj. Vol.:	1 µL split (split ratio 5:1)
Liner:	Topaz 4.0 mm ID Precision liner w/wool (cat.# 23267)
Inj. Temp.:	250 °C
Split Vent Flow Rate:	6 mL/min

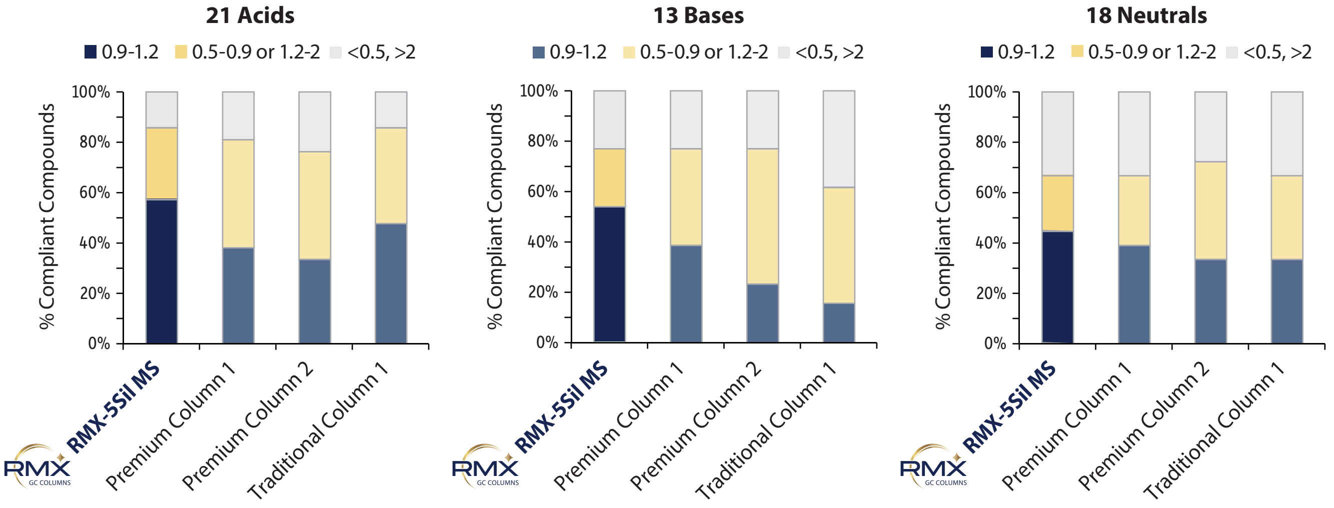
Oven	
Oven Temp.:	40 °C (hold 1 min) to 280 °C at 12.4 °C/min to 315 °C at 3.3 °C/min (hold 1 min)
Carrier Gas	He, constant flow
Flow Rate:	1.2 mL/min @ 40 °C
Detector	SRM/MRM
Acquisition Type:	SRM/MRM
Source Temp.:	330 °C
Transfer Line Temp.:	280 °C
Analyzer Type:	Triple Quadrupole
Ionization Mode:	EI
Collision Gas:	Ar
Tune Type:	PFTBA
Tune Emission Current:	70 µA
Instrument	Thermo Scientific TSQ 8000 Triple Quadrupole GC-MS
Sample Preparation	Standards were combined and diluted to a concentration of 50 ppb with internal standards added at 100 ppb.

Figure 1: (continued)

Peaks	t_R (min)	Conc. (ng/mL)	Mass 1	Product 1	Collision energy 1	Mass 2	Product 2	Collision energy 2
1. N-Nitrosodimethylamine	3.55	50	74	44	6	74	42	16
2. Pyridine	3.59	50	79	51	26	52	26	18
3. 2-Fluorophenol	5.03	50	112	92	6	92	63	14
4. Phenol-d6	6.37	50	99	71	8	99	69	18
5. Phenol	6.40	50	94	66	10	94	65	16
6. Aniline	6.45	50	93	66	10	93	65	20
7. 2-Chlorophenol	6.62	50	128	64	14	128	63	24
8. 1,4-Dichlorobenzene-d4	6.96	100	150	115	14	150	78	26
9. 2-Methylphenol	7.38	50	108	80	8	108	77	24
10. 3- and 4-Methylphenol	7.66	50	70	43	6	107	77	14
11. Nitrobenzene-d5	7.89	50	128	82	12	128	54	28
12. 2-Nitrophenol	8.54	50	139	81	12	139	109	8
13. 2,4-Dimethylphenol	8.61	50	122	107	12	122	77	20
14. Benzoic acid	8.72	50	122	105	8	122	77	20
15. 2,4-Dichlorophenol	8.95	50	162	63	24	162	98	12
16. Naphthalene-d8	9.18	100	136	134	14	136	108	18
17. Naphthalene	9.23	50	128	102	16	129	103	14
18. 4-Chloroaniline	9.35	50	127	100	10	127	65	20
19. 2,6-Dichlorophenol	9.37	50	162	63	24	164	63	26
20. 4-Chloro-3-methylphenol	10.28	50	142	107	12	107	77	12
21. 2-Methylnaphthalene	10.53	50	141	115	16	141	89	30
22. 1-Methylnaphthalene	10.71	50	141	115	16	141	89	30
23. 2,4,6-Trichlorophenol	11.09	50	132	97	10	196	97	24
24. 2,4,5-Trichlorophenol	11.09	50	132	97	10	196	97	24
25. 2-Fluorobiphenyl	11.26	50	172	171	12	172	170	22
26. o-Nitroaniline	11.66	50	138	92	12	138	65	22
27. Acenaphthylene	12.24	50	152	102	26	152	76	36
28. 3-Nitroaniline	12.49	50	138	92	12	138	65	20
29. Acenaphthene-d10	12.53	100	162	160	18	164	162	14
30. Acenaphthene	12.60	50	153	126	36	153	77	38
31. 2,4-Dinitrophenol	12.70	50	184	154	6	154	79	12
32. 4-Nitrophenol	12.90	50	139	109	6	139	81	14
33. 2,3,4,6-Tetrachlorophenol	13.21	50	232	168	12	234	131	24
34. 4-Nitroaniline	13.60	50	138	108	8	138	80	18
35. Fluorene	13.61	50	165	115	24	165	139	26
36. 4,6-Dinitro-2-methylphenol	13.71	50	198	168	6	198	121	10
37. Diphenylamine	13.88	50	169	66	22	170	66	22
38. 2,4,6-Tribromophenol	14.10	50	330	141	36	332	143	34
39. Pentachlorophenol	15.04	50	228	165	14	270	169	22
40. Phenanthrene-d10	15.40	100	188	160	20	184	156	22
41. Phenanthrene	15.46	50	178	152	18	178	151	32
42. Dinoseb	15.49	50	163	116	14	240	211	8
43. Anthracene	15.54	50	178	152	18	177	151	18
44. Fluoranthene	17.78	50	202	176	26	202	152	30
45. Benzidine	18.05	50	184	156	18	184	166	16
46. Pyrene	18.20	50	200	174	22	200	149	34
47. p-Terphenyl-d14	18.57	50	244	242	14	244	240	22
48. 3,3'-Dichlorobenzidine	20.53	50	252	154	26	252	181	22
49. Chrysene-d12	20.55	100	240	238	14	240	236	30
50. Benz[a]anthracene	20.63	50	228	202	22	226	200	28
51. Chrysene	20.63	50	228	202	22	228	201	36
52. Benzo[b]fluoranthene	22.90	50	252	226	22	250	224	24
53. Benzo[k]fluoranthene	22.91	50	252	226	22	250	224	24
54. Benzo[a]pyrene	23.66	50	252	226	22	250	224	26
55. Perylene-d12	23.81	100	264	262	20	264	260	34
56. Indeno[1,2,3-cd]pyrene	26.74	50	276	274	38	276	250	30
57. Dibenz[a,h]anthracene	26.80	50	139	126	8	139	113	14
58. Benzo[ghi]perylene	27.47	50	276	274	38	138	125	12

To compare the inertness of RMX-5Sil MS columns to other columns commonly used for semivolatiles analysis, we assessed peak asymmetry under standardized conditions at 50 ppb. The 50 ppb level was chosen for comparison so asymmetry could be evaluated at a midpoint calibration level. Evaluation at a midpoint compensates for tailing peak shapes that may blend into the baseline at low levels. Figure 2 demonstrates that for acidic, basic, and neutral semivolatiles, ideal results were obtained for more compounds on the RMX-5Sil MS column than on any of the other columns tested. The difference was especially pronounced for acidic and basic compounds, allowing more accurate identification and quantification for a wider range of semivolatiles in single run, which provides labs with opportunities for method consolidation.

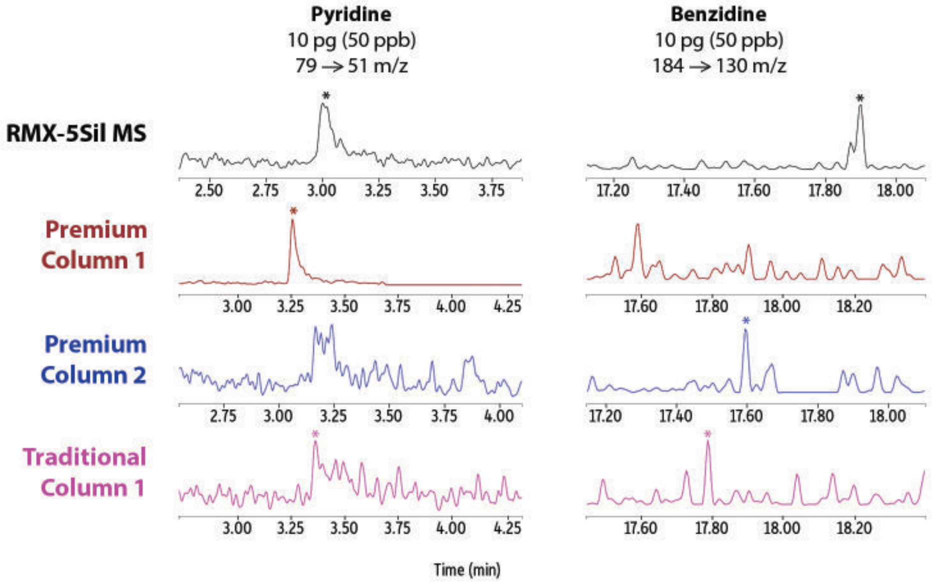
Figure 2: An evaluation of asymmetry shows that exceptionally inert RMX-5Sil MS columns produce ideal peak shape results for more acidic, basic, and neutral semivolatiles than other analytical columns.



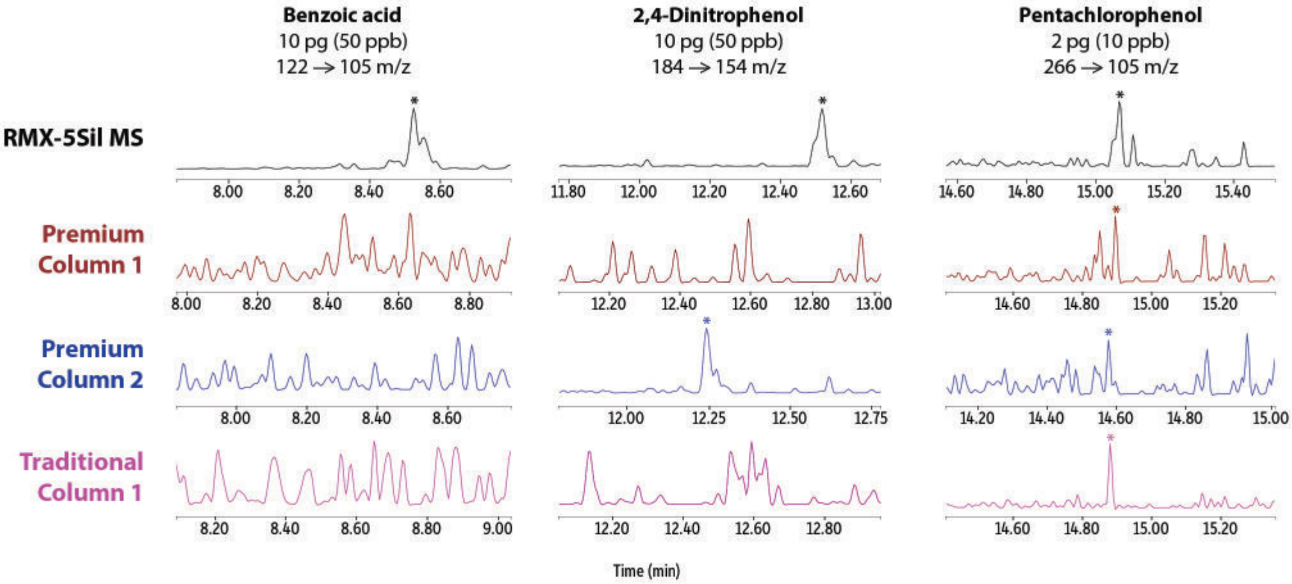
In addition to an overall improvement in peak asymmetry, better peak signals were seen at very low levels across a range of semivolatiles that are known to be particularly problematic (Figure 3). Good signals that allow for easy software integration were obtained for pyridine, benzidine, benzoic acid, 2,4-dinitrophenol, and pentachlorophenol on the RMX-5Sil MS column whereas competitor columns showed similar performance for some compounds but notably compromised performance for others. Visual disparities among peak shapes illustrate how the inertness of the RMX TriMax deactivation is more broadly effective than the traditional deactivations used in other columns.

Figure 3: Broadly inert RMX-5Sil MS columns consistently produced good peak signals at the lowest calibration point f (pg on-column) or a wide range of problematic active analytes.

Basic Compounds



Acidic Compounds



Linearity

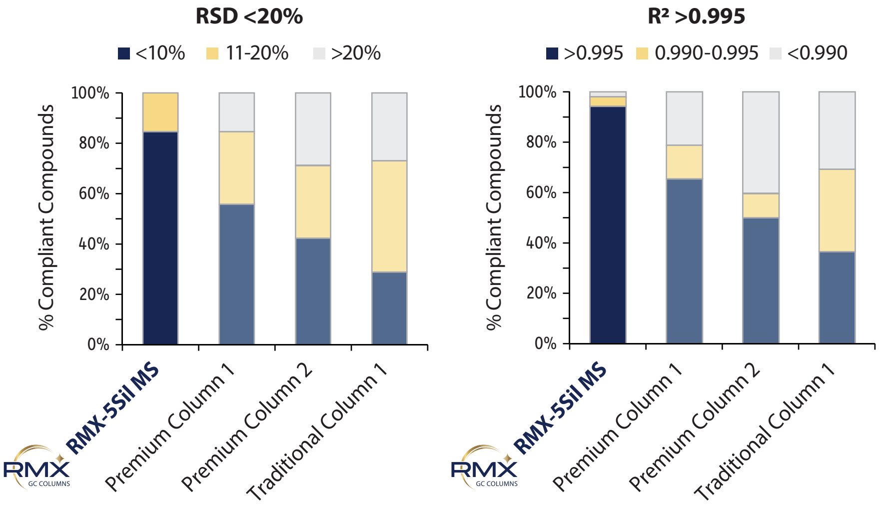
Peak symmetry improves integration and increases the subsequent signal-to-noise ratio, which can allow for linear calibration at lower levels. The linear calibration ranges for each semivolatile were established on the RMX-5Sil MS column and varied by analyte (Table II). The number of calibration points ranged 5-11, and the lowest calibration level ranged 0.5-100 ppb (0.1-20 pg on column). Calibration linearity is sensitive to peak integration, so integration settings were kept consistent for each column. As peaks get closer to the baseline or tail excessively, manual integration becomes necessary, resulting in more analyst time per sample. Additional calibration models can be applied, such as weighted linear curves or quadratic curves, but an ideal calibration would be linear. By using a linear model for each analyte, the role of peak integration becomes more important. However, it should be noted that the lowest linear calibration point is not necessarily representative of the lowest detection limit.

Table II: Results Calibration Range and Number of Calibration Points for Each Semivolatile Compound

Name	Min (ppb)	Max (ppb)	#Points
N-Nitrosodimethylamine	2	1000	8
Pyridine	50	2000	6
2-Fluorophenol	0.5	20	6
Phenol-d6	2	200	6
Phenol	2	200	5
Aniline	2	200	6
2-Chlorophenol	0.5	200	7
2-Methylphenol	5	200	6
3- and 4-Methylphenol	2	1000	8
Nitrobenzene-d5	5	1000	6
2-Nitrophenol	5	200	5
2,4-Dimethylphenol	2	200	6
Benzoic acid	100	2000	5
2,4-Dichlorophenol	2	2000	9
Naphthalene	1	50	5
2,6-Dichlorophenol	1	100	5
4-Chloroaniline	2	200	6
4-Chloro-3-methylphenol	5	2000	8
2-Methylnaphthalene	1	2000	10
1-Methylnaphthalene	1	2000	10
2,4,6-Trichlorophenol	5	1000	7
2,4,5-Trichlorophenol	10	2000	8
2-Fluorobiphenyl	0.5	2000	11
o-Nitroaniline	1	100	6
Acenaphthylene	5	200	5
3-Nitroaniline	2	100	6
Acenaphthene	5	2000	7
2,4-Dinitrophenol	50	2000	6
4-Nitrophenol	5	2000	8
2,3,4,6-Tetrachlorophenol	10	2000	7
Fluorene	5	2000	9
4-Nitroaniline	2	200	6
4,6-Dinitro-2-methylphenol	5	100	5
Diphenylamine	5	200	5
2,4,6-Tribromophenol	20	2000	7
Pentachlorophenol	10	1000	6
Phenanthrene	1	200	7
Dinoseb	10	200	5
Anthracene	5	200	6
Fluoranthene	10	200	5
Benzidine	50	2000	5
Pyrene	5	100	5
p-Terphenyl-d14	1	200	7
3,3'-Dichlorobenzidine	20	200	5
Benz[a]anthracene	20	500	5
Chrysene	10	1000	5
Benzo[b]fluoranthene	20	1000	5

After the linear calibration curves were established on the RMX-5Sil MS column, fresh calibration curves were run on each column using the same calibration range and integration settings. Linear fit for each calibration curve was compared using R^2 (unweighted) and response factor %RSD per EPA Method 8270E criteria. Results showed that the RMX-5Sil MS column produced method-compliant results for more compounds than the other columns did (Figure 4). Superior R^2 and %RSD values on the RMX-5Sil MS column demonstrate better overall calibration curve linearity, which will improve quantitative precision and accuracy.

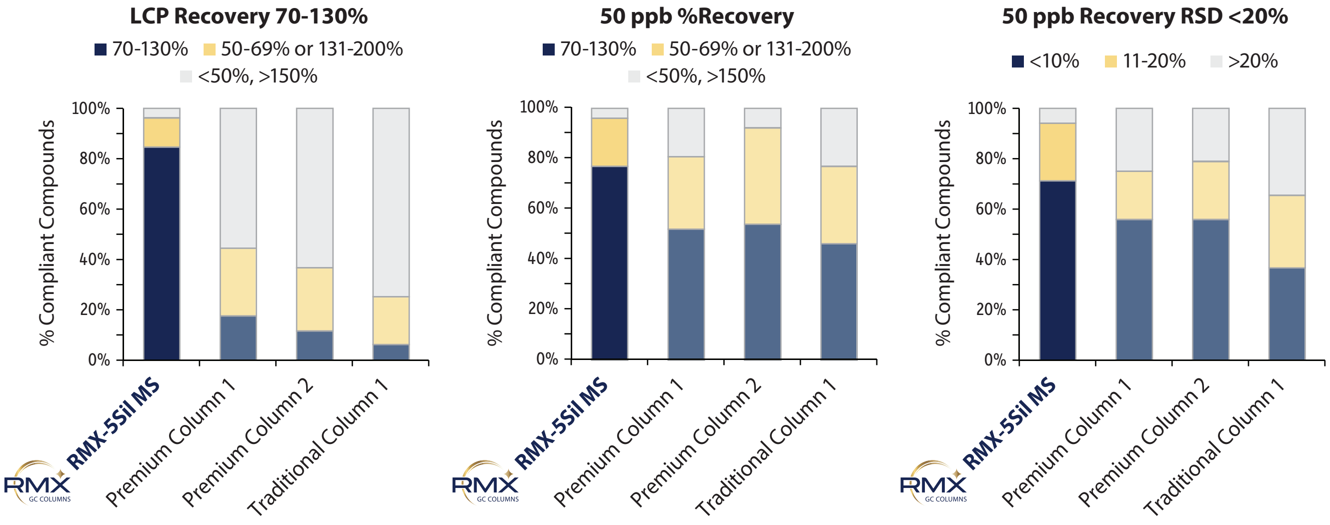
Figure 4: More semivolatile compounds meet data quality objectives (>0.995 R^2 and <10% RSD) on RMX-5Sil MS columns than on other columns, demonstrating superior calibration linearity.



Recovery

Recovery was determined at both the lowest calibration point and at the 50 ppb midpoint level to assess the impact of column choice. Repeatability of recovery results was evaluated at the 50 ppb midpoint because it is more representative of column performance than the LCP, where peak shape is more likely to be influenced by baseline noise from the instrument. As shown in Figure 5, recoveries at the LCP were substantially better on the RMX-5Sil MS column than on the other columns tested, which can be attributed to a more effective deactivation that improves peak response and integration at trace levels. While recoveries were fairly similar across all columns at the 50 ppb midpoint, recovery results were much more consistent on the RMX-5Sil MS column. Repeatability is dependent on the relationship between peak shape and the integration algorithm, and small differences in peak shape can affect integration. The highly consistent results obtained on the RMX-5Sil MS column demonstrate that its TriMax deactivation minimizes surface activity that contributes to variability across injections.

Figure 5: The RMX-5Sil MS column has the most compounds achieving 70-130% recovery at both the lowest calibration point (LCP) and at 50 ppb. In addition, it was highly consistent and has the most compounds achieving <10% RSD at 50 ppb.



Conclusion

While 5-type and 5sil-type columns have appropriate selectivity for semivolatiles analysis and are widely used around the world, traditional deactivations are not completely effective at blocking active sites. As a result, labs struggle to analyze active compounds, particularly at trace levels. Productivity may further suffer if multiple columns are needed for different analyte groups or when quality criteria begin to fail. Based on the comparative study presented here, the ground-breaking TriMax deactivation used in RMX-5Sil MS columns resulted in a significantly more inert column surface that gave superior performance across compound classes. As a result, when using RMX-5Sil MS columns, data quality objectives were met for more semivolatiles compared to other analytical columns. This improved performance for a wide range of acidic, basic, and neutral compounds gives labs more opportunity to reap the benefits of reduced solvent consumption and method consolidation relative to traditional 5-type columns.

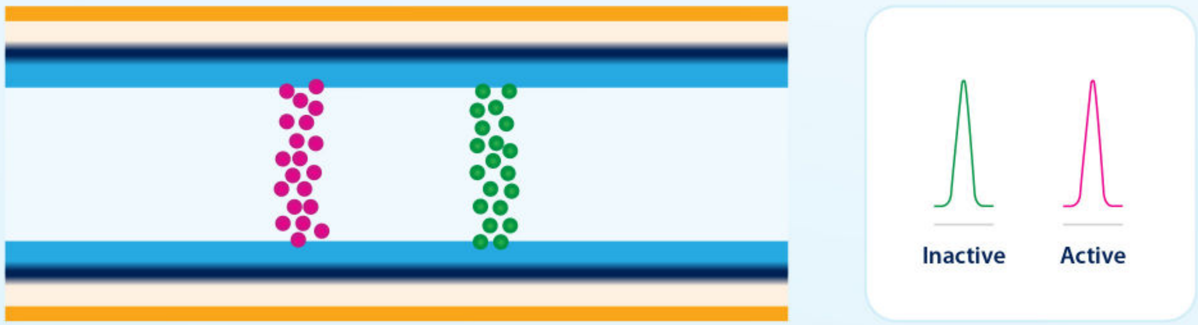
References

1. U.S. Environmental Protection Agency, Method 8270E, Semivolatile organic compounds by gas chromatography/mass spectrometry, June 2018. https://www.epa.gov/sites/default/files/2020-10/documents/method_8270e_update_vi_06-2018_0.pdf
2. U.S. Environmental Protection Agency, Method 3511, Organic compounds in water by microextraction, July 2014. https://www.epa.gov/sites/default/files/2015-12/documents/3511.pdf
3. E. Pack, C. English, R. Dhandapani, and C. Myers, Increase lab efficiency with a consolidated trace-level semivolatiles method, Featured application note, EVFA5253, Restek Corporation, 2025.

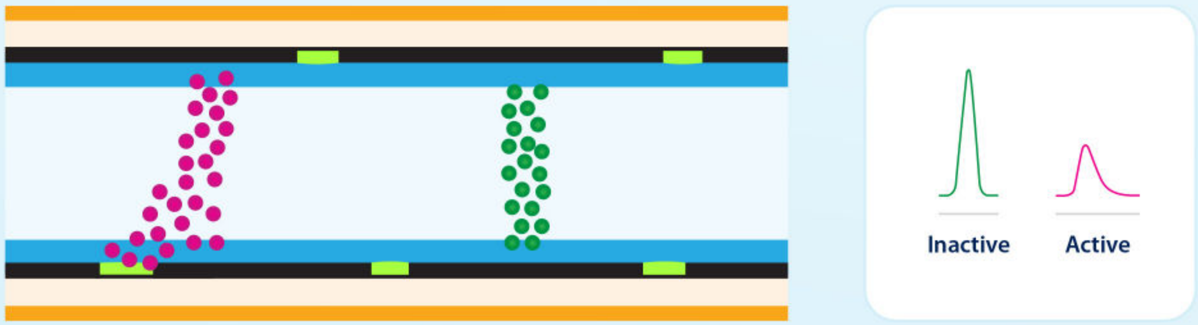
What Makes RMX Columns Better?

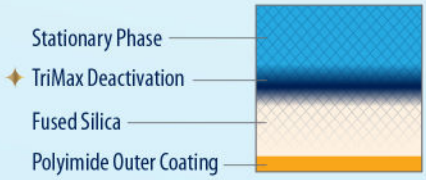
Highly Effective TriMax Deactivation Protects Analytes From Surface Interactions, Improving Peak Shape and Sensitivity for a Wide Range of Compound Chemistries

TriMax Deactivation



Non-TriMax Deactivation





● Inactive compounds:
alkanes, alkenes, alkynes, etc.

● Active compounds:
acids, bases, alcohols, esters, ethers, etc.

🟩 Residual active site

Learn More About RMX Columns Today!

Featured Products

RMX-5Sil MS GC Capillary Column

Catalog No.	Product name	Units
17323	RMX-5Sil MS GC Capillary Column, 30 m, 0.25 mm ID, 0.25 µm	ea.

Topaz Precision Inlet Liner

Catalog No.	Product Name	Units
23267	Topaz, Precision Inlet Liner, 4.0 mm x 6.3 x 78.5, for Thermo TRACE 1300/1310, 1600/1610 GCs w/SSL Inlets, w/Quartz Wool, Premium Deactivation	5-pk.

Restek Electronic Leak Detector

Catalog No.	Product Name	Units
28500	Restek Electronic Leak Detector (includes carrying case; universal AC power adaptor [U.S., UK, Europe, Australia, Japan]; 6-ft USB charging cable)	ea.

SVOC MegaMix 150 Kit, 1 mL/ampul; 6 ampuls/kit

Contains one ampul of each of the following.

Cat.# 31850: 8270 MegaMix
1000 µg/mL each in methylene chloride (3-methylphenol and 4-methylphenol at 500 µg/mL), 1 mL/ampul
Acenaphthene (83-32-9)
Acenaphthylene (208-96-8)
Aniline (62-53-3)
Anthracene (120-12-7)
Azobenzene (103-33-3)*
Benz[a]anthracene (56-55-3)
Benzo[a]pyrene (50-32-8)
Benzo[b]fluoranthene (205-99-2)
Benzo[g,h,i]perylene (191-24-2)
Benzo[k]fluoranthene (207-08-9)
Benzyl alcohol (100-51-6)
Benzyl butyl phthalate (85-68-7)
Bis(2-chloroethoxy)methane (111-91-1)
Bis(2-chloroethyl)ether (111-44-4)
Bis(2-ethylhexyl)adipate (103-23-1)
Bis(2-ethylhexyl)phthalate (117-81-7)
4-Bromophenyl phenyl ether (101-55-3)
Carbazole (86-74-8)
4-Chloroaniline (106-47-8)
4-Chloro-3-methylphenol (59-50-7)
2-Chloronaphthalene (91-58-7)
2-Chlorophenol (95-57-8)
4-Chlorophenyl phenyl ether (7005-72-3)
Chrysene (218-01-9)
Dibenz[a,h]anthracene (53-70-3)
Dibenzofuran (132-64-9)
1,2-Dichlorobenzene (95-50-1)
1,3-Dichlorobenzene (541-73-1)
1,4-Dichlorobenzene (106-46-7)
2,4-Dichlorophenol (120-83-2)
Diethylphthalate (84-66-2)
2,4-Dimethylphenol (105-67-9)
Dimethylphthalate (131-11-3)
Di-n-butyl phthalate (84-74-2)
1,2-Dinitrobenzene (528-29-0)
1,3-Dinitrobenzene (99-65-0)
1,4-Dinitrobenzene (100-25-4)
4,6-Dinitro-2-methylphenol (Dinitro-o-cresol) (534-52-1)
2,4-Dinitrophenol (51-28-5)
2,4-Dinitrotoluene (121-14-2)
2,6-Dinitrotoluene (606-20-2)
Di-n-octyl phthalate (117-84-0)
Diphenylamine (122-39-4)†
Fluoranthene (206-44-0)
Fluorene (86-73-7)
Hexachlorobenzene (118-74-1)
Hexachlorobutadiene (87-68-3)
Hexachlorocyclopentadiene (77-47-4)
Hexachloroethane (67-72-1)
Indeno[1,2,3-cd]pyrene (193-39-5)
Isophorone (78-59-1)
1-Methylnaphthalene (90-12-0)
2-Methylnaphthalene (91-57-6)
2-Methylphenol (*o*-cresol) (95-48-7)
3-Methylphenol (*m*-cresol) (108-39-4)
4-Methylphenol (*p*-cresol) (106-44-5)
Naphthalene (91-20-3)
2-Nitroaniline (88-74-4)
3-Nitroaniline (99-09-2)
4-Nitroaniline (100-01-6)
Nitrobenzene (98-95-3)
2-Nitrophenol (88-75-5)
4-Nitrophenol (100-02-7)
N-Nitrosodimethylamine (62-75-9)
N-Nitroso-di-*n*-propylamine (621-64-7)
2,2'-Oxybis(1-chloropropane) (108-60-1)
Pentachlorophenol (87-86-5)
Phenanthrene (85-01-8)
Phenol (108-95-2)
Pyrene (129-00-0)
Pyridine (110-86-1)
2,3,4,6-Tetrachlorophenol (58-90-2)
2,3,5,6-Tetrachlorophenol (935-95-5)
1,2,4-Trichlorobenzene (120-82-1)
2,4,5-Trichlorophenol (95-95-4)
2,4,6-Trichlorophenol (88-06-2)

Cat.# 31909: SVOC Additions
1000 µg/mL each in methylene chloride, 1 mL/ampul
Acrylamide (79-06-1)
Benzidine (92-87-5)
n-Decane (C10) (124-18-5)
Dibenz(a,h)acridine (226-36-8)
2,3-Dichloroaniline (608-27-5)
3,3'-Dichlorobenzidine (91-94-1)
Dimethoate (60-51-5)
Dinoseb (88-85-7)
Disulfoton (298-04-4)
Famphur (52-85-7)
n-Hexadecane (C16) (544-76-3)
Indene (95-13-6)
Methyl parathion (298-00-0)
6-Methylchrysene (1705-85-7)
4,4'-Methylene-bis(2-chloroaniline) (101-14-4)
n-Octadecane (C18) (593-45-3)
Parathion (ethyl parathion) (56-38-2)
Phorate (298-02-2)
Quinoline (91-22-5)
Sulfotepp (3689-24-5)
α-Terpineol (98-55-5)
o,o,o-Triethyl phosphorothioate (126-68-1)
Zalophus (thionazine) (297-97-2)

Cat.# 32459: Appendix IX mix #1, revised
2000 µg/mL each in methylene chloride, 1 mL/ampul
2-Acetylaminofluorene (53-96-3)
4-Aminobiphenyl (92-67-1)
p-Dimethylaminoazobenzene (60-11-7)
3,3'-Dimethylbenzidine (o-tolidine) (119-93-7)
α,α-Dimethylphenethylamine (phentermine) (122-09-8)
1-Naphthylamine (1-aminonaphthalene) (134-32-7)
2-Naphthylamine (2-aminonaphthalene) (91-59-8)
N-Nitrosodibutylamine (924-16-3)
N-Nitrosodiethylamine (55-18-5)
N-Nitrosomethylethylamine (10595-95-6)
N-Nitrosomorpholine (59-89-2)
N-Nitrosopiperidine (100-75-4)
N-Nitrosopyrrolidine (930-55-2)
5-Nitro-o-toluidine (99-55-8)
1,4-Phenylenediamine (106-50-3)
2-Picoline (109-06-8)
o-Toluidine (95-53-4)

Cat.# 32460: Methapyrilene
2000 µg/mL in methylene chloride, 1 mL/ampul
Methapyrilene hydrochloride (135-23-9)

Cat.# 31806: Appendix IX mix #2
1000 µg/mL each in methylene chloride, 1 mL/ampul
Acetophenone (98-86-2)
Aramite (140-57-8)
Atrazine (1912-24-9)
Benzaldehyde (100-52-7)
Biphenyl (92-52-4)
ε-Caprolactam (105-60-2)
Chlorobenzilate (510-15-6)
1-Chloronaphthalene (90-13-1)
Diallate (2303-16-4)
Dibenz[a,j]acridine (224-42-0)
2,6-Dichlorophenol (87-65-0)
7,12-Dimethylbenz[a]anthracene (57-97-6)
1,4-Dioxane (123-91-1)
Diphenyl ether (101-84-8)
Ethyl methacrylate (97-63-2)
Ethyl methanesulfonate (62-50-0)
Hexachloropropene (1888-71-7)
Isodrin (465-73-6)
Isosafrole (cis & trans) (120-58-1)
Kepone (143-50-0)
3-Methylcholanthrene (56-49-5)
Methyl methanesulfonate (66-27-3)
1,4-Naphthoquinone (130-15-4)
4-Nitroquinoline-N-oxide (56-57-5)
Pentachlorobenzene (608-93-5)
Pentachloroethane (76-01-7)
Pentachloronitrobenzene (Quintozene) (82-68-8)
Phenacetin (62-44-2)
Propyzamide (23950-58-5)
Safrole (94-59-7)
1,2,4,5-Tetrachlorobenzene (95-94-3)
1,3,5-Trinitrobenzene (99-35-4)

Cat.# 31879: Benzoic acid
2000 µg/mL in methylene chloride, 1 mL/ampul
Benzoic acid (65-85-0)

*1,2-diphenylhydrazine (8270-listed analyte) decomposes to azobenzene (mix component) in the injector.

†N-Nitrosodiphenylamine is a reactive species that can initiate premature decomposition of other compounds in the mix. For these reasons, diphenylamine is used in the preparation of this mixture.

Catalog No.	Units
31907	kit

GC-MS Tuning Mix

1000 µg/mL, Methylene Chloride, 1 mL/ampul

Catalog No.	Contains	Units
31615	Benzidine (92-87-5) 4,4'-DDT (50-29-3) DFTPP (decafluorotriphenylphosphine) (5074-71-5) Pentachlorophenol (87-86-5)	ea.

Acid Surrogate Mix (4/89 SOW)

2000 µg/mL, Methanol, 1 mL/ampul

Catalog No.	Contains	Units
31025	2-Fluorophenol (367-12-4) Phenol-d6 (13127-88-3) 2,4,6-Tribromophenol (118-79-6)	ea.

Base Neutral Surrogate Mix (4/89 SOW)

1000 µg/mL, Methylene Chloride, 1 mL/ampul

Catalog No.	Contains	Units
31024	2-Fluorobiphenyl (321-60-8) Nitrobenzene-d5 (4165-60-0) p-Terphenyl-d14 (1718-51-0)	ea.

Revised SV Internal Standard Mix

4000 µg/mL, Methylene Chloride, 1 mL/ampul

Catalog No.	Contains		Units
31886	Acenaphthene-d10 (15067-26-2) Chrysene-d12 (1719-03-5) 1,4-Dichlorobenzene-d4 (3855-82-1) 1,4-Dioxane-d8 (17647-74-4)	Naphthalene-d8 (1146-65-2) Perylene-d12 (1520-96-3) Phenanthrene-d10 (1517-22-2)	ea.