



GsBP™ GC Columns For Water Analysis

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GS-Tek

Our History



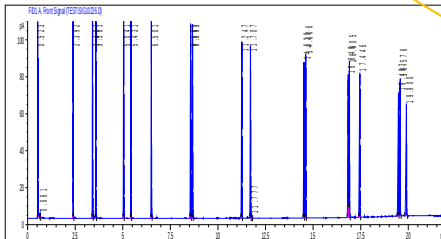
1990-2006 HP/Agilent GC column R&D



2008, own brand



2011Instrument and collaboration



GS-Tek

2009 product expansion, GC/HPLC



GS-Tek

Complete Broad Offers w/ experience and support

GsBP

▶ ***Column Products:***

- Complete offer of GsBP™-GC columns
- Complete offer of Venusil™ HPLC and SPE columns

▶ ***Lab Instruments :***

- Analyzers, RGA, NAG, LPG, Sim-Dis, PONA, DHA, Residue solvents
- Instrument spare parts and service parts

▶ ***Lab Supplies:***

- Cost effective and quality syringe filters
- Chromatographic consumables & supplies for most instruments

▶ ***You can find whatever you need w/ cost effectiveness. try it!***



GS-Tek

We deliver your needs

- Quickly
- Performance/Quality
- Cost effectively
- All time knowledgeable support
- Collaboration

GsBP™-Phases

Stationary phase	Composite	Temperature limit °C
GsBP-1, GsBP-1MS, GsBP-PONA, GsBP-SimDis	100% dimethyl polysiloxane	-60 to 325/350
GsBP-5, GsBP-5MS, GsBP-PAHs, GsBP-5Pesticides	95% dimethyl/ 5% diphenyl polysiloxane	-60 to 325/350
GsBP-XLB, GsBP-XPesticides	Proprietary methyl phenyl polysiloxane	-60 to 325/350
GsBP-35MS, GsBP-3Pesticides	65% dimethyl/ 35% diphenyl polysiloxane	-20 to 320/340
GsBP-50+MS	50% diphenyl, 50%dimethylsiloxane	-20 to 320/340

GsBP™-Phases

Stationary phase	Composite	Temperature limit °C
GsBP-1301, GsBP-624, GsBP-VMS, GsBP-FVOC, GsBP-502.2	Approx 6% cyanopropylphenyl/ 94% dimethyl polysiloxane	-20 to 260/280
GsBP-1701, GsBP-1701-MS	14% cyanopropylphenyl/ 86% dimethyl polysiloxane	-20 to 280/300
GsBP-225	50%cyanopropylmethyl 50% phenylmethylpolysiloxane	20 to 220/240
GsBP-Inowax, GsBP-Inowax-MS, GsBP-FAMEWAX	Crosslinked Polyethylene glycol (PEG)	40 to 260/280
GsBP-FFAP	Crosslinked PEG modified w/ acids	40 to 260/280
GsBP-FAME	High content of cyanopropylphenyl polysiloxane	20 to 200/220

GsBP™-Phases

Stationary phase	Composite	Temperature limit °C
GsBP-PLOT Al ₂ O ₃ / "KCl", "S", "M"	Aluminum oxide, modified with KCL, Na ₂ SO ₄ or Na ₂ MoO ₄	-60 to 200
GsBP-PLOT Molesieve 5A	Molecular Sieve zeolite, 5A	-60 to 300
GsBP-PLOT Q	Crosslinked divinylbenzene polymer	; -60 to 250/280
GsBP-PLOT U	Crosslinked divinylbenzene ethylene glycol dimethacrylate copolymer	-60 to 190/200
GsBP-PLOT GasPro	Modified porous silica layer	-60 to 300

Phase Comparison

GS-TEK	Agilent			
GsBP-1	DB-1	HP-1	CP-Sil 5 CB	Rtx-1
GsBP-1MS	DB-1ms	HP-1ms		Rtx-1MS
GsBP-5	DB-5	HP-5	CP-Sil 8 CB	Rtx-5
GsBP-5MS	DB-5ms	HP-5ms		Rtx-5MS
GsBP-XLB	DB-XLB			Rtx-XLB
GsBP-35MS	DB-35ms			Rtx-35
GsBP-50+MS	DB-17ms	HP-50+		Rtx-17MS
GsBP-1701	DB-1701		CP-Sil 19 CB	Rtx-1701
GsBP-1701MS				
GsBP-1301	DB-1301		CP-1301	Rtx-1301
GsBP-624/VMS	DB-624			Rtx-624, VMS
GsBP-225	DB-225		CP-Sil 43 CB	
GsBP-INOWAX	DB-WAX	HP-INNOWax	CP-WAX 52 CB	StablWax
GsBP-FFAP	DB-FFAP	HP-FFAP	CP-FFAP CB	StablWax B
GsBP-PLOT Al ₂ O ₃ , KCl	GS-Al ₂ O ₃	HP-PLOT Al ₂ O ₃ KCl	CP-Al ₂ O ₃ /KCl	Rtx-Alumina
GsBP-Gaspro	GS-Gaspro			
GsBP-PLOT Q/U	GS-Q	HP-PLOT Q/U	CP-PoraBond Q/U	Rx-Q

Column QC: lead to Quality and Performance

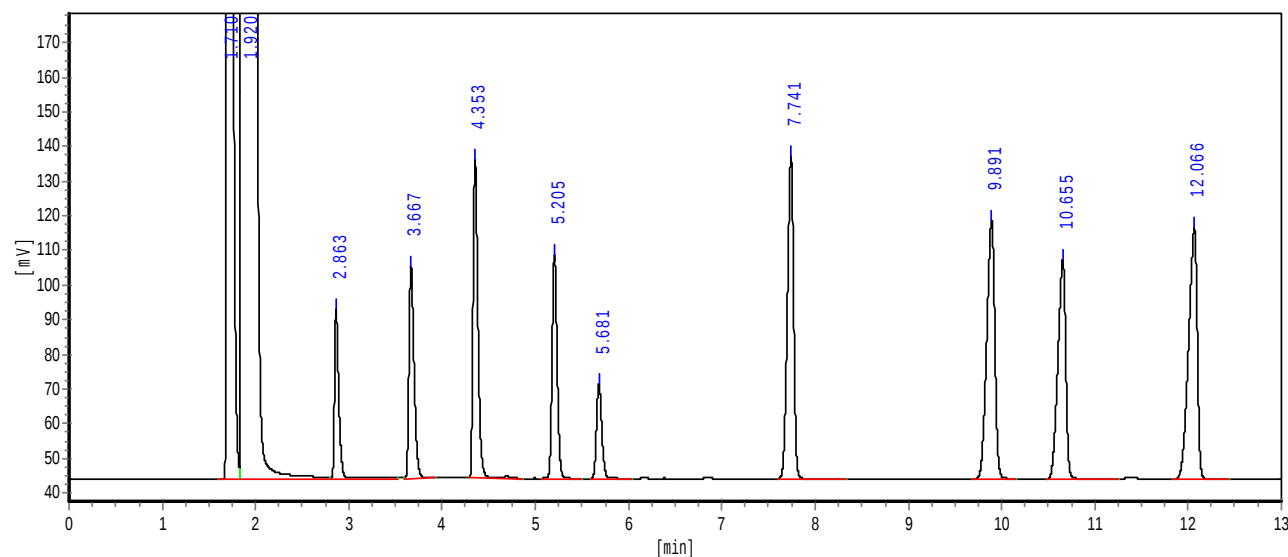


We guarantee column performance and quality thru 100% column testing with industrial stringent test samples for:

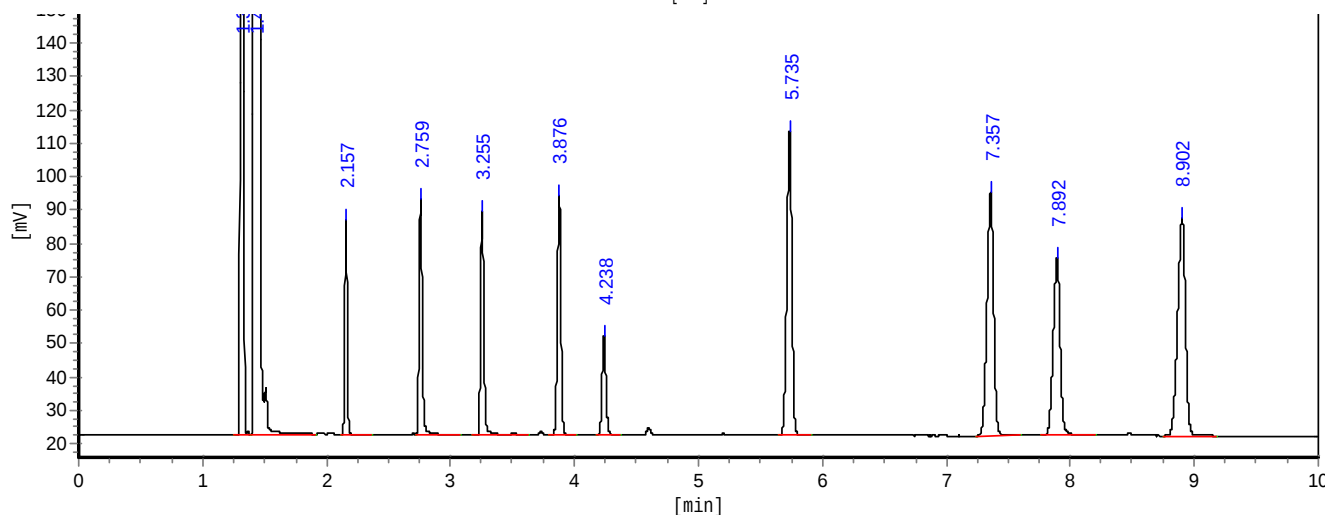
- K value: stationary phase film thickness for reproducibility
- RI: stationary phase to ensure brand equivalence
- Plate number: film thickness uniformity lead to good separations
- Peak height ratio: column inertness for accurate quantitation
- Bleed : phase thermal stability to prolong column life time
- Length and ID, to commit our specification and interchangeability

To ensure equivalence performance of GsBP[™] columns to other major brand columns

Performance Test, non-polar phase

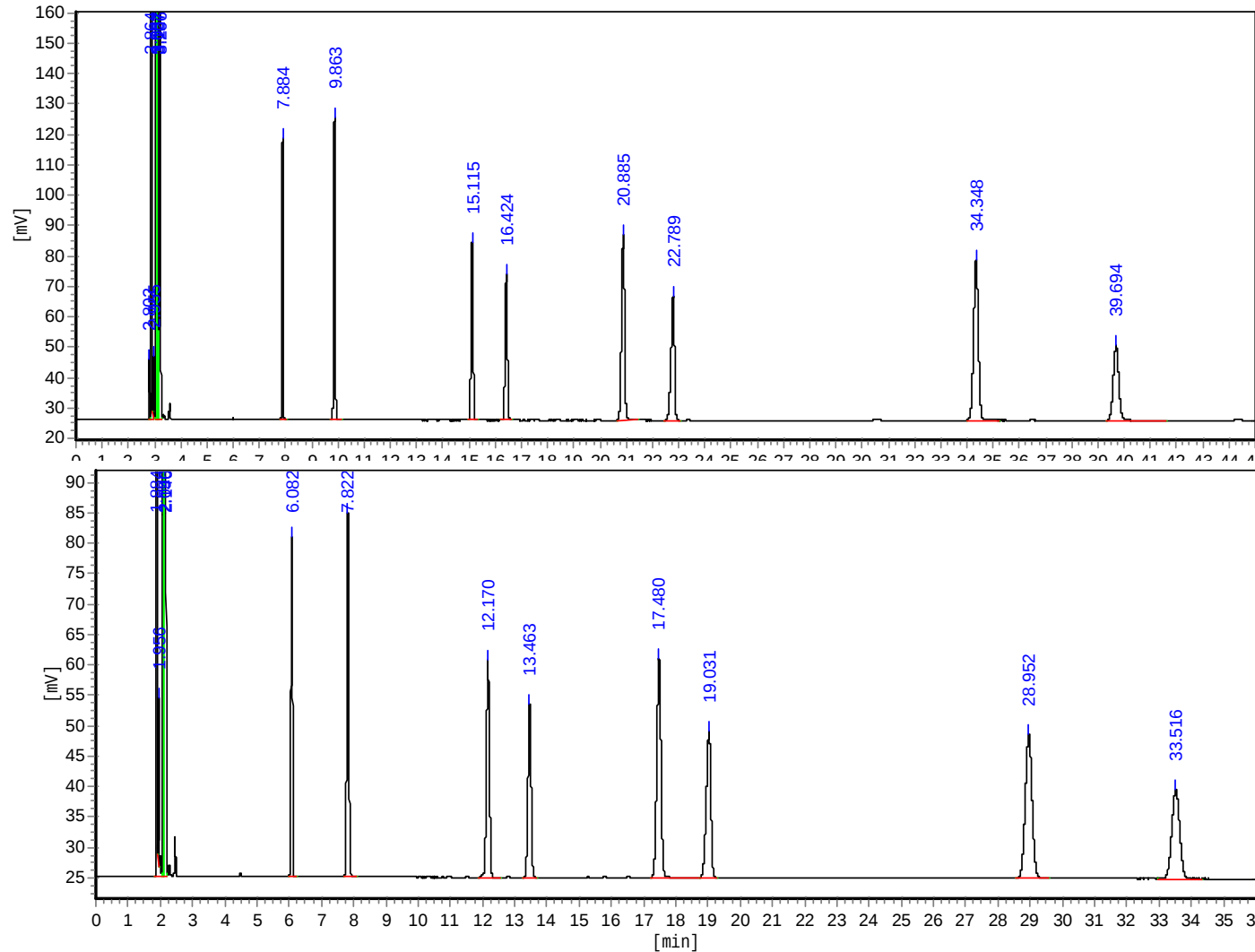


GsBP-5MS



DB-5MS

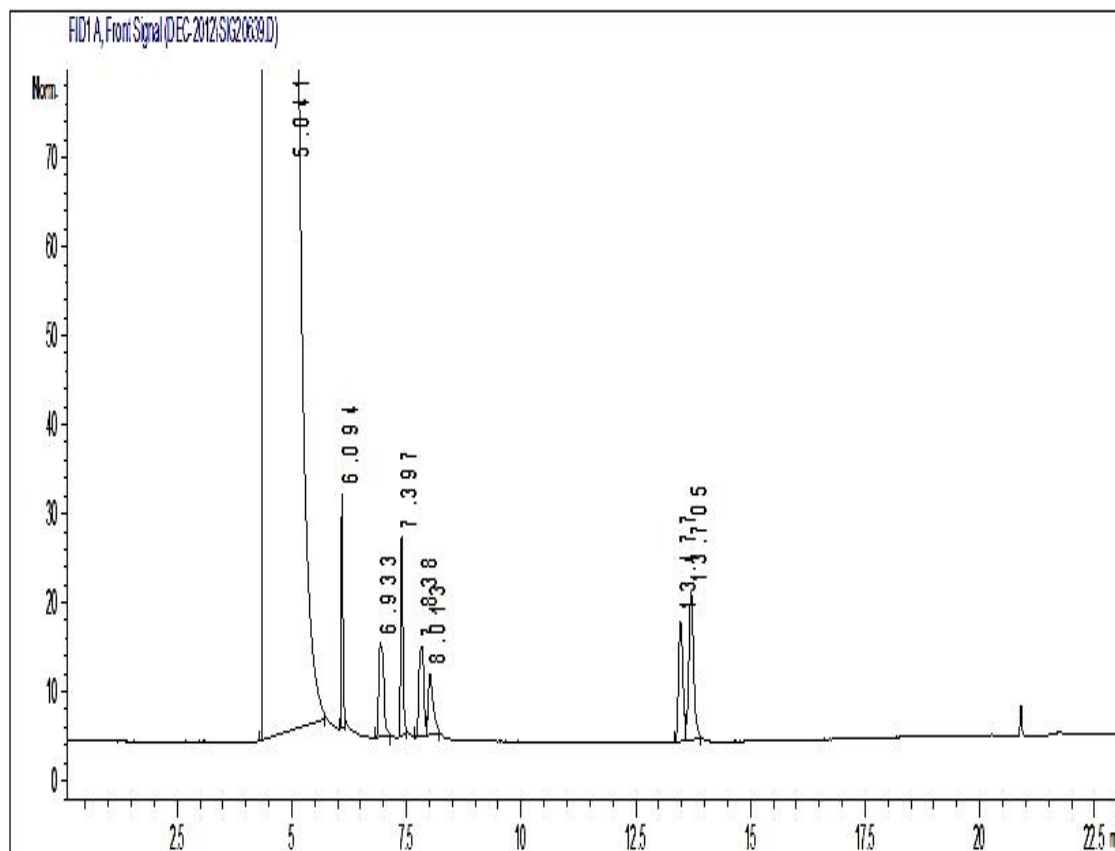
Performance Test, polar phase



GsBP-Inowax

HP-InnoWax
/DB-wax

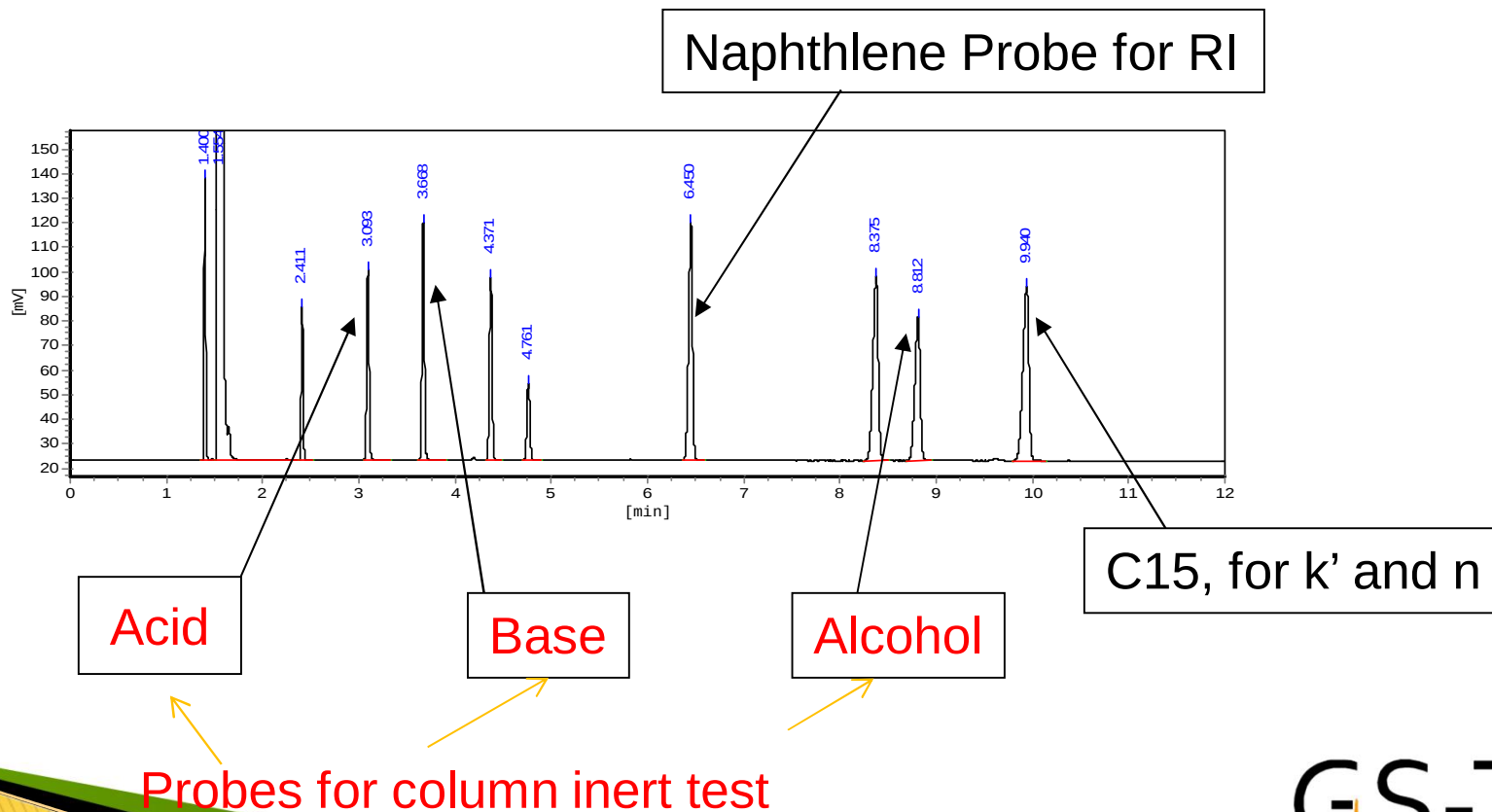
Great GSBP-624 Column Inertness



Peak	Name	Conc	RT
1	Methanol	Solvent	5.04
2	Ethanol	10ppm	6.09
3	Acetone	10ppm	6.93
4	Isopropanol	10ppm	7.40
5	Acetonitrile	10ppm	7.84
6	Dichloromethane	10ppm	8.01
7	2-Butanone	10ppm	13.48
8	Ethyl Acetate	10ppm	13.71
			2.06

Inertness Test

Test samples contains probes of acidic, basic, alcohol for column inertness, hydrocarbons as marker for retention times, column selectivity and theoretical plates



Water Analysis



- ▶ Sample
- ▶ Sample preparation
- ▶ Column Selection
- ▶ Method

Water Analysis: Sample



- ▶ Water: drinking water, high purity water, ground or surface water, underground water, sewage water, industrial waste water, moistures in soil, etc
- ▶ Water is a good solvent for most organic chemicals at low level, ppb or lower
- ▶ VOCs and sVOCs are abundant in water
- ▶ Inorganic contaminants also present in water
- ▶ pH of water sample varies widely
- ▶ Particulates are presented

Water Analysis: Samples for GCs



- ▶ Only VOCs and semi VOCs by GC technique
- ▶ Suitable detectors: FID, ECD, MSD, PFPD
- ▶ Sample preparation techniques:
 - Liquid extraction(LLE)
 - Solid phase extraction(SPE)
 - Solid phase micro-extraction(SPME)
 - Purge-trap(P/T)
 - Headspace(HS)

Water Analysis: Sample preparation

- ▶ Low detection limit: GC-FID, GC-MSD, GC-ECD, 1ng
- ▶ 1ng → 0.1ul sample(S/SL) → 10ug/ml → 10ppm minimum sample concentration
- ▶ Sample extraction magnitudes and sample preparation technique:
 - ppt: 10^5 (P/T, LLE?)
 - ppb: 10^2 (SPE, LLE)
 - ppm: 10^0 (HS, SPME, Direct Injection(DI))

Water Analysis: GC Columns



- ▶ Sample loading:
 - 0.53mm 1ul direct: more samples, but broadening peaks) by half vs 0.25mm columns
 - 0.32mm 0.5-1ul direct: adequate samples and peak width)
 - 0.25mm 0.1-0.5ul direct: limited sample and narrow peak width
 - <0.25mm, 0.05—0.1ul direct, very limited sample, no gain from narrow peak width due to sample overloading
- ▶ Length: 60m and 30m, occasional 20m, 75m, 105m
- ▶ *Only one phase ratio for 624 column, 1.0um, 1.4um, 1.8um, 3.0um, same relative retentions*

Water Analyese: GC Columns



▶ Column dimension:

- 0.25mm x 30m is a popular choice
- 0.32mm x 60m is to improve the separation (50% improving)
- Thin film can be used for faster separation
- Retention gap can be used for large sample introduction or dirty sample used

Column Stationary phase:

- * VOCs/Halogens, 624, 1701, 1301
- * sVOCs, PAHS, Phthalates, PCBs, Pesticides-5, -5MS
- * Aromatics: -1, PEG, 624

GC-MS helps peak identifications, no need for complete separations

Water Analysis: Water effect

- ▶ Water most times eluting first both in gaseous or condensed liquid drops
- ▶ Water gaseous volume is the largest
- ▶ Interfere to earlier elute VOCs, separation and quantitation (alcohol, acetaldehyde, halogens)
- ▶ Water condenses into the first a few meters to increase surface activities, (loss of acidic and basic compounds) for VOC application
- ▶ Water won't strip off most stationary phases
- ▶ Contaminate GC liner quickly and cause inaccurate quantitation of active compounds

Understanding 624 columns



- ▶ Mid-polar thick film columns designed for VOCs and halogen separations, slightly acidic
- ▶ Various Trade names: VRX, VOCCol, volatile, 502.2, 624, VMS, FVOC, etc (polarity increasing order)
- ▶ Functionary groups: cyanopropyl, Phenol/methyl, Withstand/resistant to water/moisture
- ▶ Different selectivity/separations between each brand for VOCs BP lower than 100C
- ▶ Small differences in retention times
- ▶ Lower plate numbers from thick film than respective non-polar phase columns

624 columns issues

- ▶ Observed column activity to result in alcohol loss
- ▶ High bleeding, not very good for GC-MS, ghost peaks, noise peaks, or jet clogging
- ▶ Many co-elutions, different co-elutions for different brands, no difference for intrinsic coelutions
- ▶ Better to use with a confirmation column, such as -1 column, or PEG column, for peak identifications
- ▶ Increase post-run time to bake out any possible heavy compound, prolong analysis time
- ▶ Need longer precondition times, step wise, from 150C, 200C, 220C, 240C, and 250C, trim column detector side length to avoid detector contaminated

Co-elution issues



- ▶ 624 column cannot separate all VOCs, neither any single GC column
- ▶ Co-elutions not an issue with GC-MSD, as most co-elution compounds are functionally different
- ▶ Critical separations are easily affected by sampling technique (e.g., Headspace), and GC oven temperature variations between brands and model
- ▶ Use a confirmation column as needed, such as PEG phase or -1phase column
- ▶ Increase column length may improve co-elution from variation of critical separations, but not Intrinsic ones

Co-elution examples

RT	Compound name	Group
3.72	ethyl ether	ether
3.72	ethyl vinyl ether	ether
3.72	furan	ether
4.27	acetonitrile	nitrile
4.27	bromoethane	halogen
4.27	carbon disulfide	
4.27	ethyl formate	formate
4.27	iodomethane	halogen
4.27	iso-propanol	alcohol
7.16	2,2-dichloropropane	halogen
7.16	cis-1,2-dichloroethylene	halogen
7.19	2-butanone (MEK)	ketone
7.53	methacrylonitrile	
7.55	2-propyn-1-ol (propargyl alcohol)	alcohol
7.55	sec-butanol	alcohol
7.59	bromochloromethane	halogen

RT	Compound name	Group
9.15	heptane	
9.18	crotonaldehyde	aldehyde
9.18	fluorobenzene	halogen
10.02	ethyl acrylate	ester
10.02	tert-butyl acetate	ester
10.03	1-penten-3-one (ethyl vinyl ketone)	ketone
10.34	2,3-pentanedione	ketone
10.34	3-pentanone	ketone
10.37	dibromomethane	halogen
10.37	ethyl propionate	ketone
10.38	1,4-dioxane	
10.6	2-pentanol	alcohol
10.6	3-pentanol	alcohol
11.93	glycidol	alcohol
11.93	toluene	aromatics

Co-elution Examples

RT	Compound name	Group
12.63	1-pentanol	alcohol
12.63	2-penten-1-ol	alcohol
13.14	hexanal	ketone
13.16	3-hexanol	alcohol
13.16	propylene glycol (1,2-propanediol)	alcohol
14.62	m-xylene	aromatics
14.62	p-xylene	aromatics
14.63	furfural	ketone
14.63	nonane	
15.28	o-xylene	aromatics
15.28	styrene	aromatics
15.29	3-heptanone	ketone
15.57	2-ethoxyethyl acetate	ester
15.57	amyl acetate	ester
15.58	DMSO (methyl sulfoxide)	
15.6	heptanol	alcohol
15.61	bromoform	halogen
15.63	2-heptanol	alcohol
15.63	cyclohexanol	alcohol

RT	Compound name	Group
16.82	3-chlorotoluene	halogen
16.82	4-chlorotoluene	halogen
16.82	decane	
17.22	1-heptanol	alcohol
17.22	a-methylstyrene	aromatics
17.22	cis-4-hepten-1-ol	alcohol
17.22	trans-2-hepten-1-ol	alcohol
17.45	3-octanone	ketone
17.45	benzaldehyde	aldehyde
17.68	4-methylstyrene	aromatics
17.68	iso-butylbenzene	aromatics
17.68	sec-butylbenzene	aromatics
19.35	4-chlorostyrene (diisobutyl ketone)	ketone
19.35	4-tert-butyltoluene	aromatics
19.63	m-tolualdehyde	aldehyde
19.63	o-tolualdehyde	aldehyde
22.65	1-decanol	alcohol
22.65	2-phenoxyethanol	alcohol
22.65	a-ethylphenethyl alcohol	alcohol

EPA Standard Methods



- ▶ Many EPA methods established for analyses
- ▶ Not frequent updates like ASTM method, some may not work well because of progress in column technology
- ▶ EPA 8270 is a challenging, base neutral, acid to column, instrument and sample preparations
- ▶ EPA 8260(many sub method) allows co-elution as too many VOCs to identify
- ▶ Best approach to use both 624 columns and - 1phase columns for 8260 methods for confirmations

GS-Tek Recommendations

Cat No	Column Description	Applications	Instrument	Sample preparation	EPA method
1125-3010	GsBP-1MS, 30m x 0.25mm x 1.0um	EO, PO, oxygenates	GC-FID	HS, SPE	confirmation column
0132-6010	GsBP-1, 60m x 0.32mm x 1.0um	TPH	GC-FID	HS, SPE	confirmation column
0153-3030	GsBP-1, 30m x 0.53mm x 3.0um	MTBEs	GC-FID	HS, SPE	confirmation column
0632-3002	GsBP-TPH, 30m x 0.32mm x 0.25um	TPH	GC-FID	HS, SPE	
1525-3002	GsBP-5MS, 30m x 0.25mm x 0.25um	SVOCS, phenol, phthlates, PAH, pesticides, halogens,	GC-FID, GC-MSD	HS, SPE	8270, 625, 525, 528, 604, 8040, 8041, 506, 606, 8060, 8061
1525-6002	GsBP-5MS, 60m x 0.25mm x 0.25um	Dioxane, Phenol, PAHs	GC-FID, GC-MSD	HS, SPE	8270, 625, 525, 528, 604, 8040, 8041, 506, 606, 8060, 8061
1625-3005	GsBP-XLB, 30m x 0.25mm x 0.5um	PCBs, Pesticides	GC-ECD, GC-MSD	HS, SPE	508.1, 608, 8081a, 8082

GS-Tek Recommendations

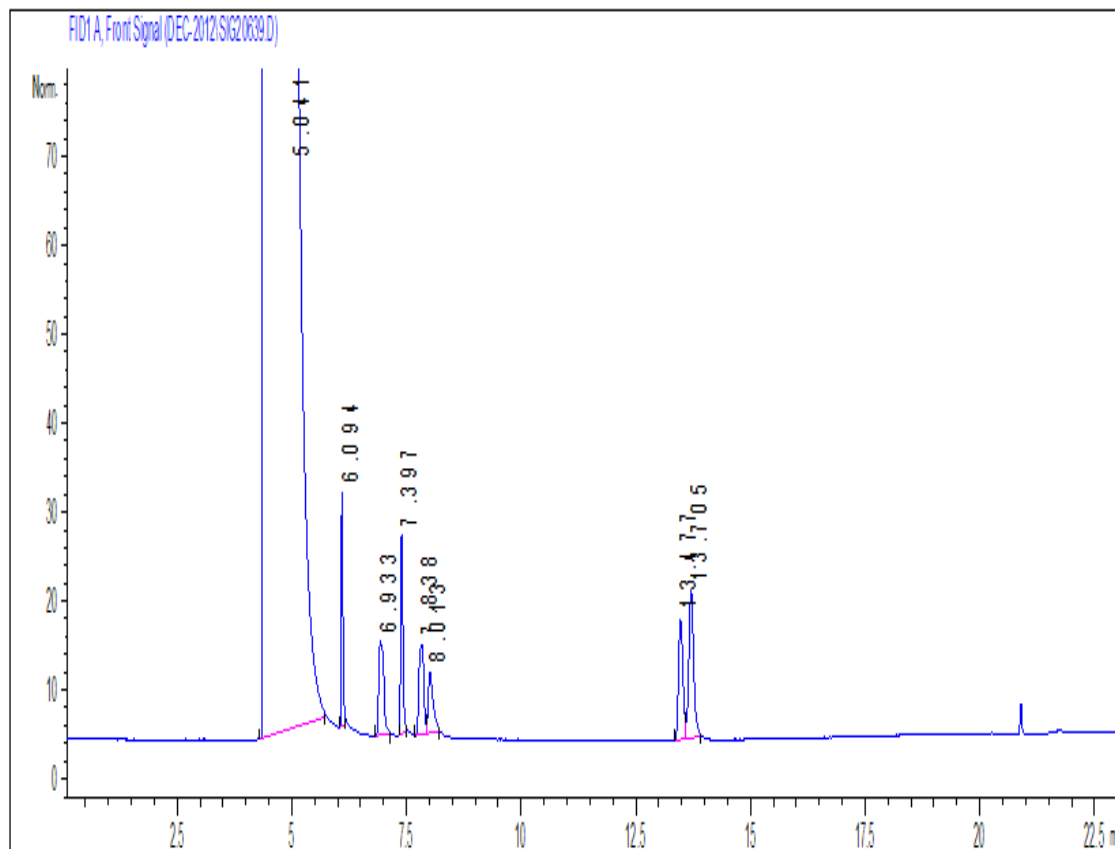
Cat No	Column Description	Applications	Instrument	Sample preparation	EPA method
2025-6002	GsBP-Inowax, 60m x 0.25mm x 0.25um	Aromatics, MEK, alcohols, in Water	GC-FID, GC-MSD	SPE, LLE	BTEX
2032-6005	GsBP-Inowax, 60m x 0.32mm x 0.5um	Aromatics, MEK, alcohols, in Water	GC-FID, GC-MSD	SPE, LLE	BTEX
3525-3002	GsBP-35MS, 30m x 0.25mm x 0.25um	PCBs, Pesticides	GC-ECD, GC-MSD	HS, SPE	515, 615, 8150, 8151
6225-6014UI	GsBP-624UI, 60m x 0.25mm x 1.4um	VOCs in Water	GC-FID/ECD, GC-MSD	LLE	8240, 8260, 624, 524.2
6232-6018UI	GsBP-624UI, 60m x 0.32mm x 1.8um	VOCs in Water	GC-FID/ECD, GC-MSD	LLE	8260, 624
6253-3030	GsBP-624, 30m x 0.53mm x 3um	VOCs in Water	PT-GC-ECD	PT/HS	503, 602, 8020, 524.2, 624, 8240, 8260, 8011, 8015, 8031
6353-7530	GsBP-502.2, 75m x 0.53mm x 3um	VOCs in Water	PT-GC-ECD	PT/HS	8021, 8010
6353-A030	GsBP-502.2, 105m x 0.53mm x 3um	VOCs in Water	PT-GC-ECD	PT/HS	502.2, 8021
6425-6014	GsBP-624MS, 60m x 0.25mm x 1.4um	VOCs in Water	GC-FID/ECD, GC-MSD	LLE	8260, 624
9006-DHA	GSBP-DHA, 100m x 0.25mm x 0.5um+2m	Benzene, Alcohol in fuel/water			

Examples of Application



- ▶ EPA Method 8260 Standards
- ▶ EPA Method 8270 Standards
- ▶ 502.2 samples
- ▶ Plasticizer residues in water
- ▶ Azo dyes
- ▶ Pesticide
- ▶ BTEX
- ▶ PAHs
- ▶ PCBs/Aroclors EPA 8082A
- ▶ Diesel fuel

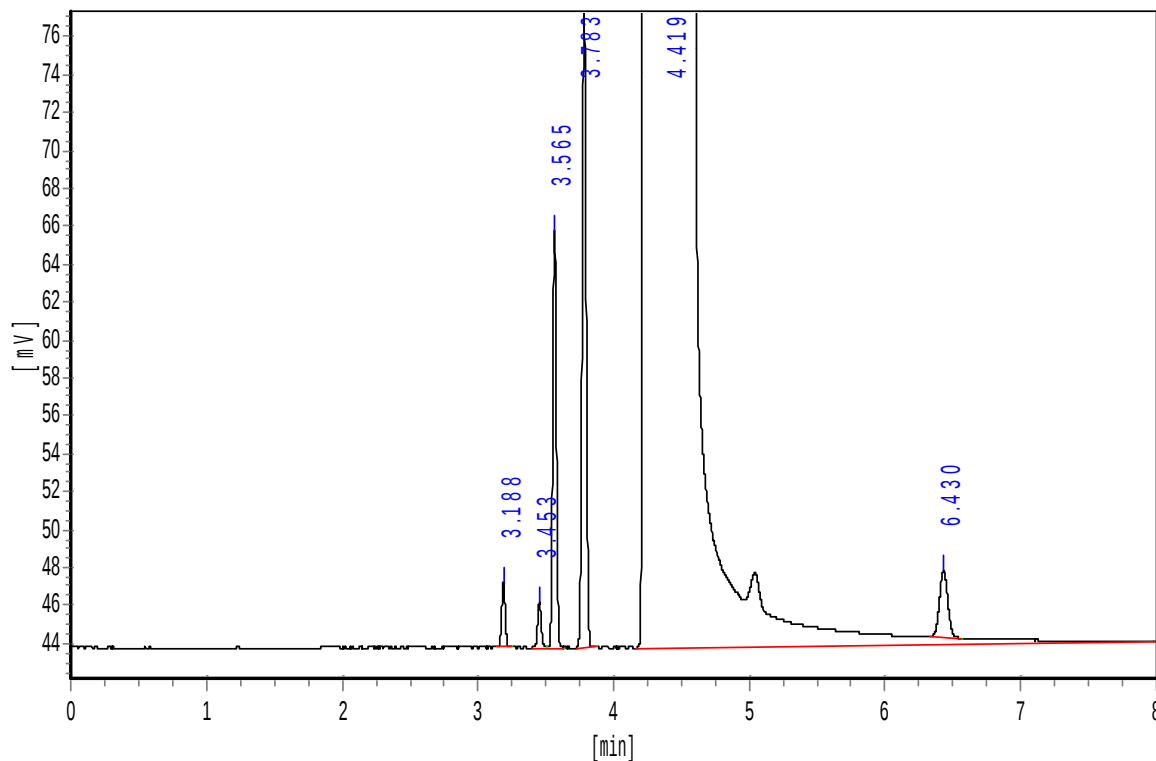
Ppm level Residual Solvents on GSBP-624 Columns, good column inertness



Peak	Name	Conc	RT
1	Methanol	Solvent	5.04
2	Ethanol	10ppm	6.09
3	Acetone	10ppm	6.93
4	Isopropanol	10ppm	7.40
5	Acetonitrile	10ppm	7.84
6	Dichloromethane	10ppm	8.01
7	2-Butanone	10ppm	13.48
8	Ethyl Acetate	10ppm	13.71
			20.06

Column: GsBP-624, 30m x 0.32mm x 1.8um
Oven: 50C

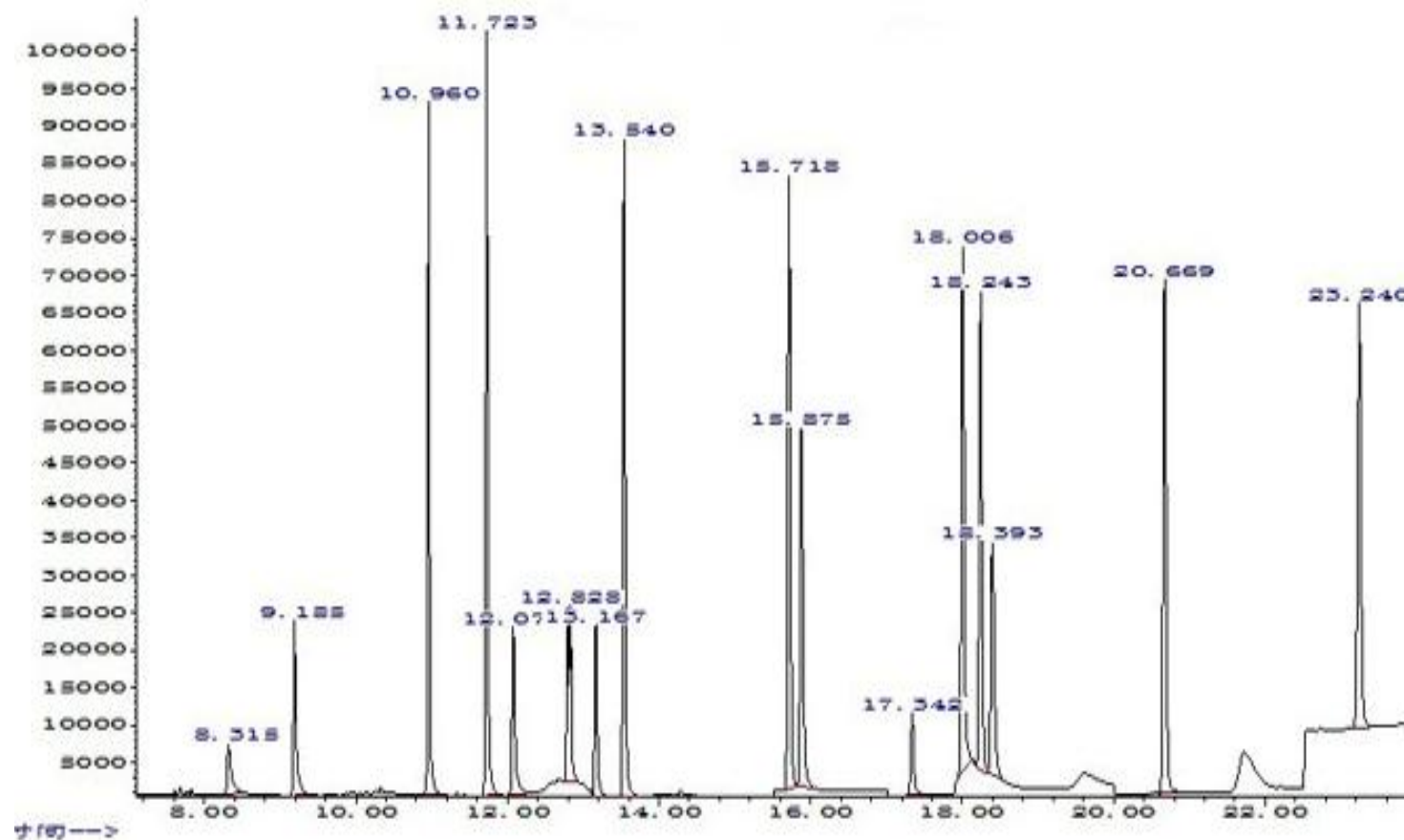
Bromomethane/Halogens



dichlorodifluoromethane	3.188
chloromethane	3.453
vinyl chloride	3.565
bromomethane	3.783
meoh	4.419
chloroethane	5.039
trichlorofluoromethane	6.43

Column: GsBP-624, 30m x 0.32mm x 1.8um
Oven: 45C

Phthalates on GsBP-5MS by GC-MS

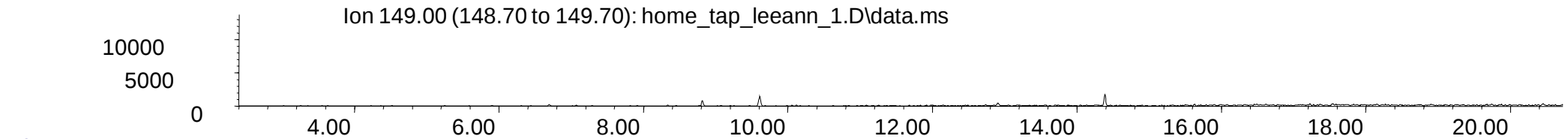


Column: GsBP-5MS, 30m x 0.25mm x 0.25um

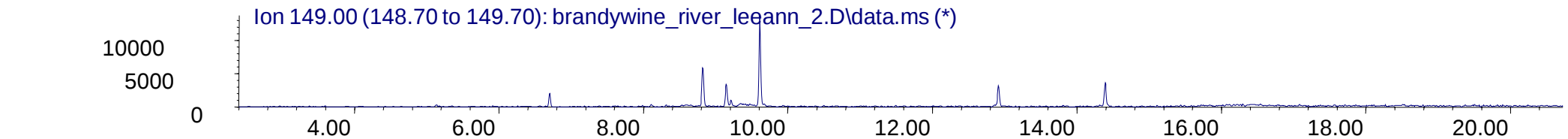
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phthalate in 4 water samples

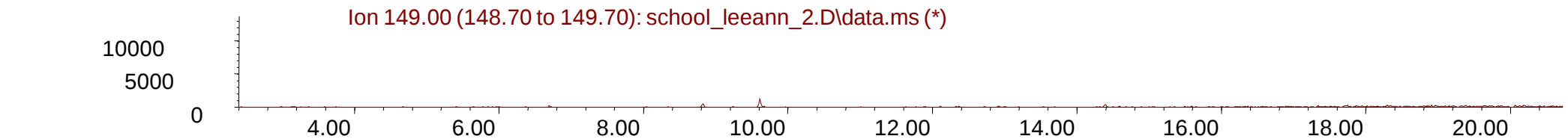
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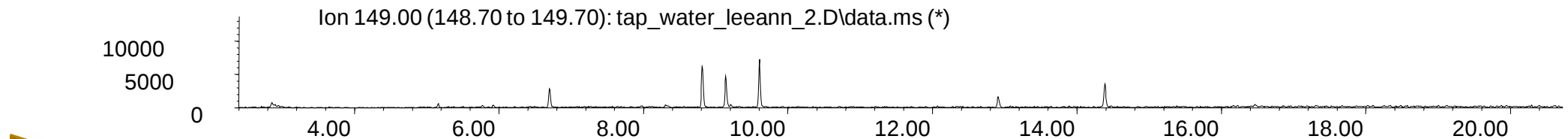
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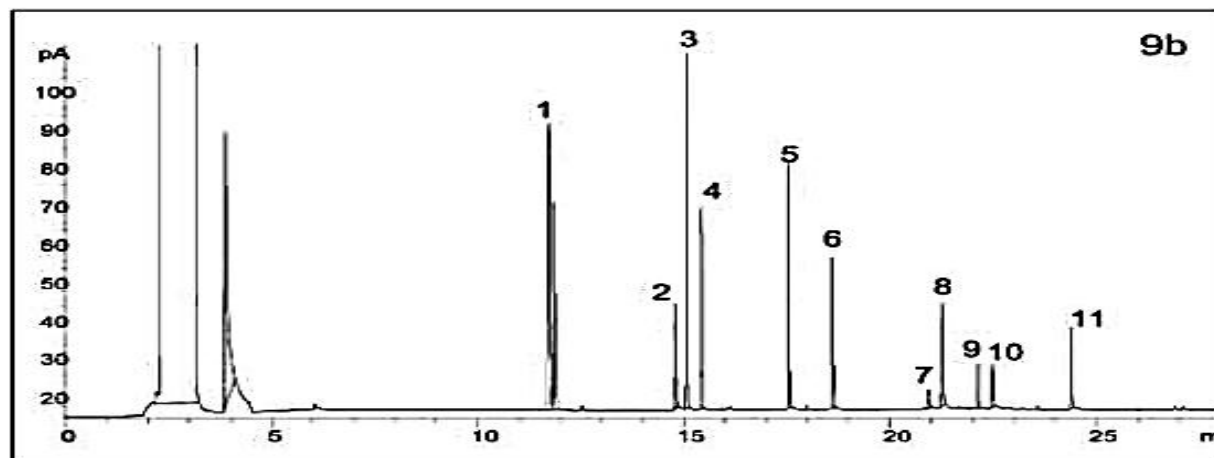
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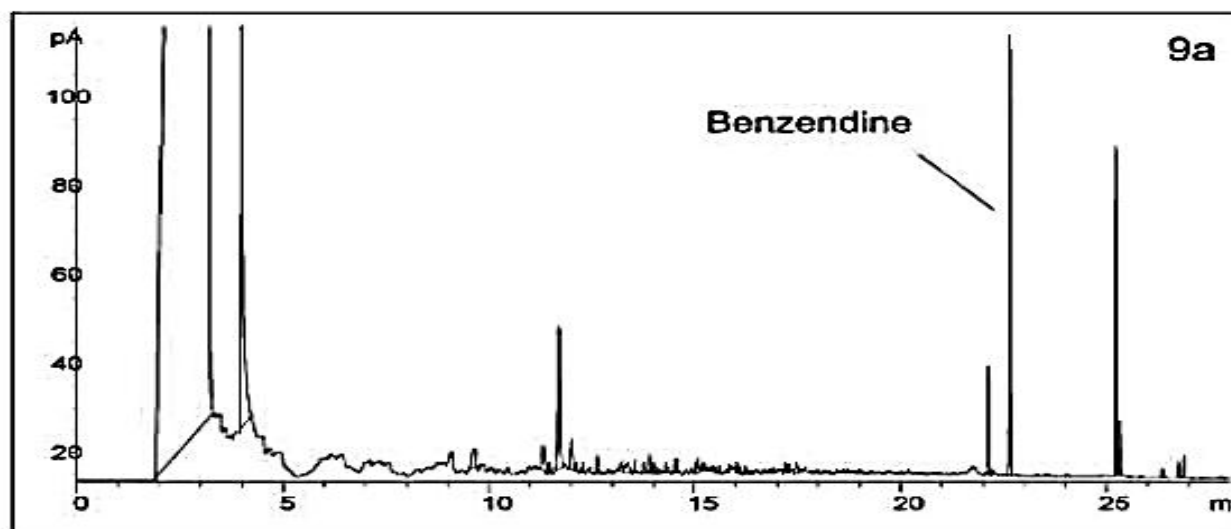
Column: GsBP-5MS, 30m x 0.25mm x 0.25um

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Excellent Column Inertness for Base, Acid and Neutral EPA 8270 GsBP-5MS



- 1 Phenol
- 2 2-Chlorophenol
- 3 2-nitrophenol
- 4 2,4-dimethylphenol
- 5 2,4-dichlorophenol
- 6 4-chloro,3-methylphenol
- 7 2,4,6-trichlorophenol
- 8 2,4-dinitrophenol
- 9 4-nitrophenol
- 10 2-methyl, 6-nitrophenol
- 11 Pentachlorophenol

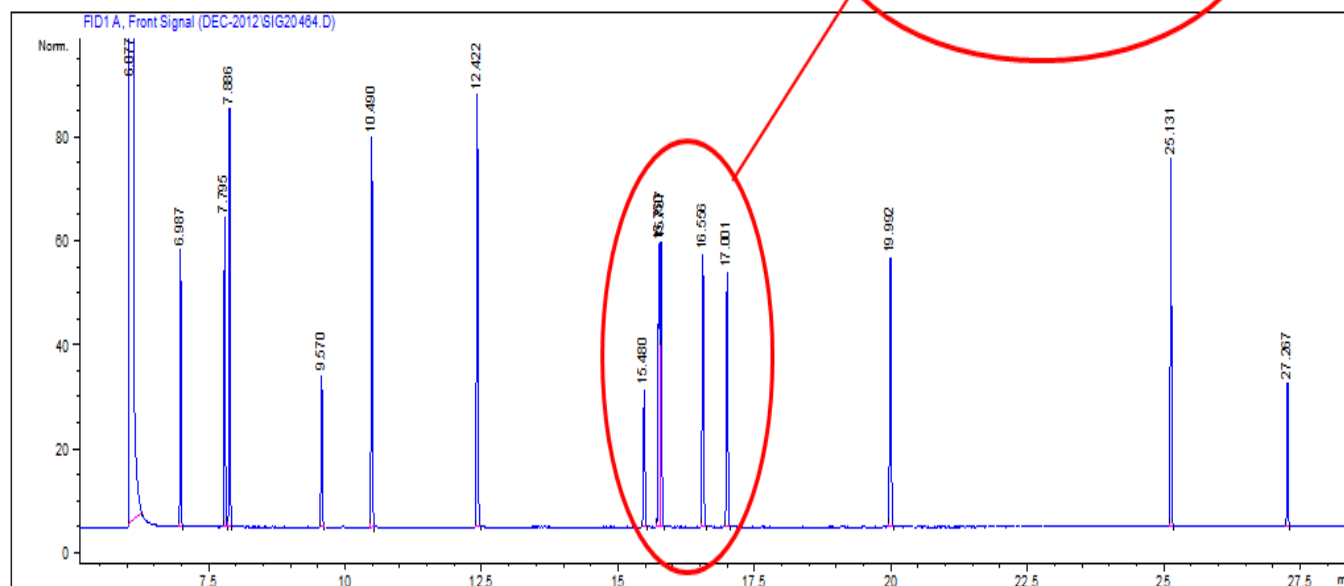


Column: GsBP-5MS, 30m x 0.25mm x 0.5um

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14 VPHs on GsBP-PONA Column, BTEX

Sample: 1ul 14 components MA VPH Standard With Surrogate

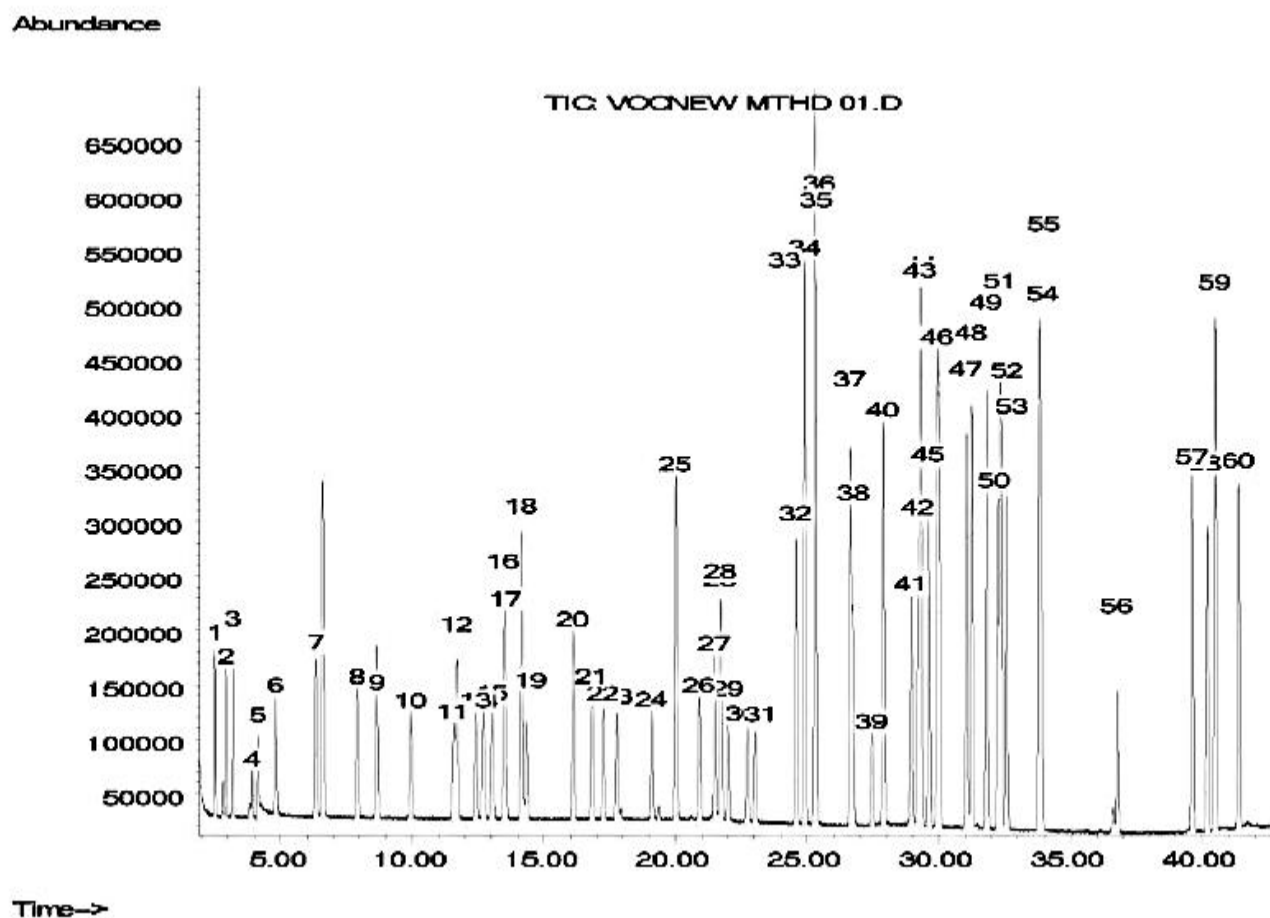


Peak Name	RT(min)	Resolution
Methanol	5.984	
Pentane	6.578	
MTBE	7.057	
2 - methylpentane	7.115	2.38
Benzene	8.272	
Iso - Octane	8.917	
Toluene	10.605	
Ethylbenzene	13.965	
m - Xylene	14.32	
p - Xylene	14.368	1.2
o - Xylene	15.47	
Nonane	16.136	

Column: GsBP-PONA, 100m x 0.25mm x 0.5um

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VOCs on GsBP-VMS Column



Column: GsBP-VMS, 30m x 0.25mm x 1.4um

GS-Tek

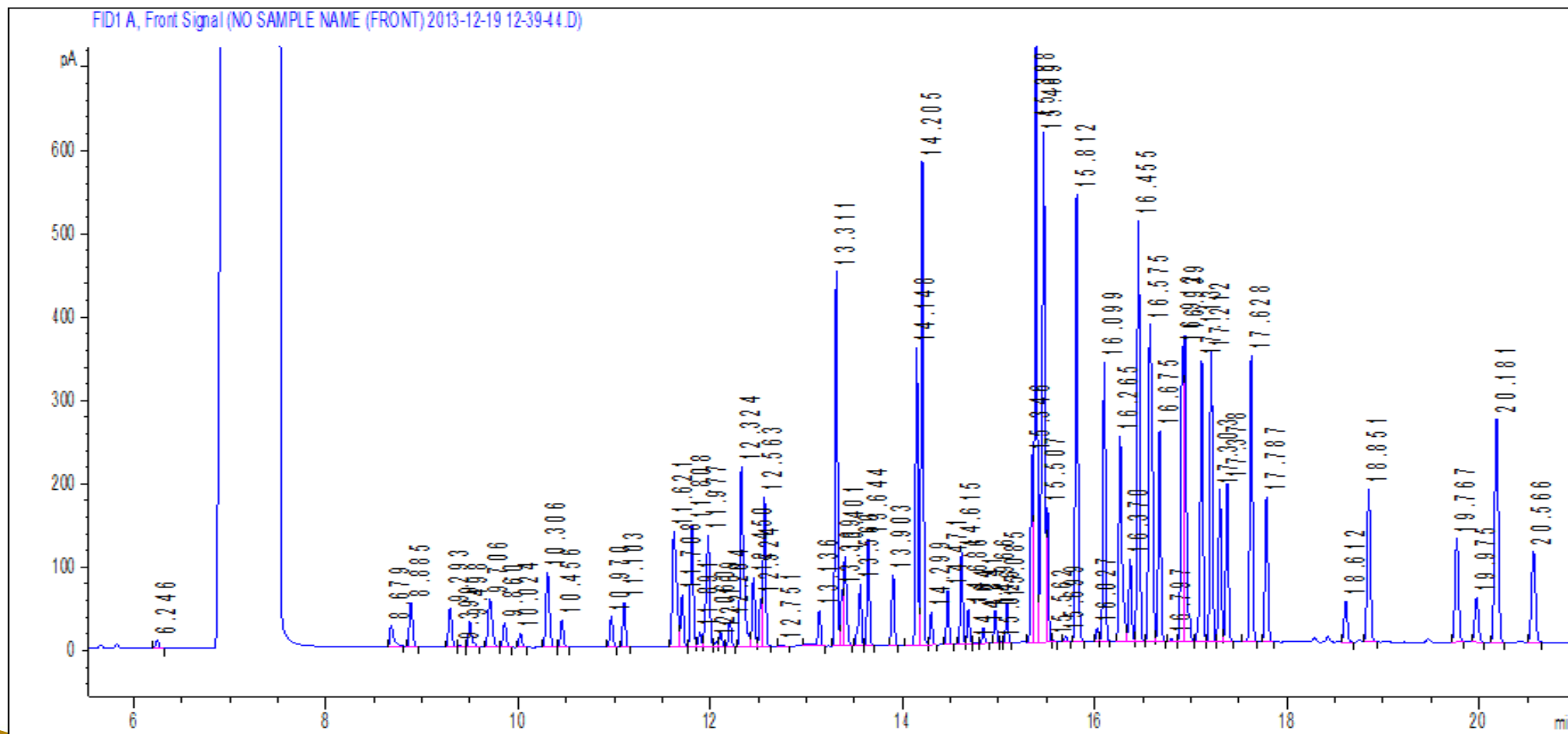
VOCs Identifications

Peak No	Peak Name	Retention time (min)	Peak No	Peak Name	Retention time (min)
1	dichlorodifluoromethane	2.5	31	1,2-ethylenedibromide	23.04
2	methyl chloride	2.93	32	chlorobenzene	24.59
3	vinyl chloride	3.19	33	1,1,1,2-tetrachloroethane	24.91*
4	bromomethane	3.93	34	ethylbenzene	24.91*
5	chloroethane	4.14	35	m- dimethylbenzene	21.92*
6	trichlorofluoromethane	4.82	36	p- dimethylbenzene	21.92*
7	1,1-dichloroethylene	6.34	37	o- dimethylbenzene	26.64
8	dichloromethane	7.92	38	ethylbenzene	26.72
9	trans-1,2-Dichloroethylene	8.66	39	tribromomethane	27.46
10	1,1-dichloroethane	9.95	40	isopropylbenzene	27.89
11	2,2-dichloropropane	11.58	41	bromobenzene	28.97
12	cis-1,2-dichloroethylene	11.71	42	1,1,2,2-tetrachloroethane	29.29*
13	trichloromethane	12.42	43	1,2,3-trichloropropane	29.31*
14	chlorobromomethane	12.71	44	n-propylbenzene	29.31*
15	1,1,1-trichloroethane	13.05	45	2-chlorobenzene	29.63
16	1,1-dichloropropene	13.52 *	46	1,3,5-trimethylbenzene	29.97
17	carbon tetrachloride	13.52*	47	4-chlorobenzene	31.06*
18	benzene	14.16	48	n-butylbenzene	31.06*
19	1,2-dichloroethane	14.36	49	1,2-dibrom-3-chlor-propan	31.14
20	trichloroethylene	16.12	50	benzene	31.82
21	1,2-dichloropropane	16.83	51	1,3-dichlorobenzene	31.25*
22	dibromomethane	17.26	52	4-p-isopropyltoluene	32.36*
23	bromodichloromethane	17.78	53	1,4-dichlorobenzene	32.58
24	trans-1,3-dichloropene	19.11	54	n-butylbenzene	32.58
25	methylbenzene	20.00	55	1,2-dichlorobenzene	33.85
26	cis-1,3-dichloropropene	20.91	56	1,2-dibrom-3-chlor-propan	36.78
27	1,1,2-trichloroethane	21.50	57	1,2,4-trichlorobenzene	39.64
28	tetrachloroethylene	21.72	58	hexachlorobutadiene	40.19
29	1,3-dichloropropane	21.99	59	naphthalene	40.5
30	dibromochloromethane	22.74	60	1,2,3-trichlorobenzene	41.4

EPA 8260

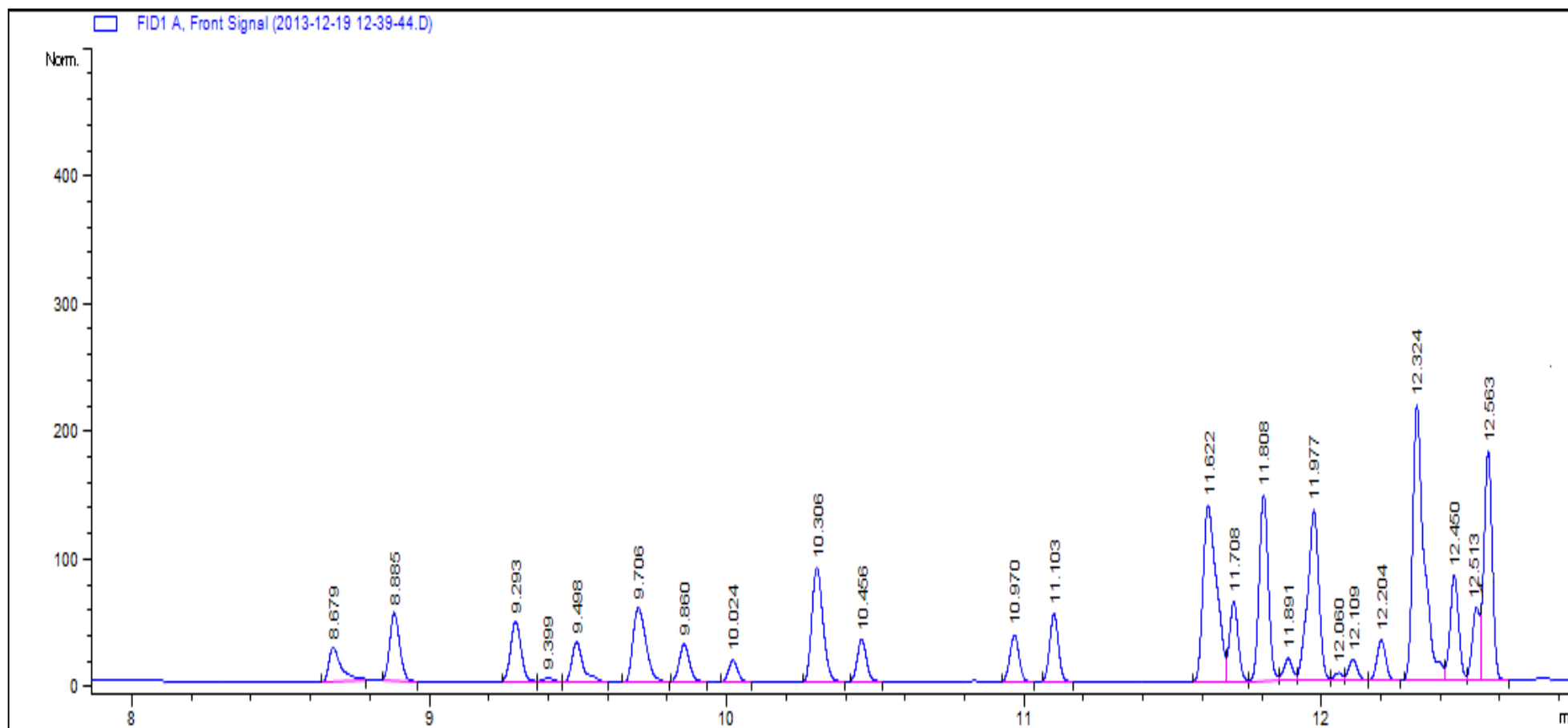
- Instrument: Agilent 7890 w/ FID
- Column: *GsBP-624 60m x 0.14mm*
- Oven: 35 °C (hold 5 min) to 60 °C at 11 °C /min to 220 °C at 20 °C /min (hold 2 min)
- Carrier: Hydrogen, column flow 1.2ml/min
- Injector: Split, 240 °C, split ratio 50:1
- Detector: FID 260 °C
- Sample: EPA Method 8260, 81components
- Inject amount: 1ul

EPA 8260

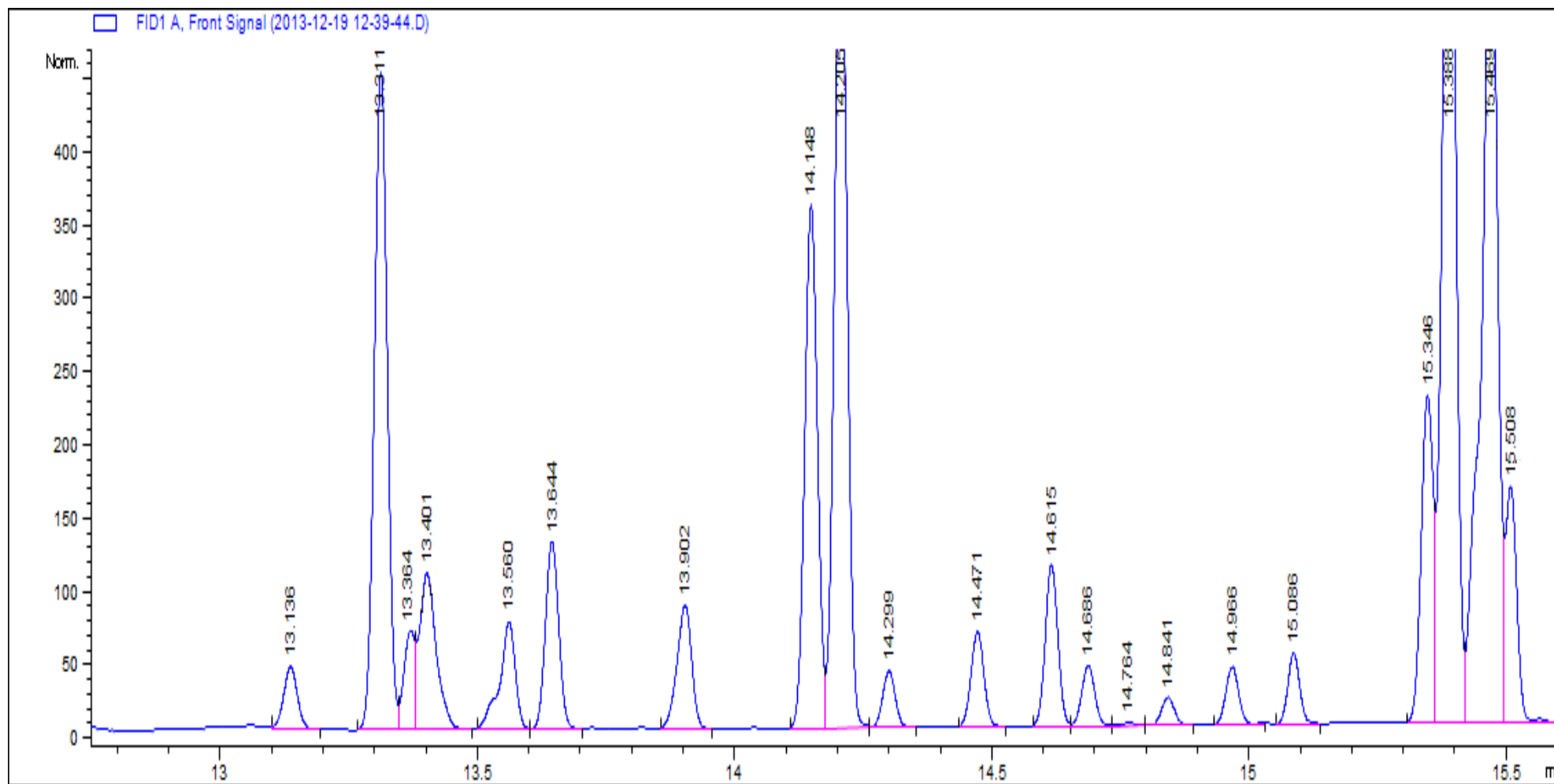


GS-Tek

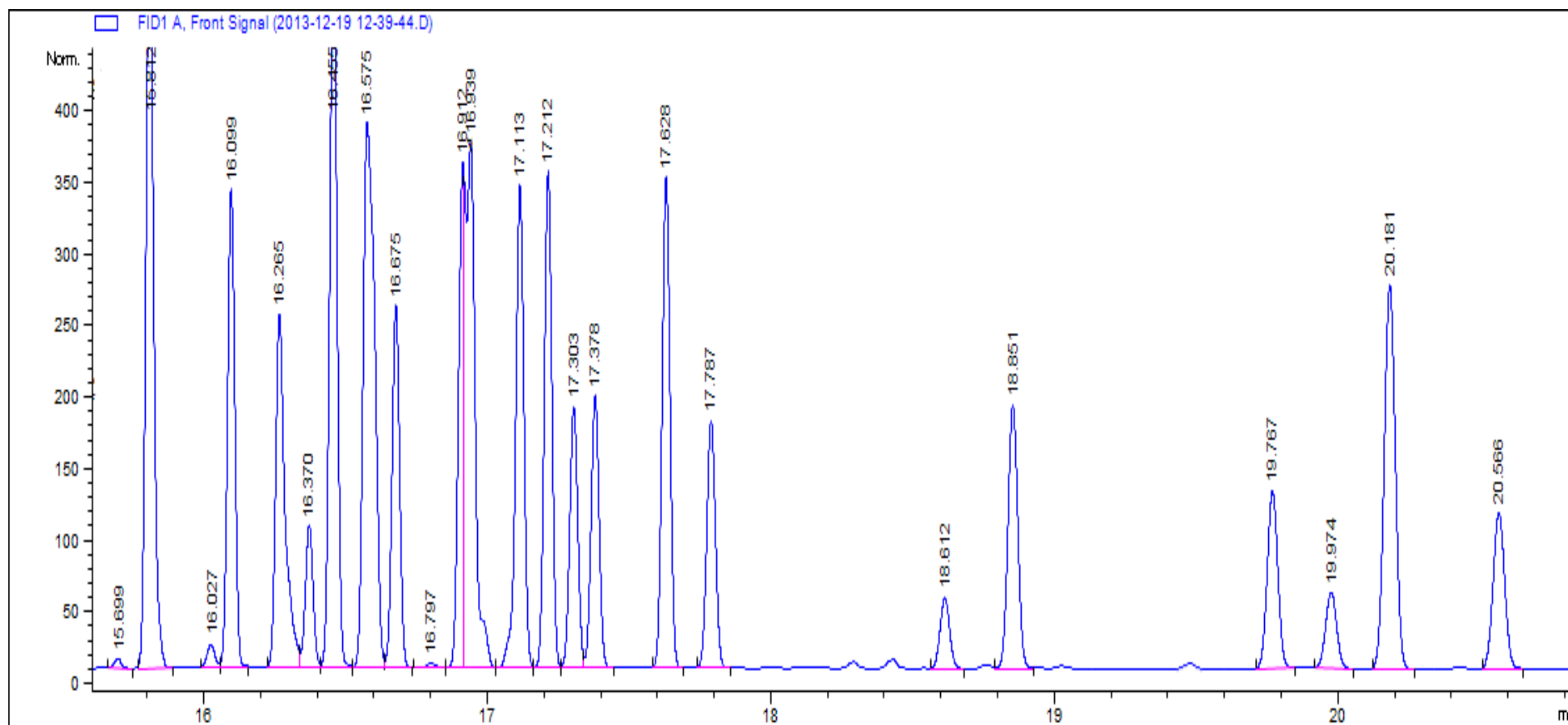
EPA 8260



EPA 8260



EPA 8260



VOCs Identifications

Peak	Compound	Retention Time	Resolution
1	Vinyl chloride	6.246	
2	Diethyl ether (ethyl ether)	8.679	
3	1,1 - Dichloroethene	8.885	
4	1,1,2 - Trichlorotrifluoroethane (CFC - 113)	9.293	
5	Iodomethane (methyl iodide)	9.399	2.87
6	Carbon disulfide	9.498	2.66
7	Acetonitrile	9.706	
8	Allyl chloride (3-chloropropene)	9.86	3.59
9	Methylene chloride (dichloromethane)	10.024	
10	Acrylonitrile	10.306	
11	<i>trans</i> - 1,2 - Dichloroethene	10.456	
12	1,1 - Dichloroethane	10.97	
13	Chloroprene (2-chloro - 1,3 - butadiene)	11.103	4.05
14	<i>cis</i> - 1,2 - Dichloroethene	11.621	

VOCs Identifications

Peak	Compound	Retention Time	Resolution
15	2,2-Dichloropropane	11.621	0.00
16	Propionitrile	11.708	2.25
17	Methyl acrylate	11.708	0.00
18	Methacrylonitrile	11.808	3.12
19	Bromochloromethane	11.891	2.56
20	Tetrahydrofuran	11.977	2.44
21	Chloroform	12.06	2.40
22	1,1,1-Trichloroethane	12.109	1.57
23	Dibromofluoromethane	12.109	0.00
24	Carbon tetrachloride	12.204	2.91
25	1,1-Dichloropropene	12.324	3.36
26	1,2-Dichloroethane-d4	12.45	3.59
27	Benzene	12.524	2.61
28	1,2-Dichloroethane	12.563	1.41

VOCs Identifications

Peak	Compound	Retention Time	Resolution
29	Isobutyl alcohol (2-methyl-1-propanol)	12.751	
30	Trichloroethene	13.136	
31	1,2-Dichloropropane	13.311	
32	Methyl methacrylate	13.369	2.27
33	1,4-Dioxane	13.401	1.14
34	Dibromomethane	13.56	
35	2-Chloroethanol	13.644	2.79
36	Bromodichloromethane	13.903	
37	2-Nitropropane	14.148	
38	<i>cis</i> -1,3-Dichloropropene	14.205	2.12
39	Toluene-d8	14.299	3.56
40	Toluene	14.471	
41	<i>trans</i> -1,3-Dichloropropene	14.615	
42	Ethyl methacrylate	14.686	2.58

VOCs Identifications

Peak	Compound	Retention Time	Resolution
43	1,1,2 - Trichloroethane	14.764	2.82
44	Tetrachloroethene	14.841	2.76
45	1,3 - Dichloropropane	14.966	
46	Dibromochloromethane	15.026	2.34
47	1,2 - Dibromoethane (EDB)	15.085	2.42
48	Chlorobenzene	15.346	
49	Ethylbenzene	15.388	1.58
50	1,1,1,2 - Tetrachloroethane	15.388	0.00
51	<i>m</i> -Xylene	15.469	2.71
52	<i>p</i> -Xylene	15.469	0.00
53	<i>o</i> -Xylene	15.507	1.42
54	Styrene	15.507	0.00
55	Bromoform	15.562	2.33
56	Isopropylbenzene (cumene)	15.699	

VOCs Identifications

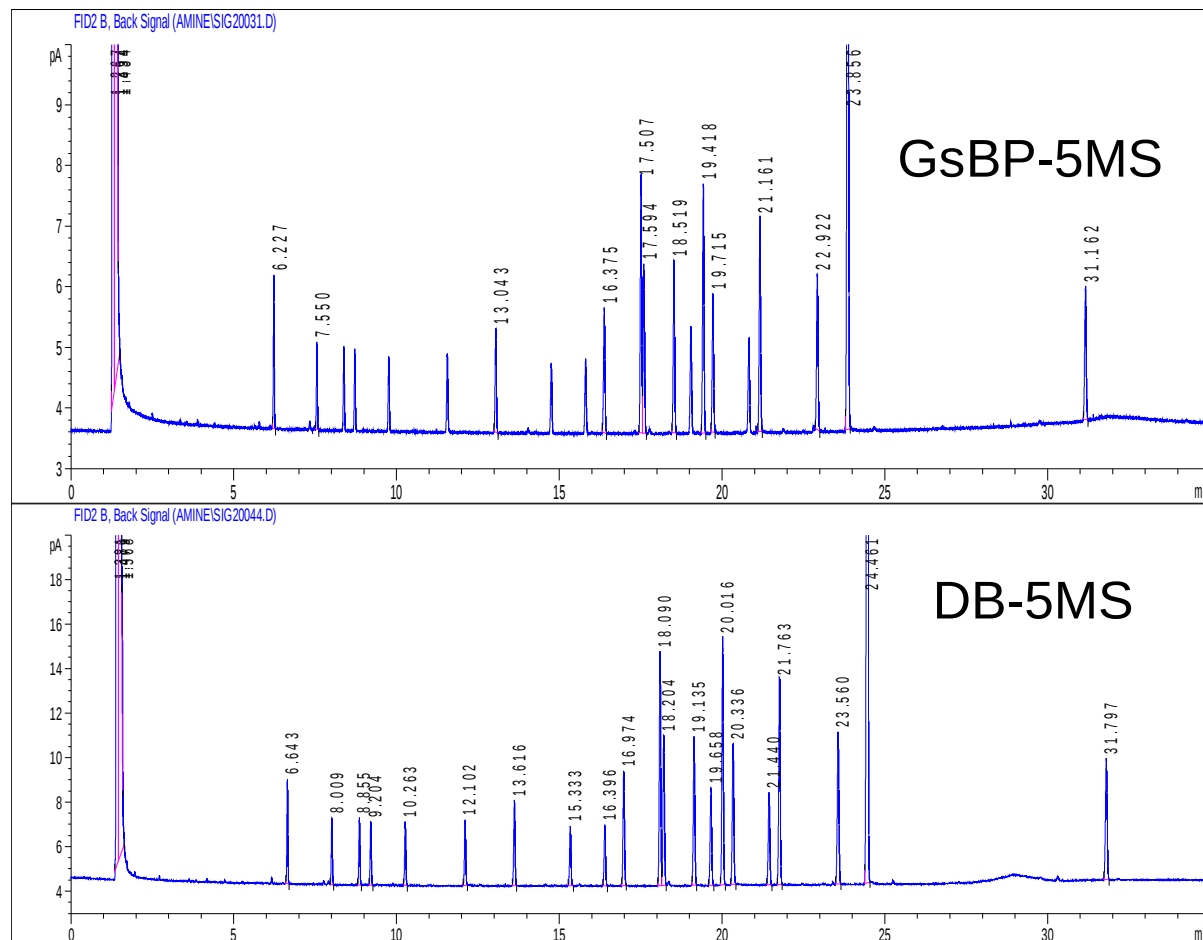
Peak	Compound	Retention Time	Resolution
57	<i>cis</i> - 1,4- Dichloro- 2- butene	15.812	
58	1- Bromo- 4- fluorobenzene (BFB)	16.027	
59	1,1,2,2- Tetrachloroethane	16.099	2.49
60	<i>trans</i> - 1,4- Dichloro- 2- butene	16.265	
61	Bromobenzene	16.37	3.28
62	1,2,3- Trichloropropane	16.37	0.00
63	<i>n</i> - Propylbenzene	16.455	2.92
64	2- Chlorotoluene	16.575	3.48
65	1,3,5- Trimethylbenzene	16.675	2.86
66	4- Chlorotoluene	16.797	3.69
67	<i>tert</i> - Butylbenzene	16.912	3.61
68	Pentachloroethane	16.939	1.10
69	1,2,4- Trimethylbenzene	17.113	
70	<i>sec</i> - Butylbenzene	17.212	3.25

VOCs Identifications

Peak	Compound	Retention Time	Resolution
71	4-Isopropyl toluene (<i>p</i> -Cymene)	17.303	3.06
72	1,3-Dichlorobenzene	17.303	0.00
73	1,4-Dichlorobenzene	17.378	2.44
74	<i>n</i> -Butylbenzene	17.628	
75	1,2-Dichlorobenzene	17.787	
76	1,2-Dibromo-3-chloropropane (DBCP)	18.612	
77	Nitrobenzene	18.851	
78	1,2,4-Trichlorobenzene	18:24	
79	Hexachloro-1,3-butadiene	19.975	
80	Naphthalene	20.181	
81	1,2,3-Trichlorobenzene	20.566	

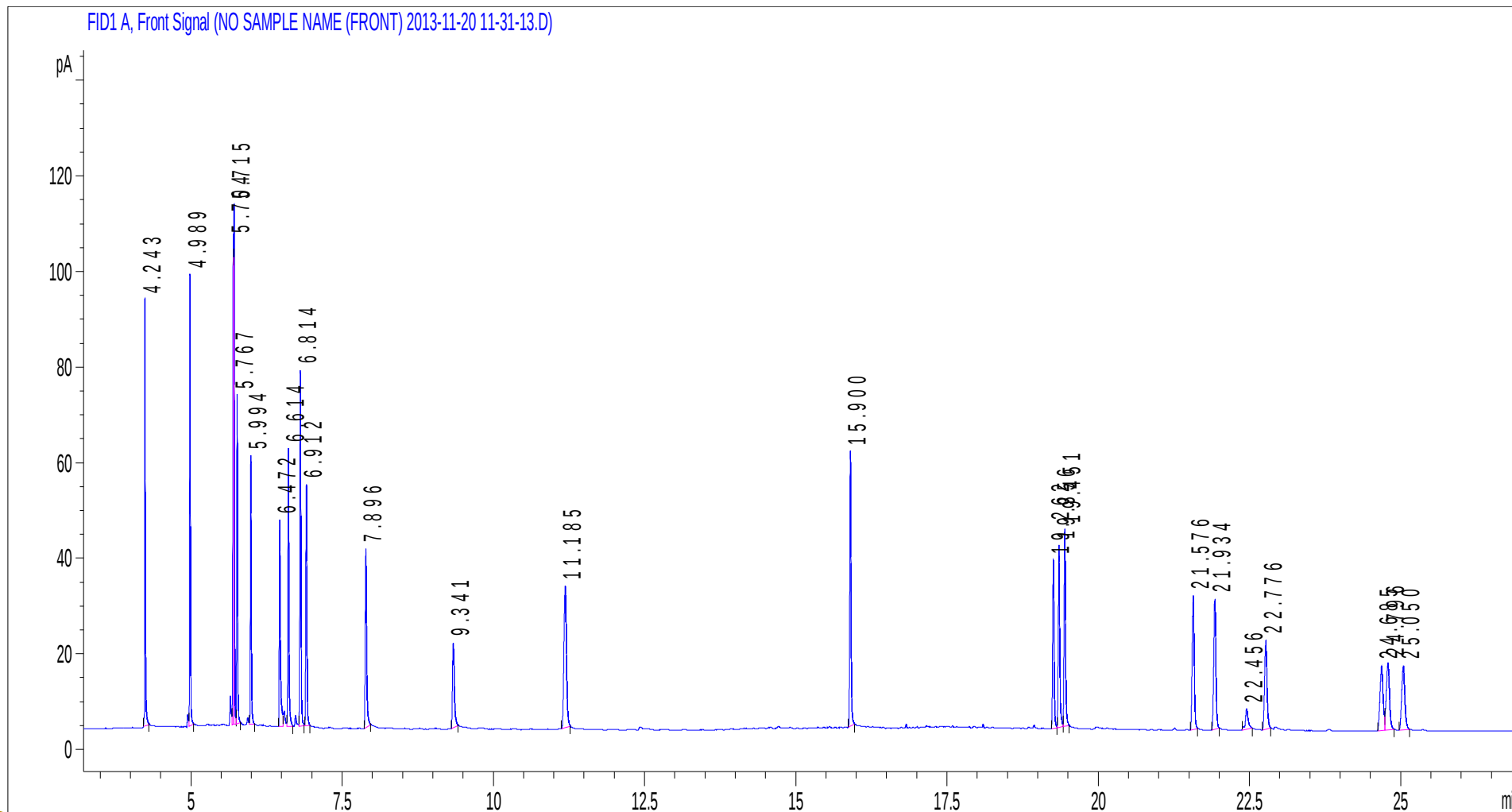
* Red label means that component is co-eluted.

22 Chlorinated Pesticides



	2,4,5,6-Tetrachloro-m-xylene(IS)	12	Dieldrin
1		13	p,p'-DDE
2	α -BHC	14	Endrin
3	β -BHC	15	Endosulfan II
4	γ -BHC	16	p,p'-DDD
5	δ -BHC	17	Endrin aldehyde
6	Heptachlor	18	Endosulfan sulfate
7	Aldrin	19	p,p'-DDT
8	Heptachlor epoxide	20	Endrin ketone
9	γ -Chlordane	21	Methoxychlor
10	Endosulfan I	22	Decachlorobiphenyl(IS)
11	α -Chlordane		

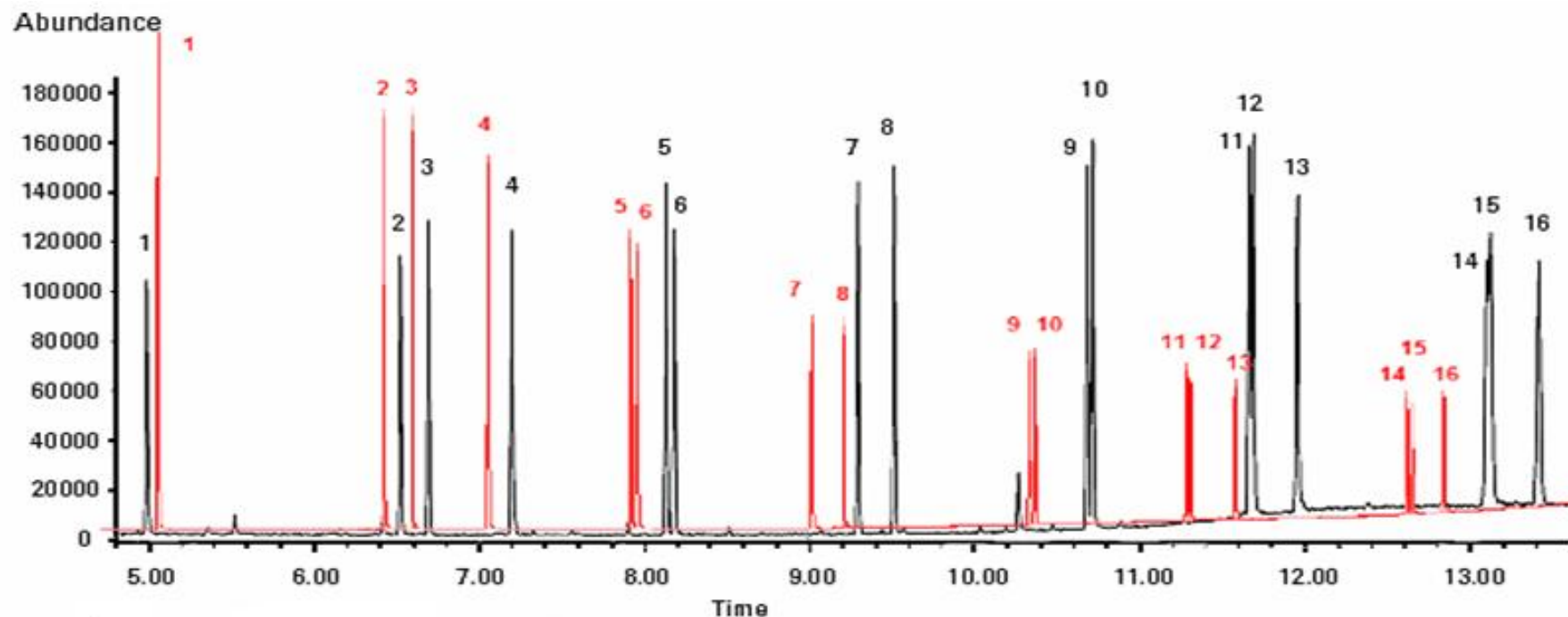
Azo dyes GsBP-5MS 30m x 0.25mm x 0.25µm



Peak Name of Azo Dyes

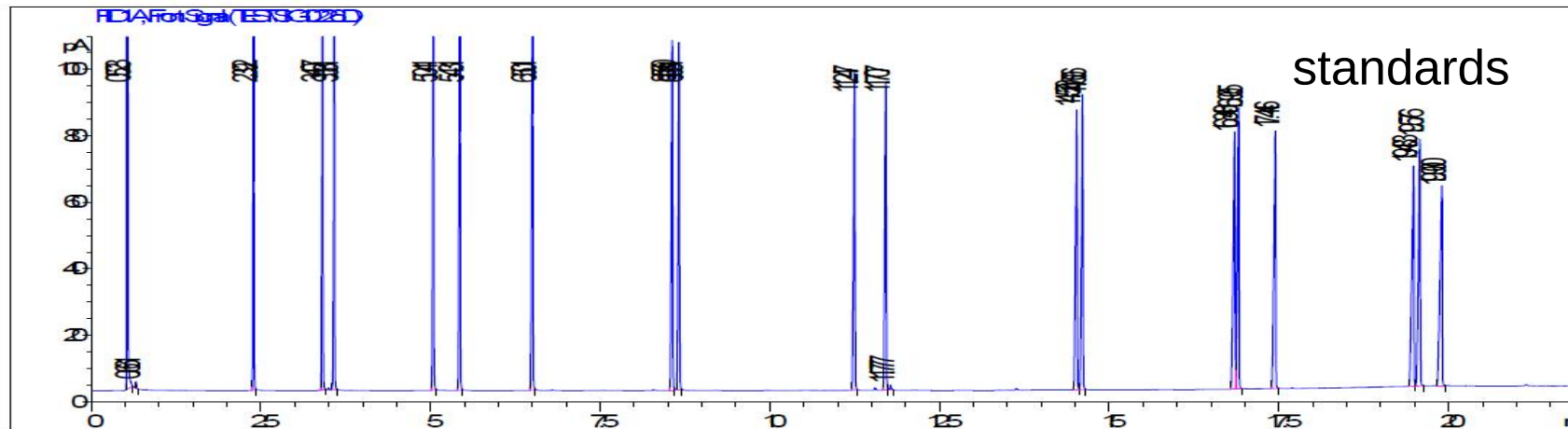
1	Aniline	9	2.4.5-Trimethyl aniline	17	3.3 '- dichloro -4.4' - diaminodiphenyl methane
2	1,4 - phenylenediamine	10	2-Methyl-4- chloroaniline	18	4,4 '- diaminodiphenyl methane
3	2-Methylaniline	11	2,4-diaminotoluene	19	3.3 '- dimethyl -4.4' - diaminodiphenyl methane
4	2,4-Dimethylaniline	12	2.4-diaminoanisole	20	3.3 '- dimethylbenzidine 4.4 '- diaminodiphenyl sulfide
5	2,6-Dimethylaniline	13	2 - Naphthylamine	21	
6	O-anisidine / 2 - methoxyaniline	14	4 - aminobiphenyl	22	3.3 '- dichloro-benzidine
7	4-Chloroaniline	15	4-AMINOPHENYL ETHER	23	3.3 '- dimethoxybenzidine
8	2 - methoxy-5 - methylaniline	16	Benzidine		

PAHs, 17, GsBP-5MS 30m x 0.25mm x 0.25µm

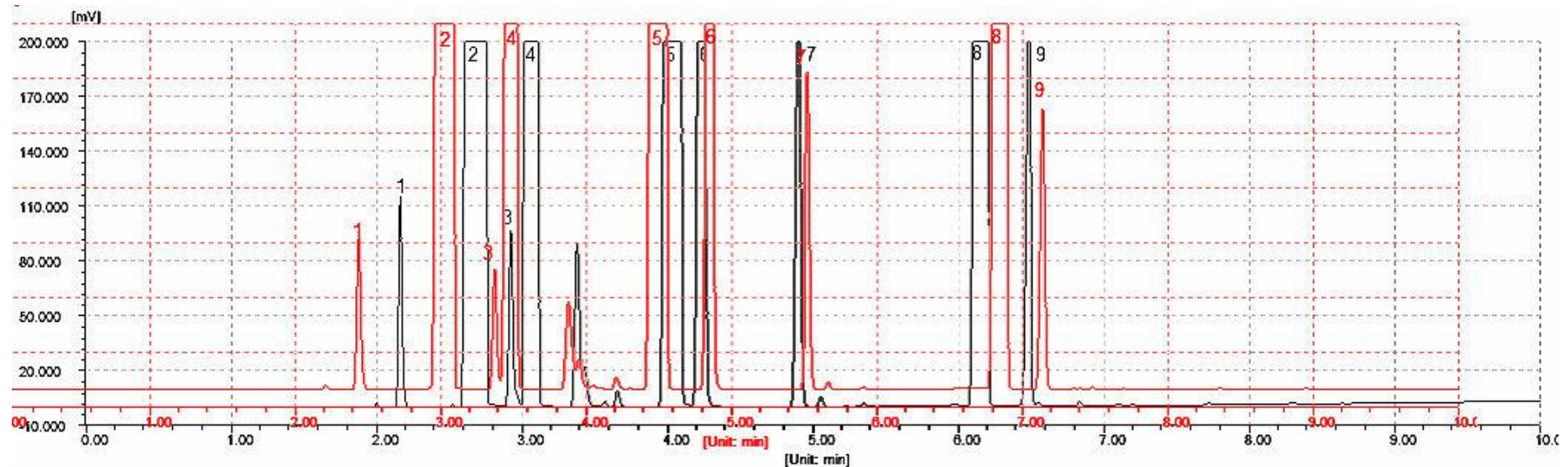


- | | |
|-------------------|----------------------------|
| 1. Naphthalene | 9. Benz(a)anthracene |
| 2. Acenaphthylene | 10. Chrysene |
| 3. Acenaphthene | 11. Benz(b)anthracene |
| 4. Fluorene | 12. Benz(k)anthracene |
| 5. Phenanthrene | 13. Benzo(a)pyrene |
| 6. Anthracene | 14. Indeno(1,2,3-cd)pyrene |
| 7. Fluoranthene | 15. Dibenzo(a,h)anthracene |
| 8. Pyrene | 16. Benzo[ghi]Pyrene |

18 PAHS Quick Separation, GsBP-PAH, 0.18mmx20m



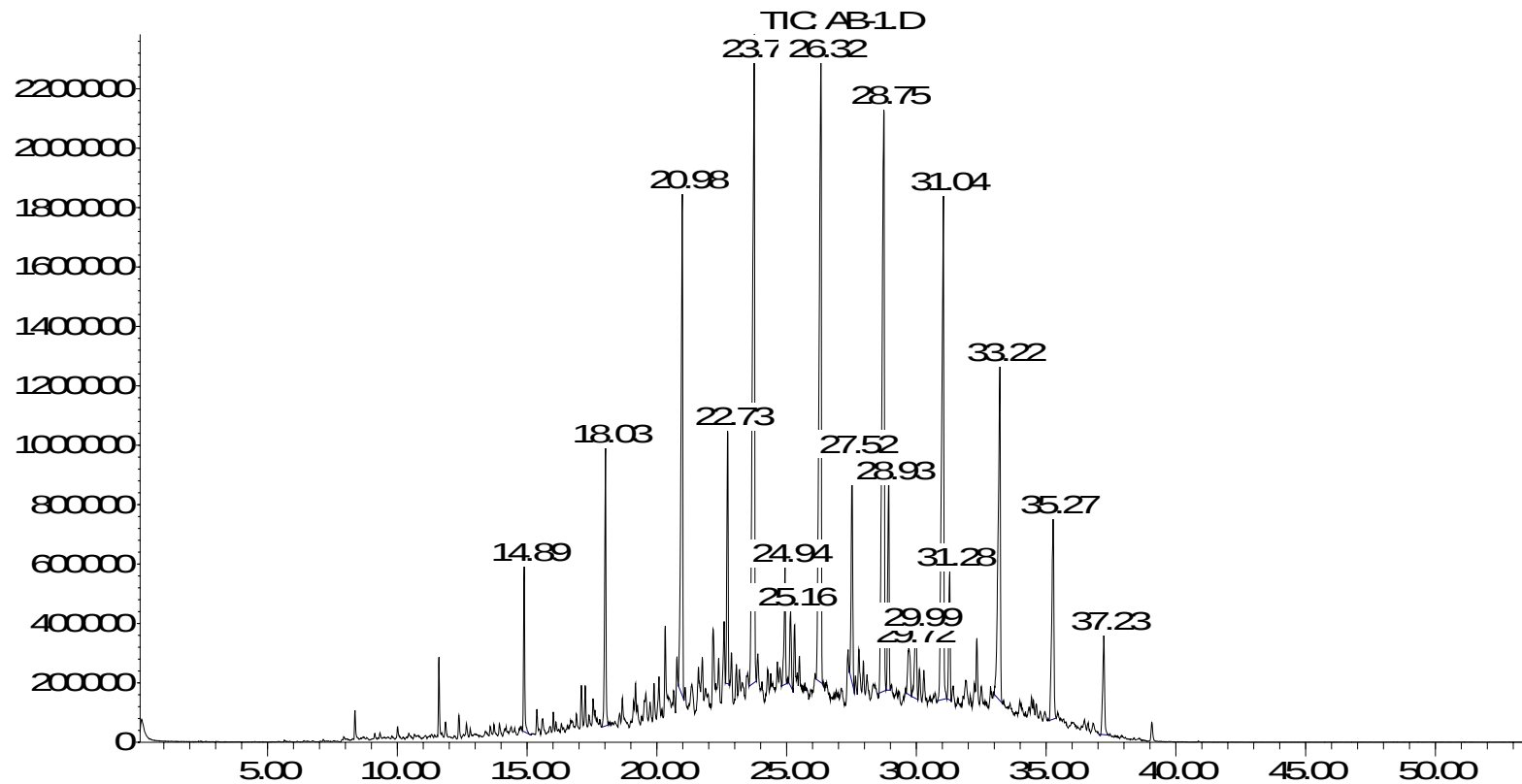
9 Haloalkanes , GsBP-1701 30m x 0.32mm x 1µm



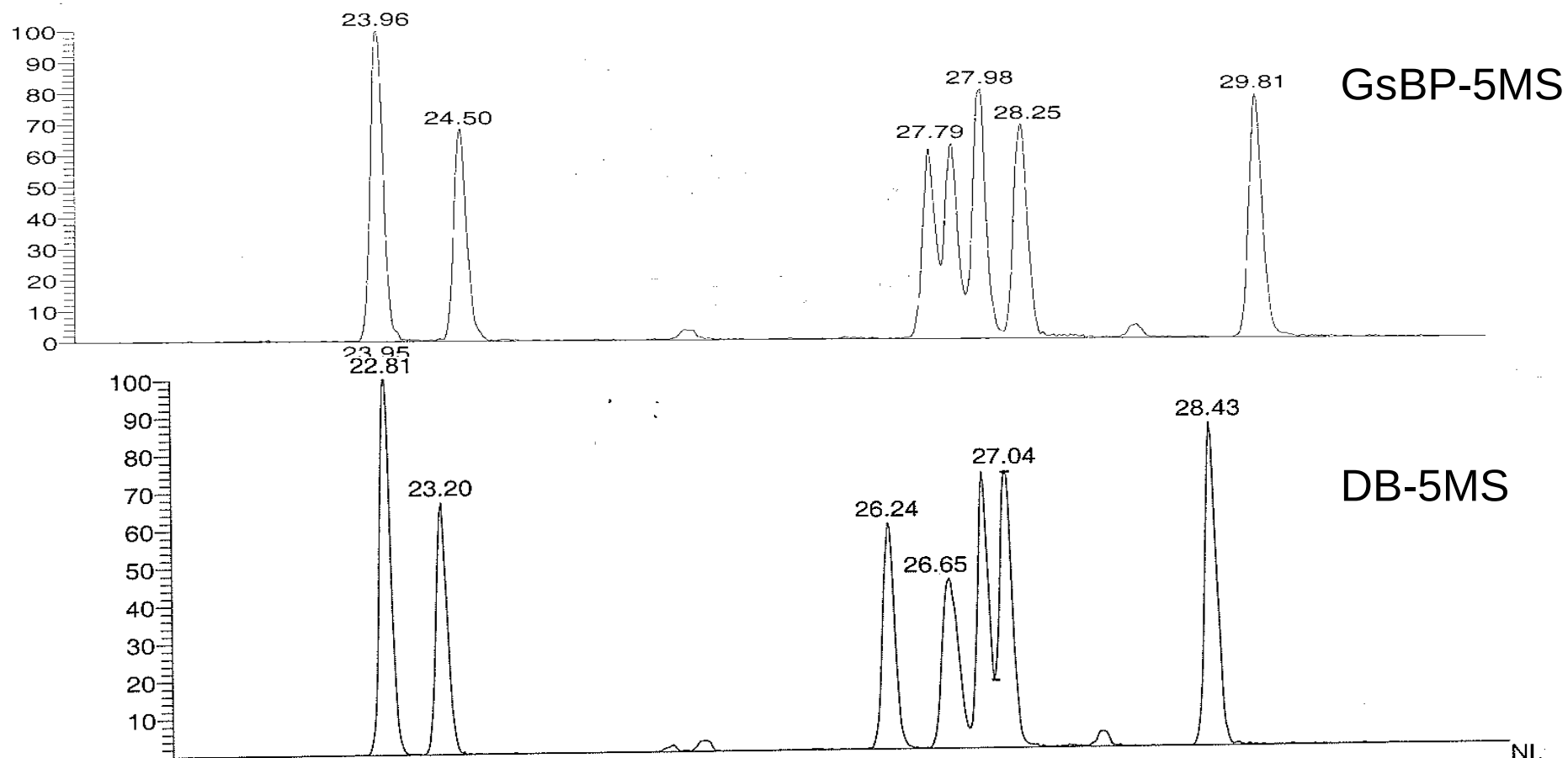
Peak name: Dichloromethane, 1,2- Dichloroethane, Carbon tetrachloride, Trichloroethylene, 1,1,2- Trichloroethane, Tetrachlorethylene, 1,1,1- trichloroethane, tetrachloroethane, 1,2,3 – trichloropropane.

Diesel fuel , GsBP-1MS 30m x 0.25mm x 0.25um

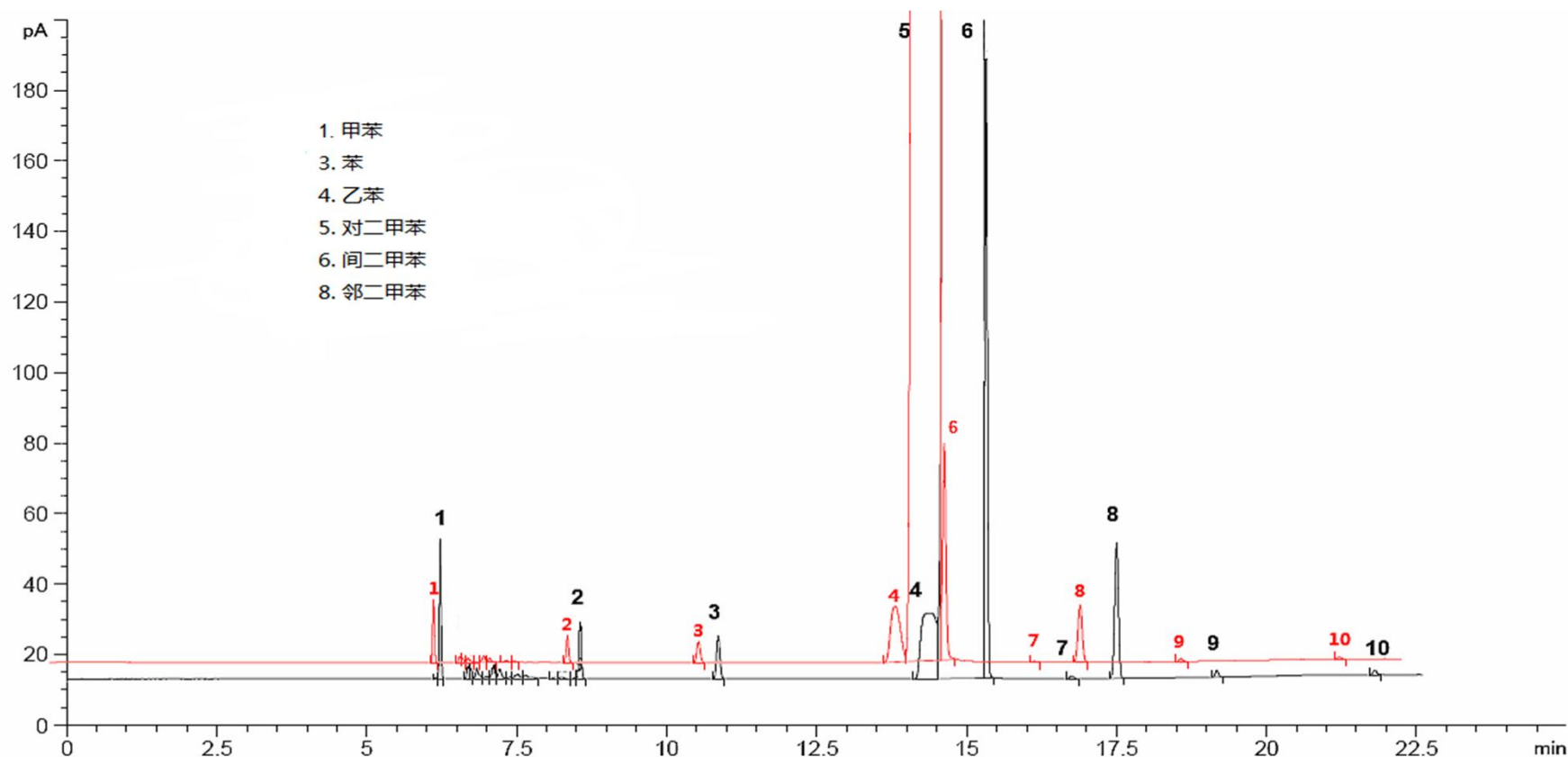
Abundance



Dioxins , GsBP-5MS 60m x 0.25mm x 0.25um

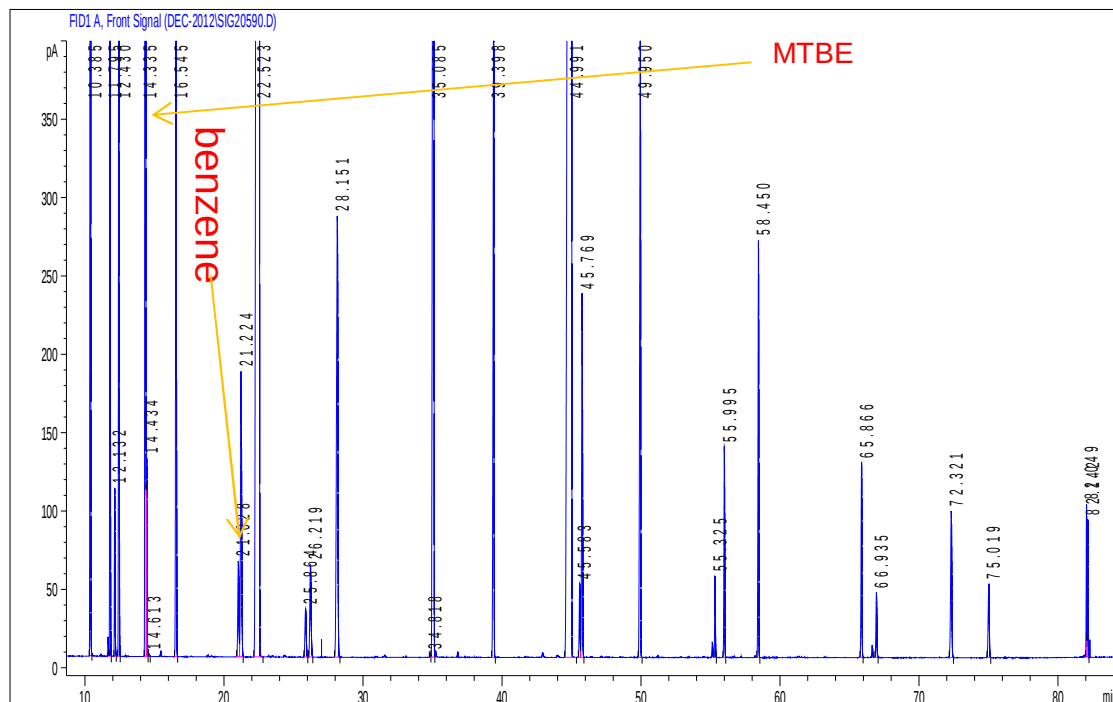


BTEX on GsBP-Inowax Column



Column: 2032-6005, GsBP-Inowax, 60m x 0.32mm x 0.5um

Benzene and Ethanol



Peak No.	Compound	Concentration (%)	Retention Time (min)	Partition Ratio (k')	Resolution
1	Ethanol	8%	10.385	0.289	
2	Pentane	2%	11.795	0.464	
3	Tert-butanol	0.50%	12.132	0.506	
4	2-methylbutene-2	2.50%	12.43	0.543	
5	Methyl tert-butyl ether (MTBE)	10%	14.335	0.780	
6	2,3-dimethylbutane	0.50%	14.434	0.792	1.86
7	Hexane	2%	16.545	1.054	
8	1-methylcyclopentene	0.50%	21.028	1.611	
9	Benzene	1%	21.224	1.635	2.81
10	Cyclohexane	28.90%	22.523	1.796	
11	3-ethylpentane	0.20%	25.864	2.211	
12	1-tert-2-dimethylcyclopentane	0.50%	26.219	2.255	4.69
13	Heptane	2%	28.151	2.495	

Column: GsBP-PONA, 100m x 0.25mm x 0.5um

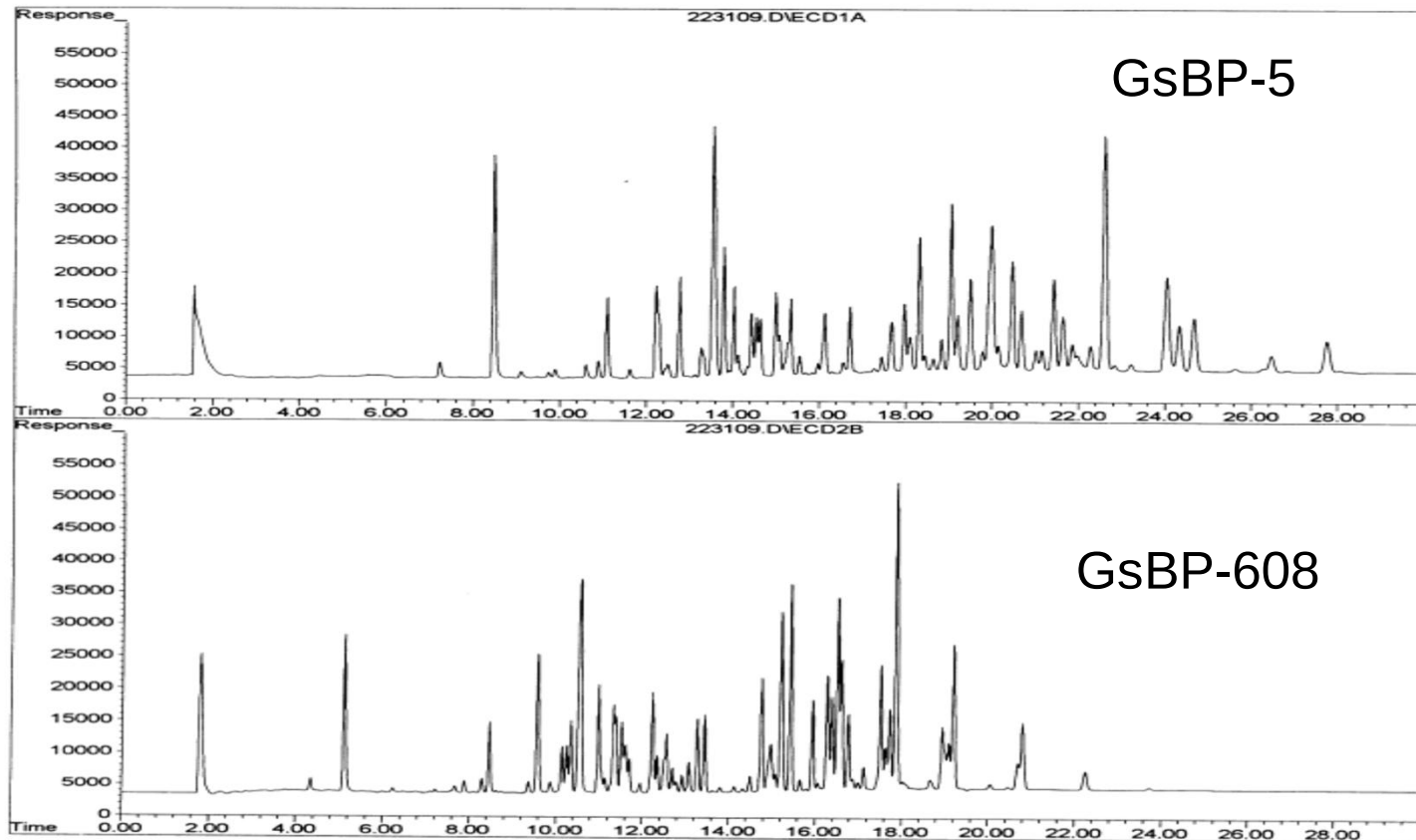
PCB Congeners EPA 8280A, Rev 1 (2007)

- ▶ To determine the concentrations of 19 PCB congeners (total 209) and 6 Aroclors in extracts from river/lake water samples
- ▶ Complete resolutions of PCBs from single column is not achievable. Confirmation with another column is required.
- ▶ Identification is done by GC-ECD or GC-MSD
- ▶ Linearity range, 30ng/ml to 3000 ng/ml
- ▶ Sample extraction: Soxhlet Liquid-Liquid, with hexane/acetone, Acetone/DCM, removal of lipid from microorganisms with a column, purge dry down to 1mL
- ▶ Aroclors can be degraded from water aging, sample preparation, and sample storage time.
- ▶ Sample Interference by Phthalates or toxaphene that are removed by SPE with silica or alumina packing. PCBs elute first

PCB Congeners EPA 8082A-Rev1

- ▶ Columns: GsBP-5MS, GsBP-608 or GsBP-1701(confirmation) (Y-Connection)
- ▶ Analytical, GsBP-5MS, 30m x 0.53mm x 1.5um
- ▶ Confirmation column: GsBP-608, 30m x 0.53mm x 0.5um
- ▶ Oven temp: various, typical one: 150 °C (1.0 min hold) to 280 °C (17 min hold) at 8 °C/min

Aroclor 1016/1260

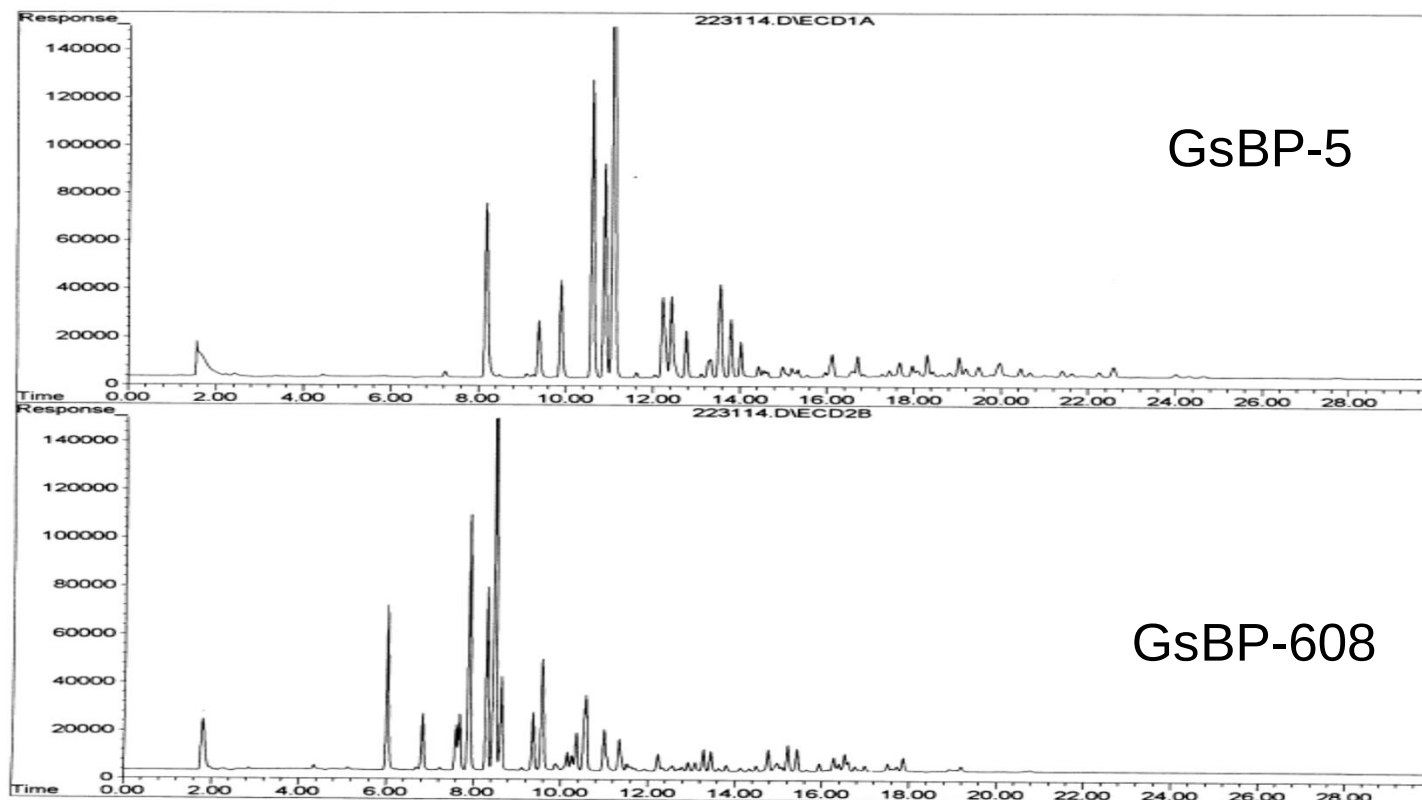


Column 1: 1553-3015, GsBP-5MS, 30m x 0.53mm x 1.5 μ m

Column 2: 5253-3005, GsBP-608, 30m x 0.53mm x 0.5 μ m

GS-Tek

Aroclor 1221

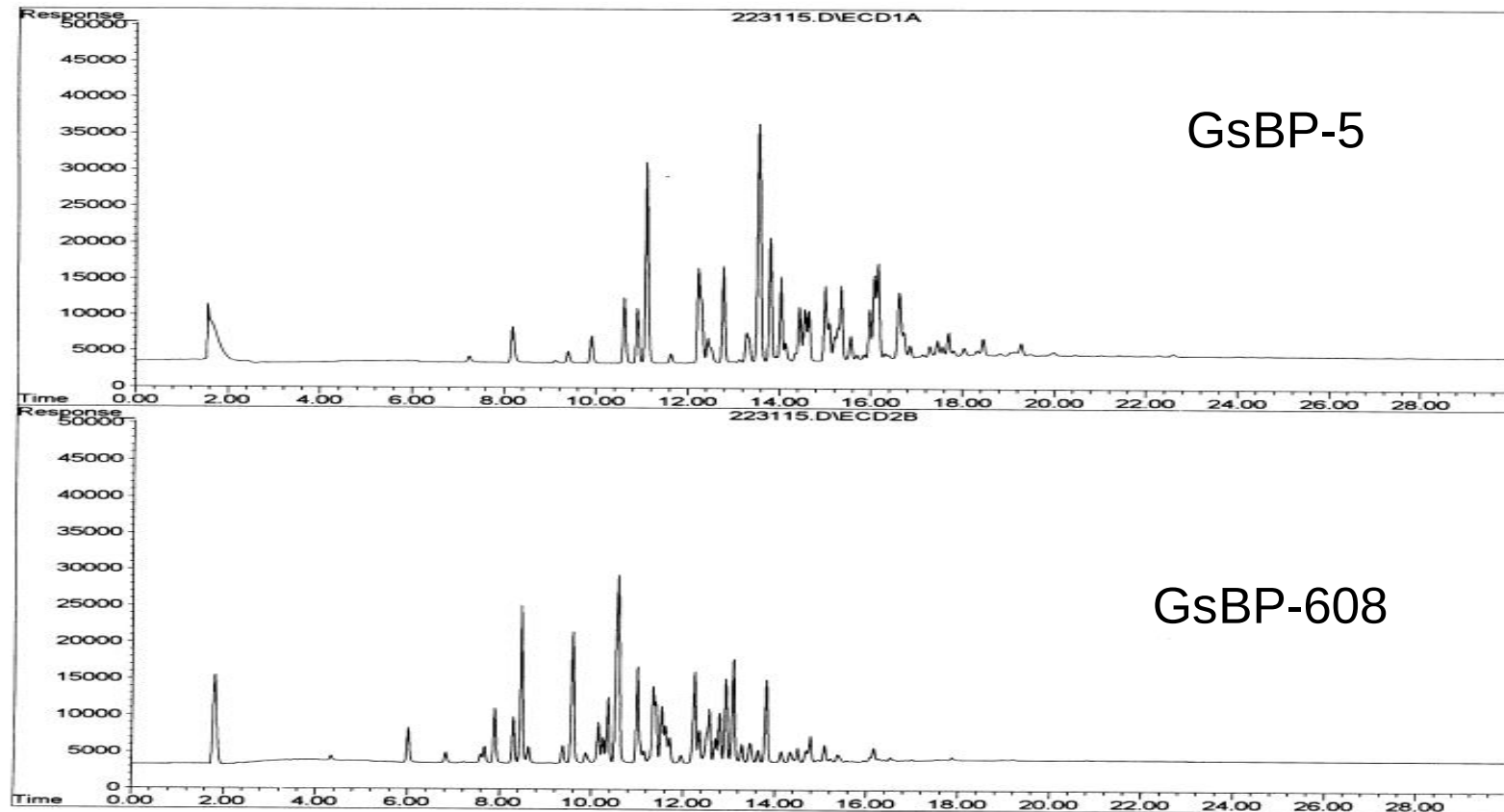


Column 1: 1553-3015, GsBP-5MS, 30m x 0.53mm x 1.5 μ m

Column 2: 5253-3005, GsBP-608, 30m x 0.53mm x 0.5 μ m

GS-Tek

Aroclor 1232

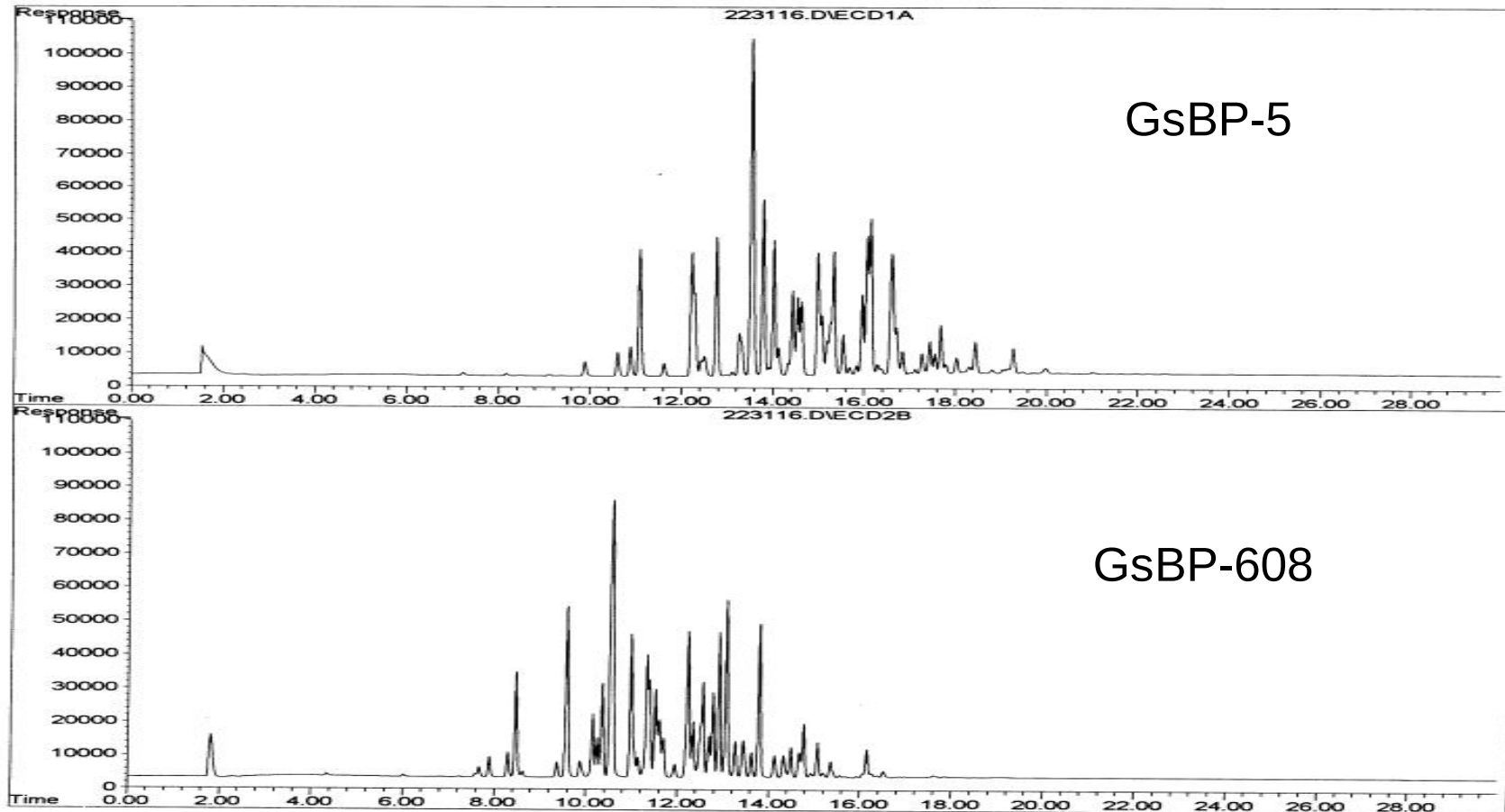


Column 1: 1553-3015, GsBP-5MS, 30m x 0.53mm x 1.5um

Column 2: 5253-3005, GsBP-608, 30m x 0.53mm x 0.5um

GS-Tek

Aroclor 1242

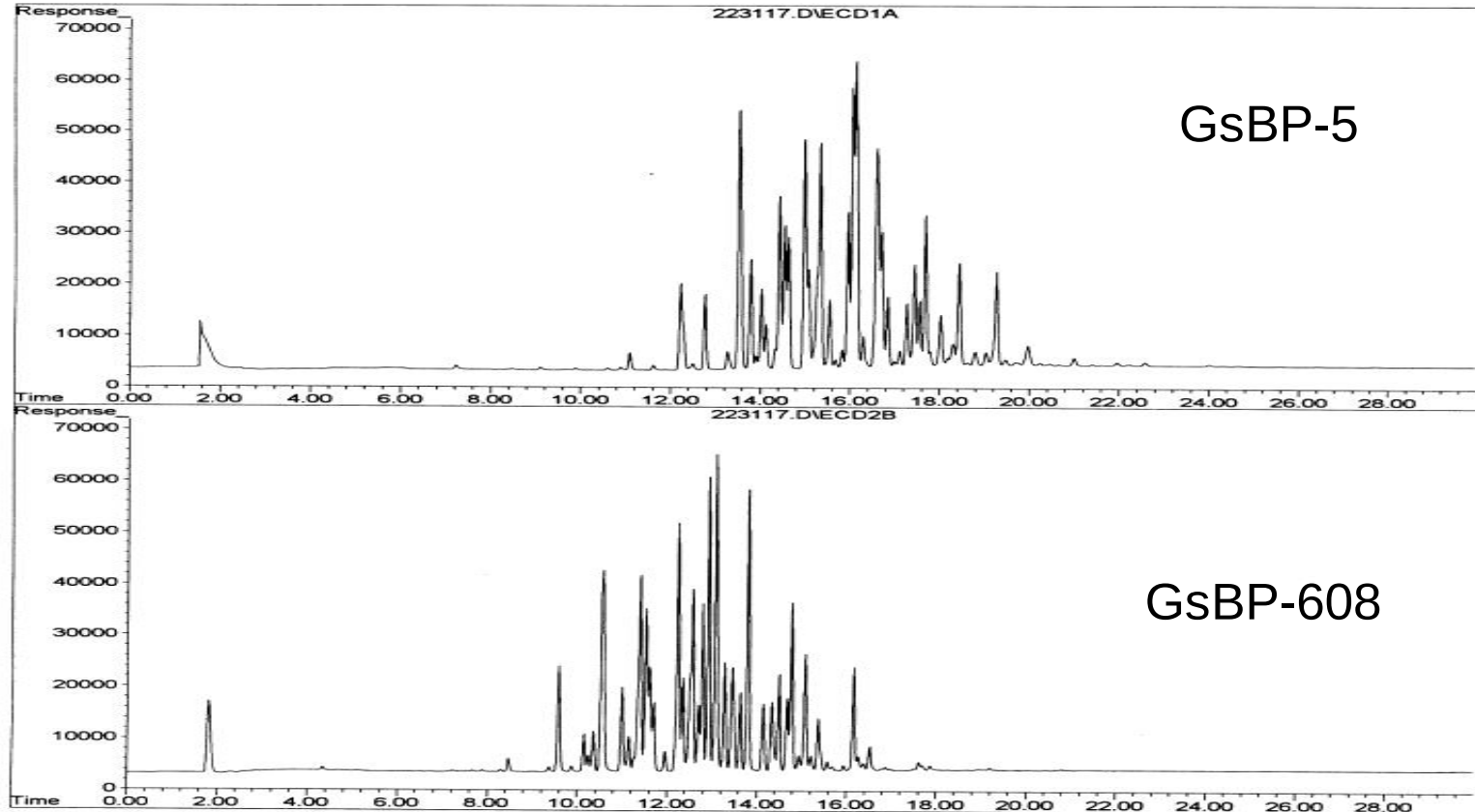


Column 1: 1553-3015, GsBP-5MS, 30m x 0.53mm x 1.5um

Column 2: 5253-3005, GsBP-608, 30m x 0.53mm x 0.5um

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Aroclor 1248

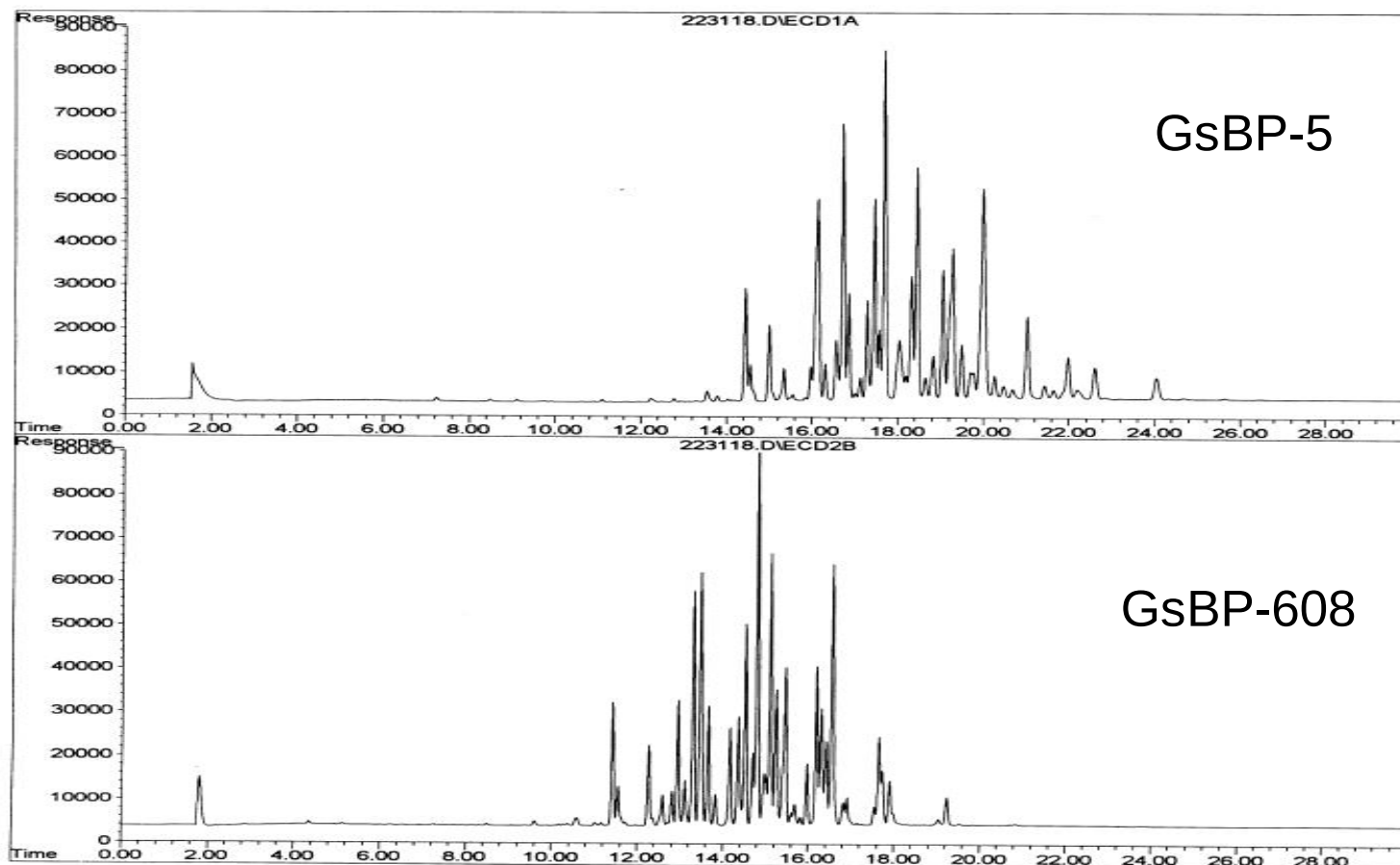


Column 1: 1553-3015, GsBP-5MS, 30m x 0.53mm x 1.5 μ m

Column 2: 5253-3005, GsBP-608, 30m x 0.53mm x 0.5 μ m

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Aroclor 1254



Column 1: 1553-3015, GsBP-5MS, 30m x 0.53mm x 1.5 μ m

Column 2: 5253-3005, GsBP-608, 30m x 0.53mm x 0.5 μ m

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Thanks and Collaboration

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Q/A



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