GC Column Technology - Advancements and Practical Applications

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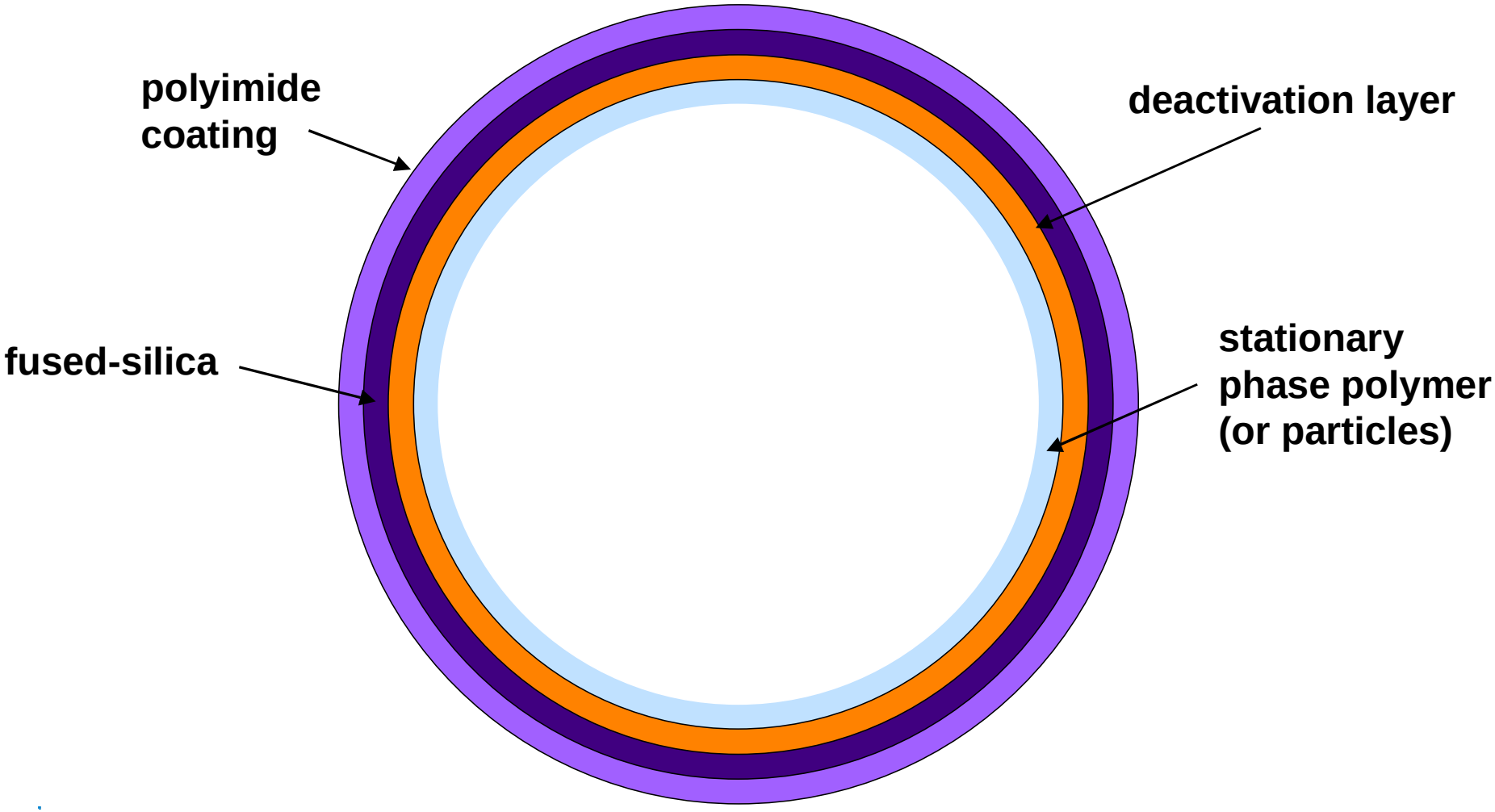
Capillary Column Research

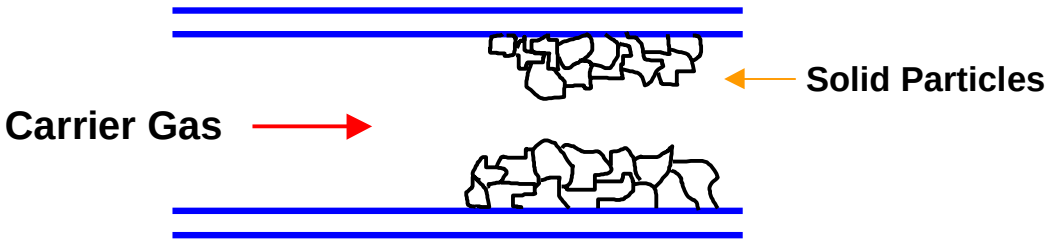
- **Column deactivation chemistry:**
  - **extend performance envelope- general use phases**
  - **optimize column chemistry - specific use columns**
- **Stationary phase chemistries:**
  - **improved upper temp limits- increased thermal stability & lower bleed**
  - **improved low temperature performance- increased flexibility for volatiles**
  - **improved chemical & physical stability- longer life, improved resolution**
  - **improved selectivities/ new applications**

Capillary Column Cross Section

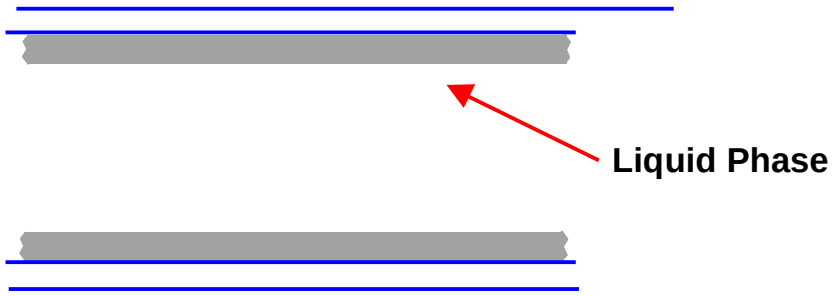


Capillary Column Types

Porous Layer Open Tube (PLOT)



Wall Coated Open Tube (WCOT)



Optimized Column Deactivation

- Compatible with desired stationary phase polymer
  proper surface energy (polymer "wets" surface)
  provides functional groups for covalent bonding

- **Permits good chromatography: minimal absorption, symmetric peaks for compounds of interest:**

  If general-use phase: broad analyte spectrum capability- organic acids to organic bases

- Deactivation stable to solvent injection or wash

Optimized Deactivation

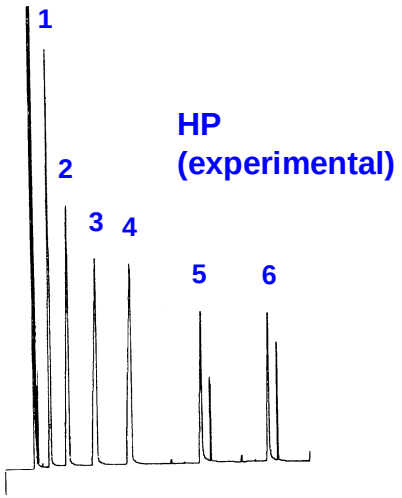
- **“Broad Range” is difficult in practice.**
- **Deactivation affects performance**

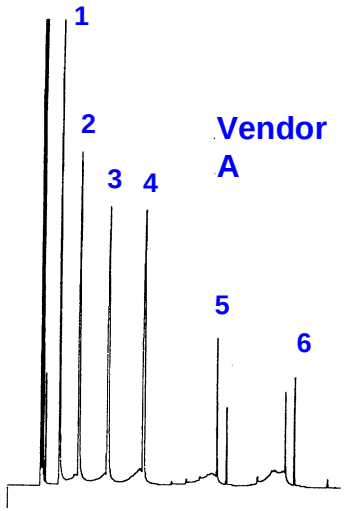
Common Deactivation Chemistries and Column Performance

Deactivation Method	Column Characteristics
Chlorosilanes	Acidic
Alkoxysilanes	Slightly Acidic
Silazanes or cyclic silazanes	Basic
Hydrosilanes or hydrosiloxanes	Acidic
Siloxane	Slightly Acidic
Polyethylene glycol (Carbowax)	Acidic

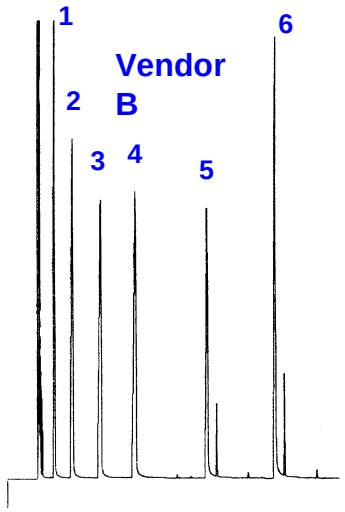
Acid Performance

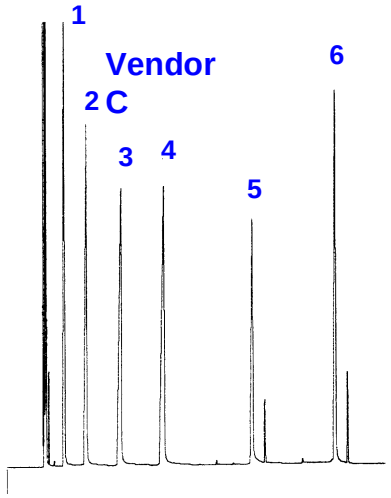
5% phenyl, 30 m x 0.32 mm x 0.25 µm





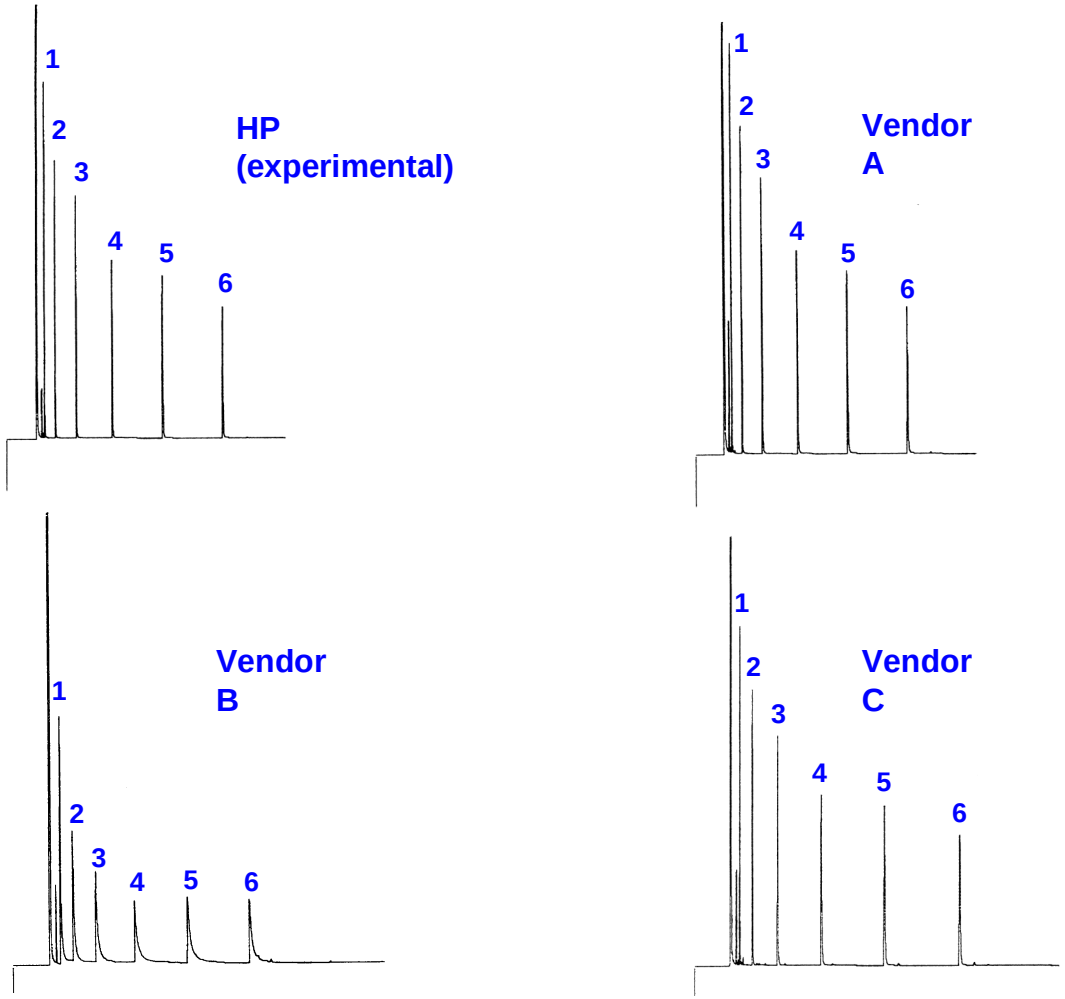
1. pentanoic acid
2. hexanoic acid
3. heptanoic acid
4. octanoic acid
5. decanoic acid
6. dodecanoic acid





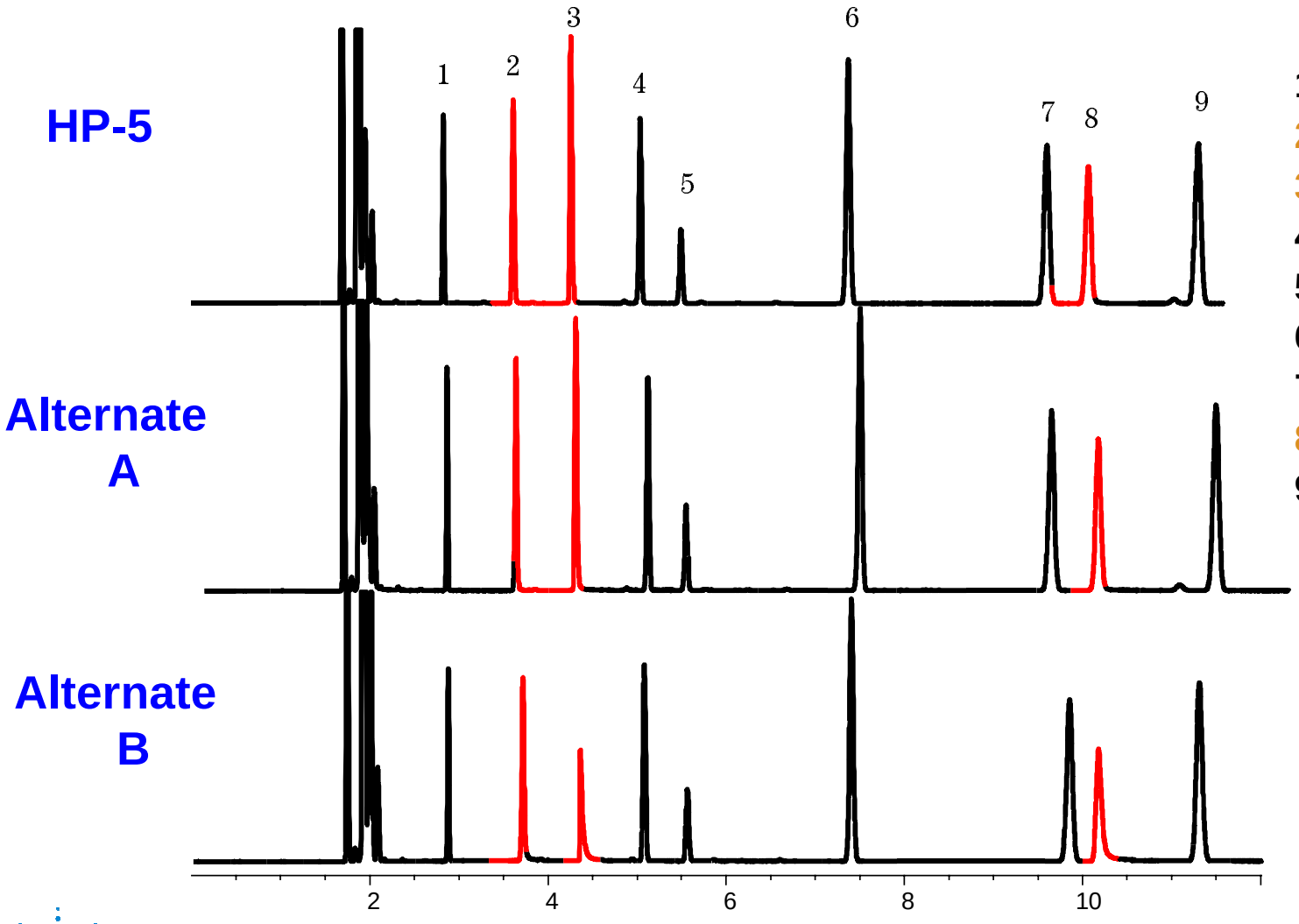
Base Performance

5% phenyl, 30 m x 0.32 mm x 0.25 µm



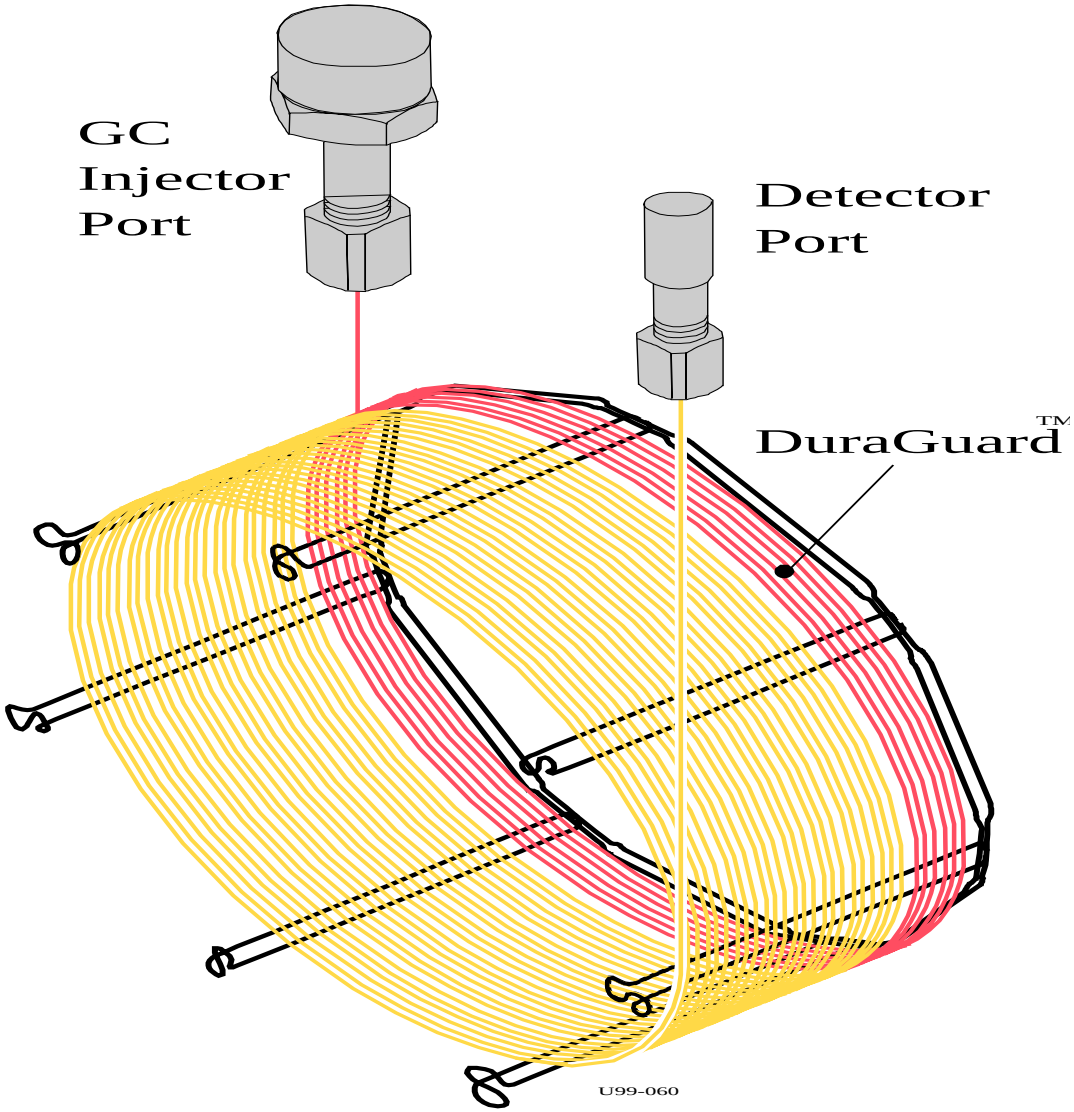
1. pentylamine
2. hexylamine
3. heptylamine
4. octylamine
5. nonylamine
6. decylamine

HP-5 Equivalent Columns: Broad Spectrum Chemical Test



1. Undecane
2. 4-Chlorophenol
3. 1-Decylamine
4. Tridecane
5. Methyl Caprate
6. Tetradecane
7. Acenaphthalene
8. 1-Dodecanol
9. Pentadecane

DuraGuard



Stationary Phase Advancements

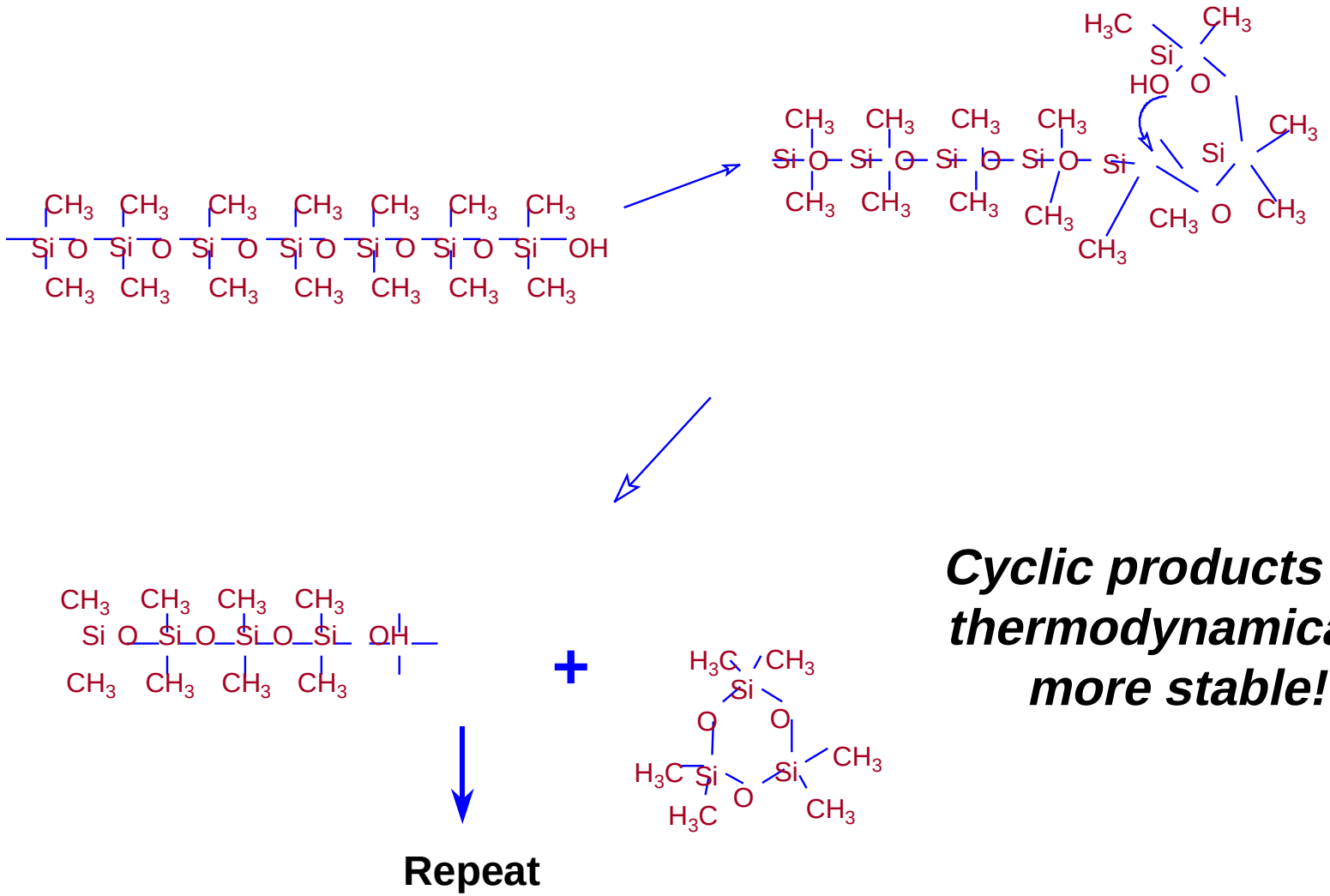
- **Improved upper temp performance- Reducing bleed- “MS” phases.**
- **Extending minimum temp limits- more flexibility for volatiles- Waxes.**
- **Improved phase stability- longer life, improved resolution, expanded compatibility -PLOTs.**
- **New selectivities / applications.**

What is Bleed?

- thermodynamic equilibrium process occurs to some degree in all columns
- polysiloxane backbone releases low molecular weight, cyclic fragments
- occurs at low level in low temperature, O2-free, clean system
- increased by increased temperature, oxygen exposure or chemical contamination

Bleed: Why Does It Happen?

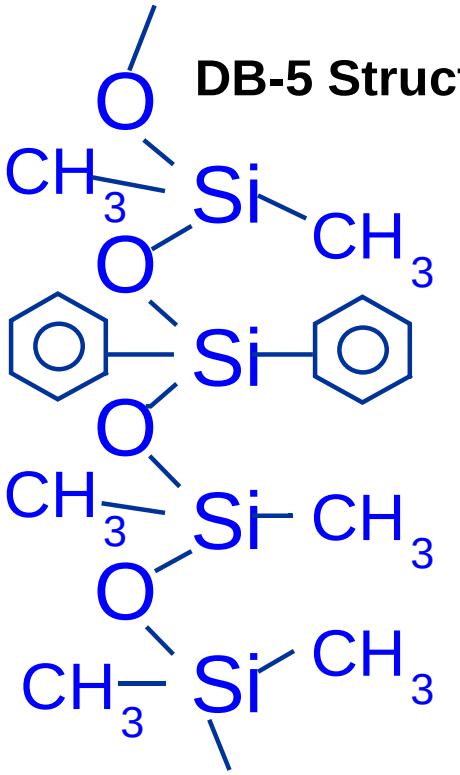
"Back Biting" Mechanism of Product Formation



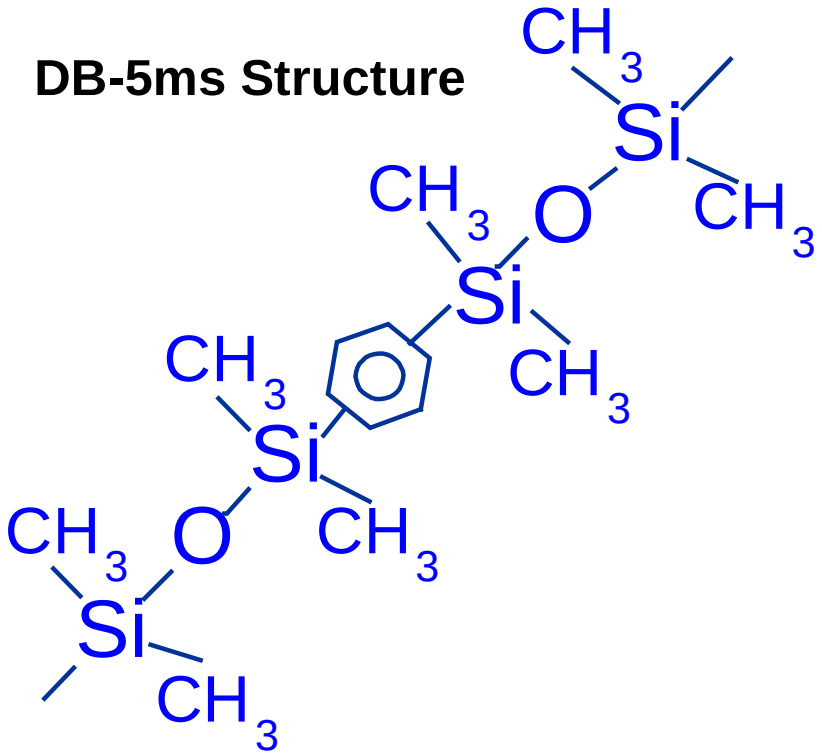
Cyclic products are thermodynamically more stable!

DB-5MS Structure

DB-5 Structure



DB-5ms Structure



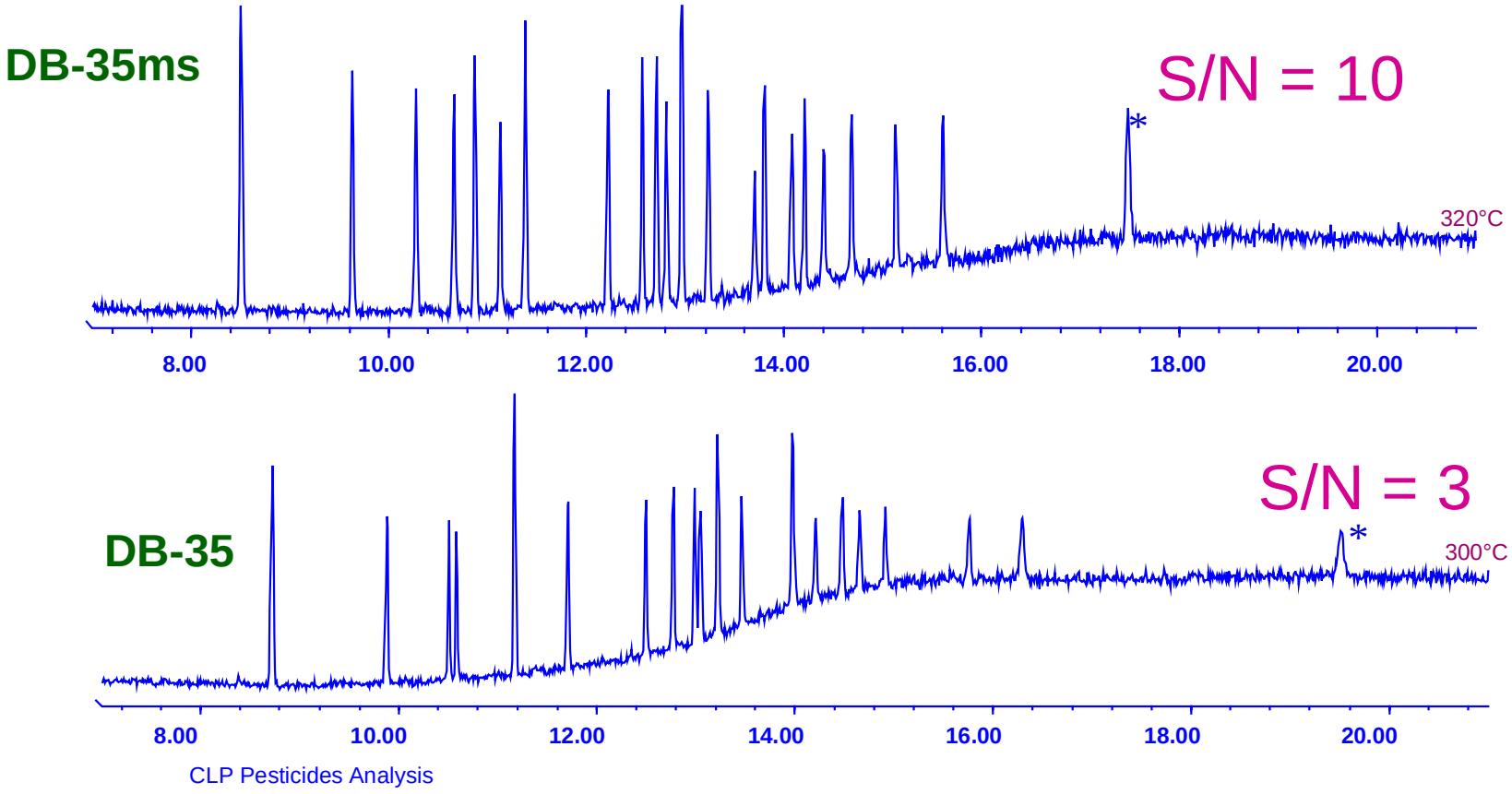
DB-5
5% Phenyl

DB-5ms
1. **Increased stability**
2. **Different selectivity**
3. **Optimized to match DB-5**

Dial 1-816-650-0621 for e-Seminar Audio

Low Bleed Stationary Phases

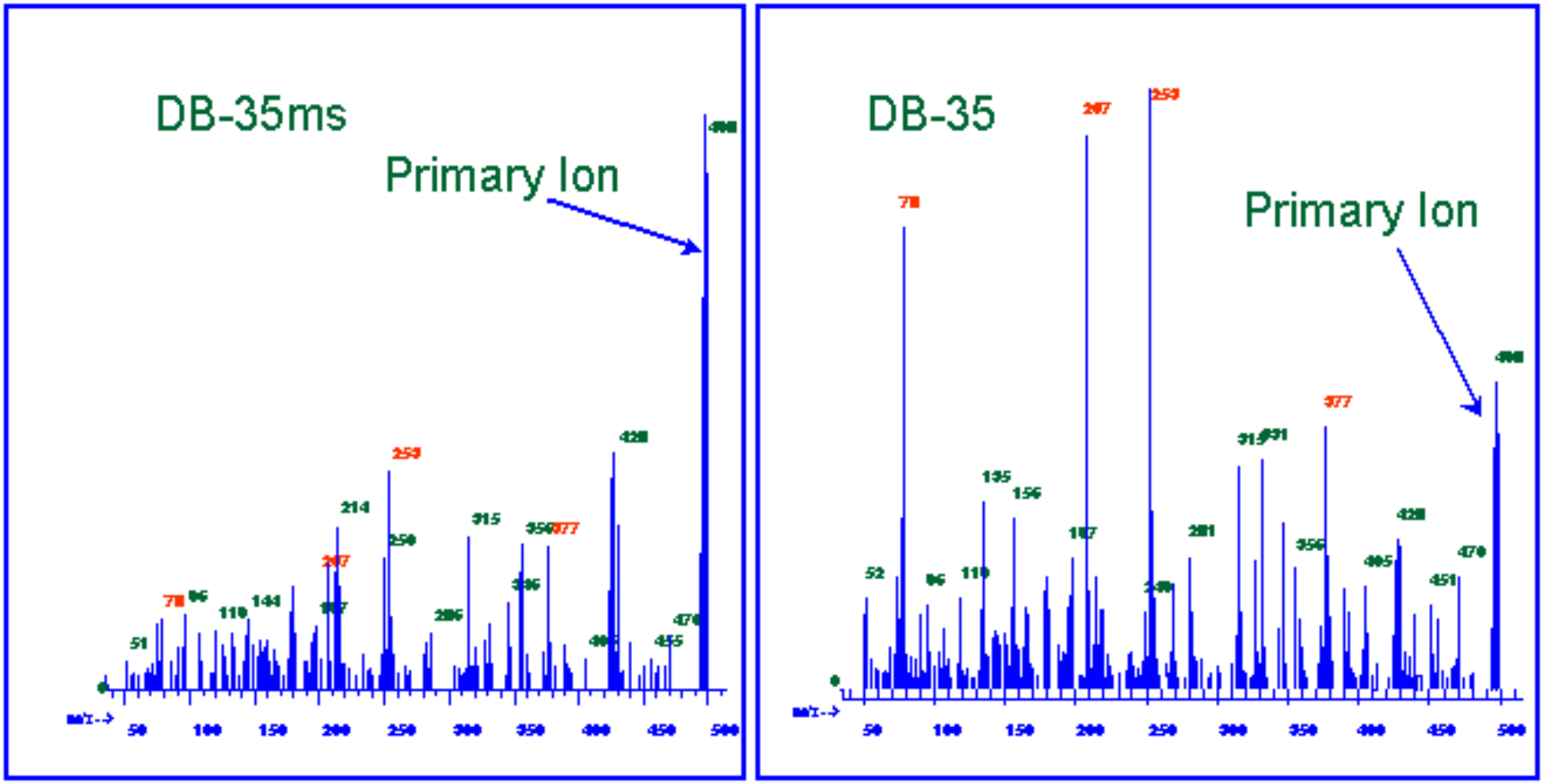
DB-35ms vs. DB-35



CLP Pesticides Analysis

* 5ng Decachlorobiphenyl

Low Bleed Stationary Phases
Spectral Purity



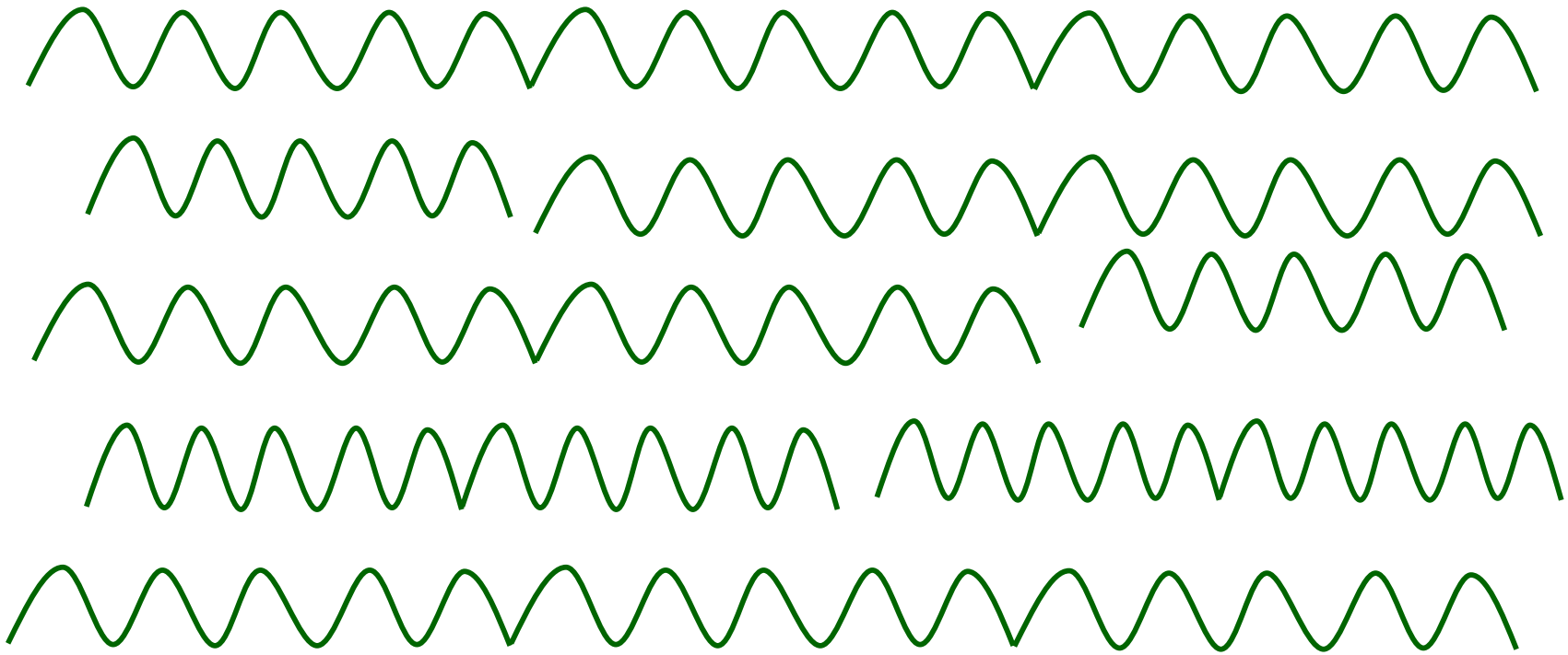
DB-1ms
The World's #1 Phase Just Got Better

- **Virtually identical selectivity to DB-1**
- **Higher temperature limit than DB-5ms (340/360°C)**
- **Legendary column to column reproducibility**
- **Engineered to perform: never hand selected**

DB-1ms: Optimizing an Already Robust Phase

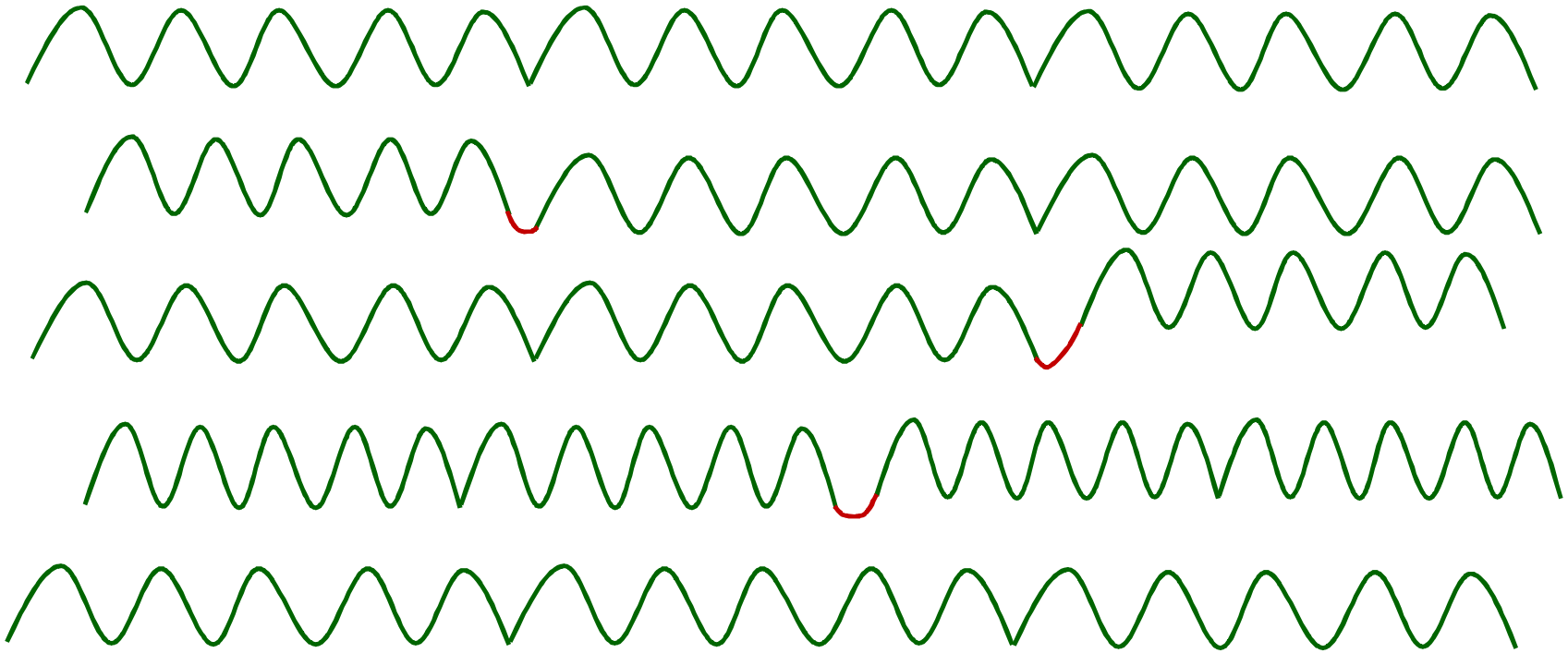
- **Changes to fused silica surface prior to polymerization**
- **Changes to polymerization chemistry**
- **Changes to chemical manifolds used to process columns**

Molecular Weight Distribution and Bleed in DMPS Columns



DMPS chains of inconsistent lengths

Molecular Weight Distribution and Bleed in DMPS Columns



DMPS chains of ***consistent*** lengths

DB-1ms
Compare the Retention Indices

Compound	DB-1	DB-1ms	MFG A	MFG B	MFG C
3,5-dimethylpyridine	952.4	954.0	959.1	966.1	958.7
1-nitrohexane	1009.4	1009.7	1009.9	1015.1	1015.0
1,4-diisopropylbenzene	1152.1	1152.7	1153.5	1157.3	1157.0
1-nonanol	1156.9	1157.2	1156.7	1161.1	1161.0
2-decanone	1169.3	1169.7	1170.4	1174.1	1173.0

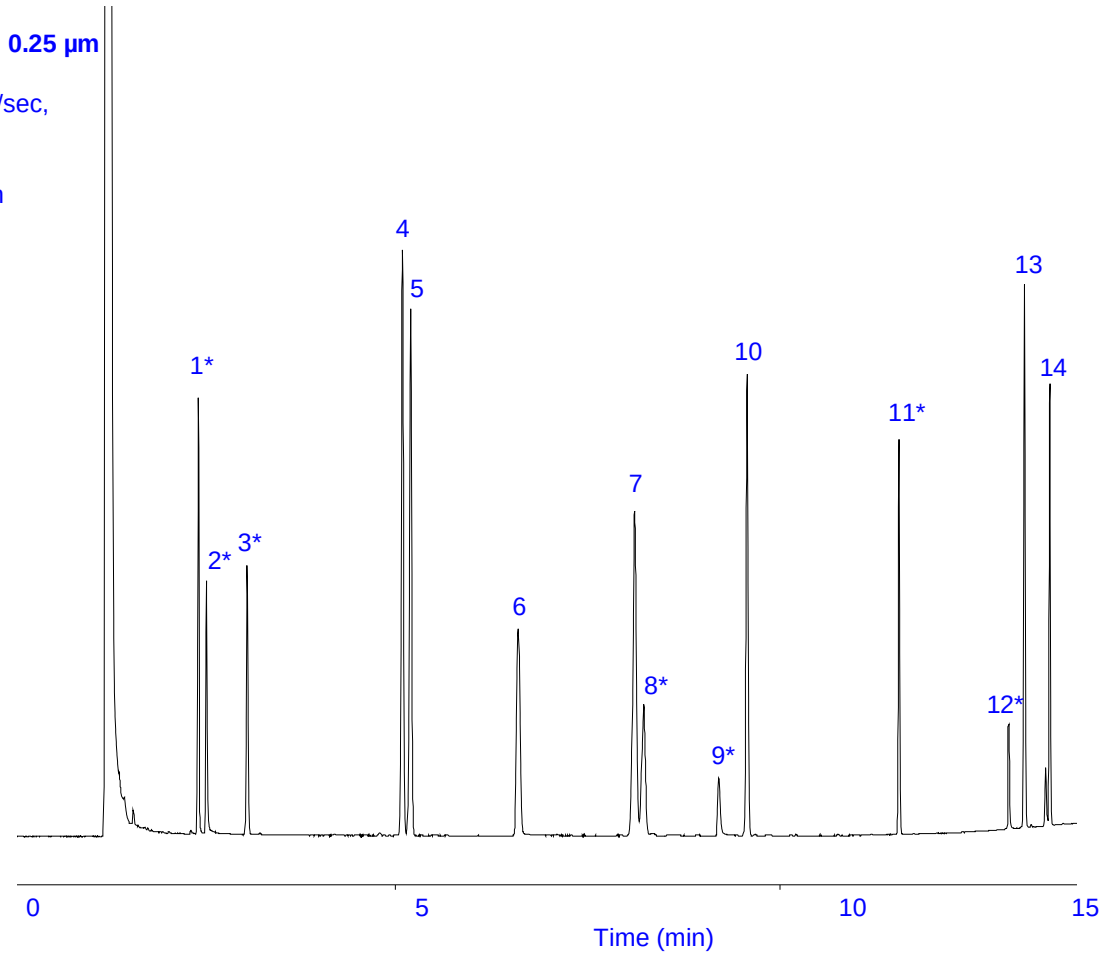
Retention Indices at 90°C

DB-1ms
Inertness

Column:	**DB-1ms**
	30 m x 0.25 mm I.D., 0.25 µm
J&W P/N:	**122-0132**
Carrier:	Hydrogen at 39.8 cm/sec, measure at 125°C
Oven:	125°C for 8.5 min 125-265°C at 20°/min
Injector:	Split 1:50, 250°C
Detector:	FID, 300°C

1. 2-Ethylhexanoic Acid*
2. 1,6-Hexanediol
3. 4-Chlorophenol*
4. 1-Methylnaphthalene
5. Tridecane
6. 1-Undecanol
7. Tetradecane
8. Dicyclohexylamine*
9. 2,4-Dinitrophenol*
10. Acenaphthene
11. N-Nitrosodiphenylamine*
12. Pentachlorophenol
13. Phenanthrene
14. Carbazole

***Active Analytes**



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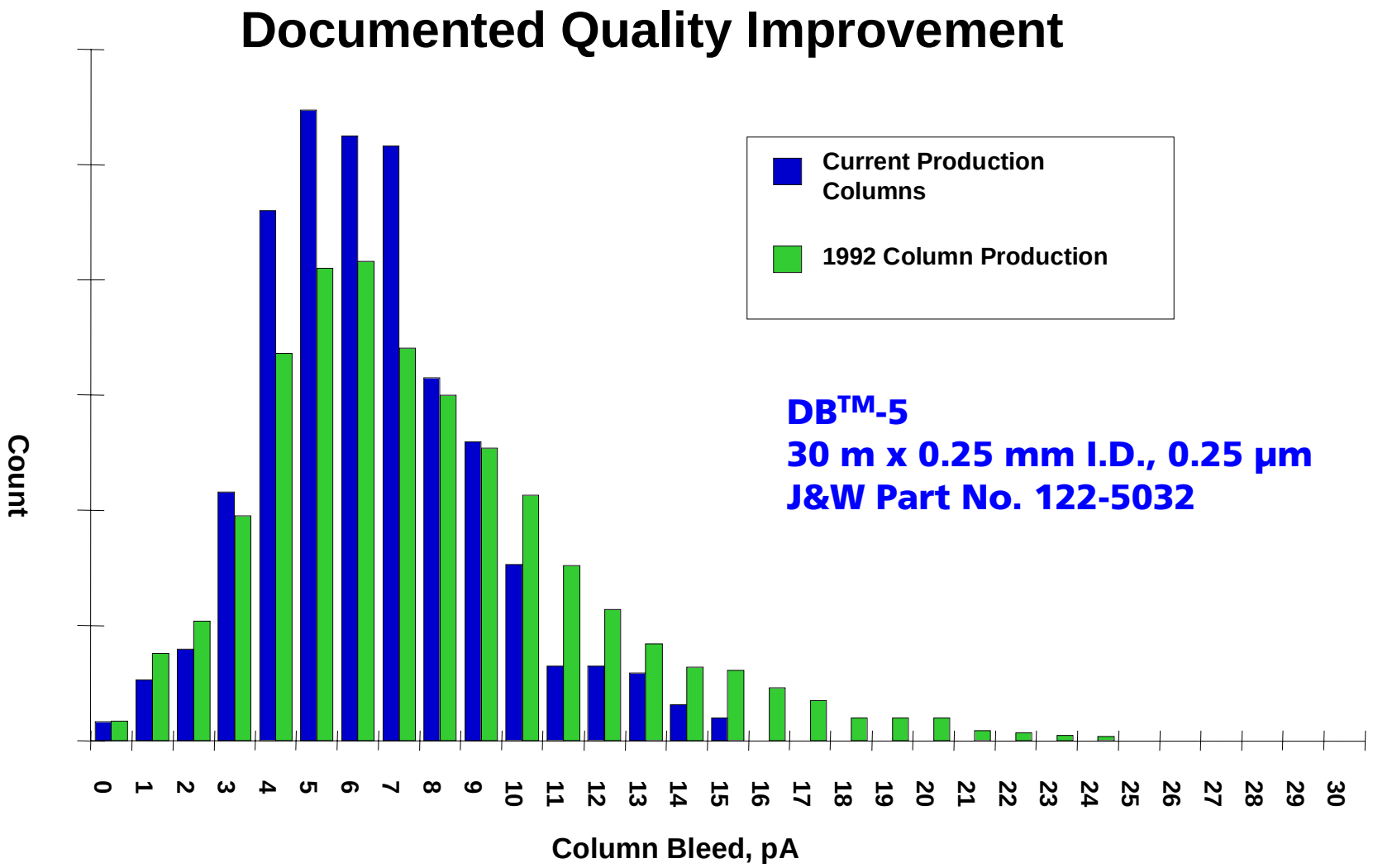
Dial 1-816-650-0621 for e-Seminar Audio

Improved Bleed Performance



Dial 1-816-650-0621 for e-Seminar Audio

Extending Low Temp Limits- Goals

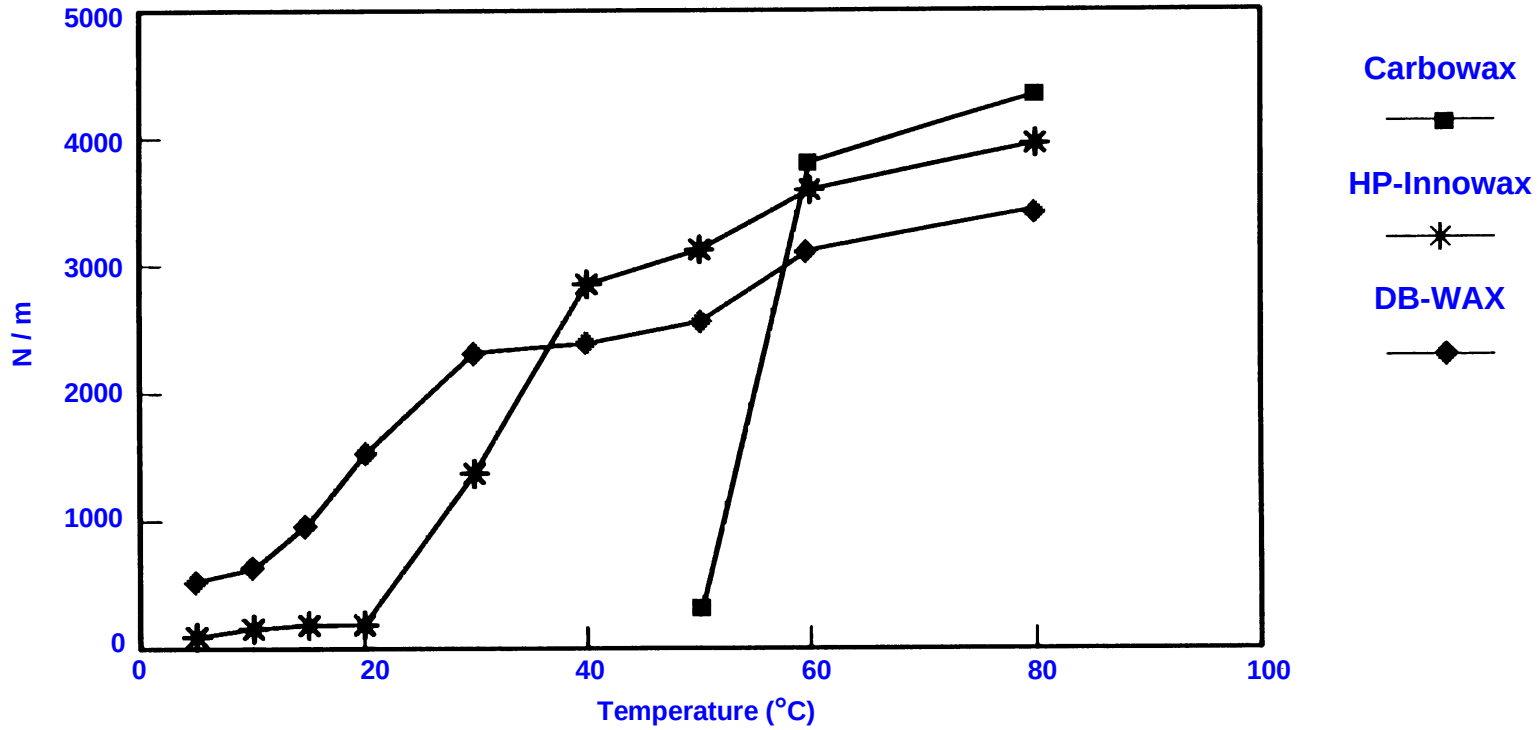
- **Retain peak shape, efficiency at low temperatures**
- **Retain (if possible) original phase polarity (RI)**
- **Retain or expand maximum temperature capability**

PEG (WAX) Phases

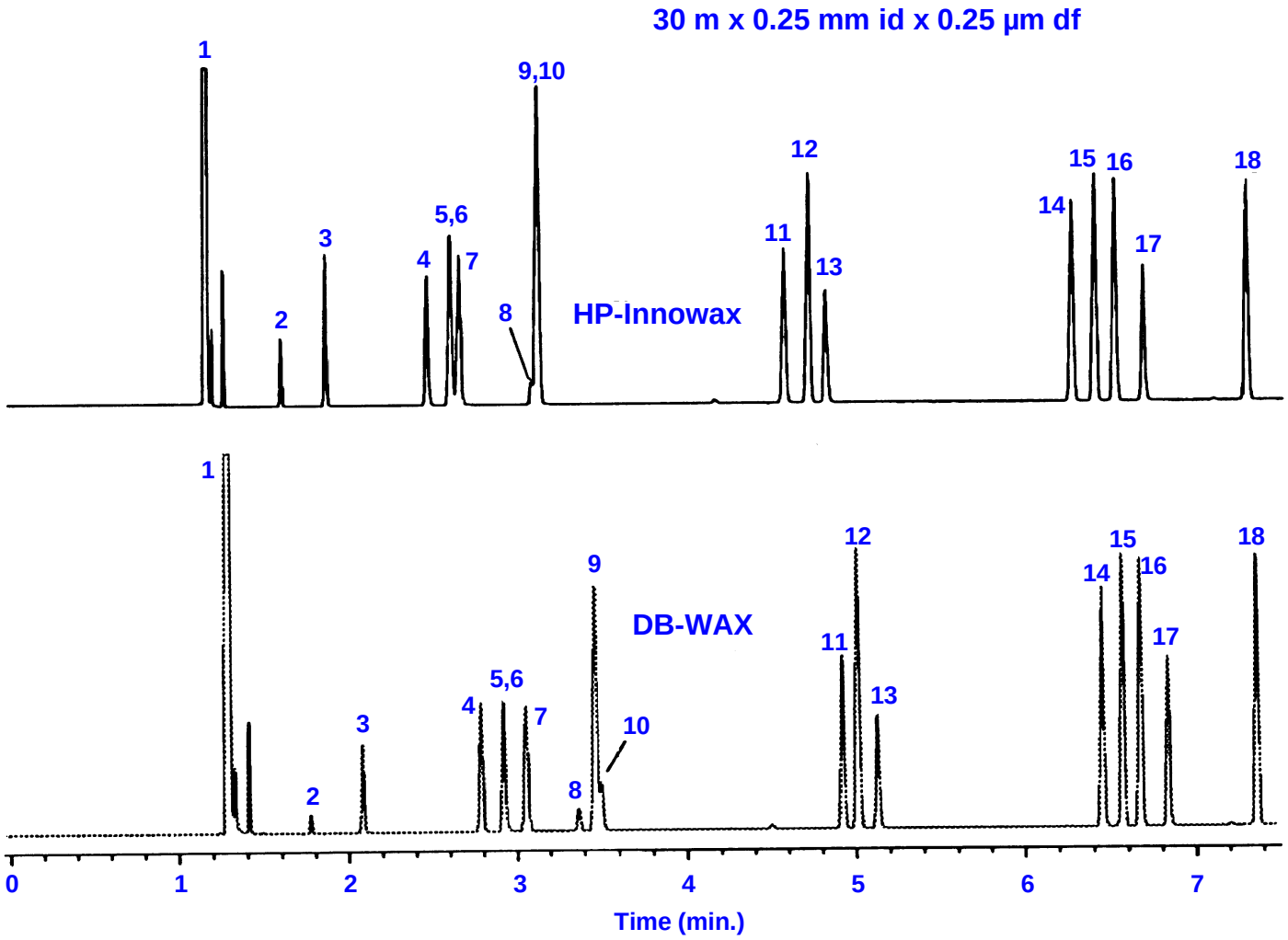
- **Carbowax- uncrosslinked PEG (HP 20M)**
- **DB-WAX- crosslinked via free radicals**
- **HP Innowax- crosslinked via side-chain functional groups**

  Goal: Reduce crystallinity, reduce melting point, reduce lower temp limit.

Melting Point of PEG Phases
N / m vs. Temperature



PEG Column Comparison
Solvent Analysis



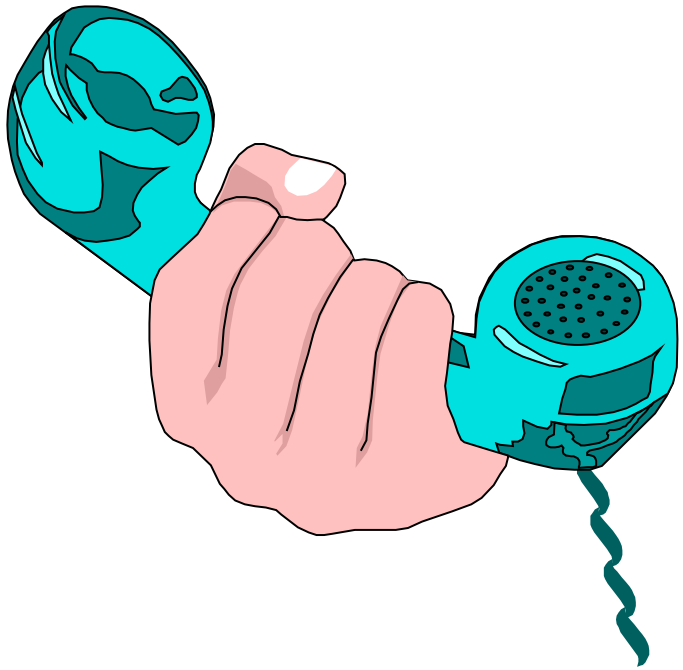
1. pentane
2. methyl formate
3. acetone
4. ethyl acetate
5. methyl ethyl ketone
6. methanol
7. 2-methyl-2-propanol
8. methylene chloride
9. benzene
10. ethanol
11. 2-butanol
12. toluene
13. n-propanol
14. ethyl benzene
15. p-xylene
16. m-xylene
17. 1-butanol
18. o-xylene

Break Number 1

For Questions and Answers

Press *1 on Your Phone to

Ask a Question



Phase Stability: PLOT Column Enhancements

- thicker phase layers - improved resolution
- improved particle to particle cross-linking or binding:
- decreased particle generation
  - less detector "spiking" and noise
  - less detector contamination
- improved chemical stability- longer column life
- improved selectivities

Bonded PLOT Columns

- **Virtually no spiking- use with valved, on-line, MS applications.**
- **No trap needed**

Bonded Porous Polymer PLOT Columns

General applications- hydrocarbons and light polars, including:

- HC up to C10, C2 -C4 isomers (natural gas, refinery gas).
- Halogenated HC
- CO_2, Air/CO,methane
- Polar compounds: Solvents, Alcohols, Ketones, Esters, Aldehydes, Amines, Acids

Bonded Porous Polymer PLOT Columns

HP PLOT Q: Polystyrene divinylbenzene- based

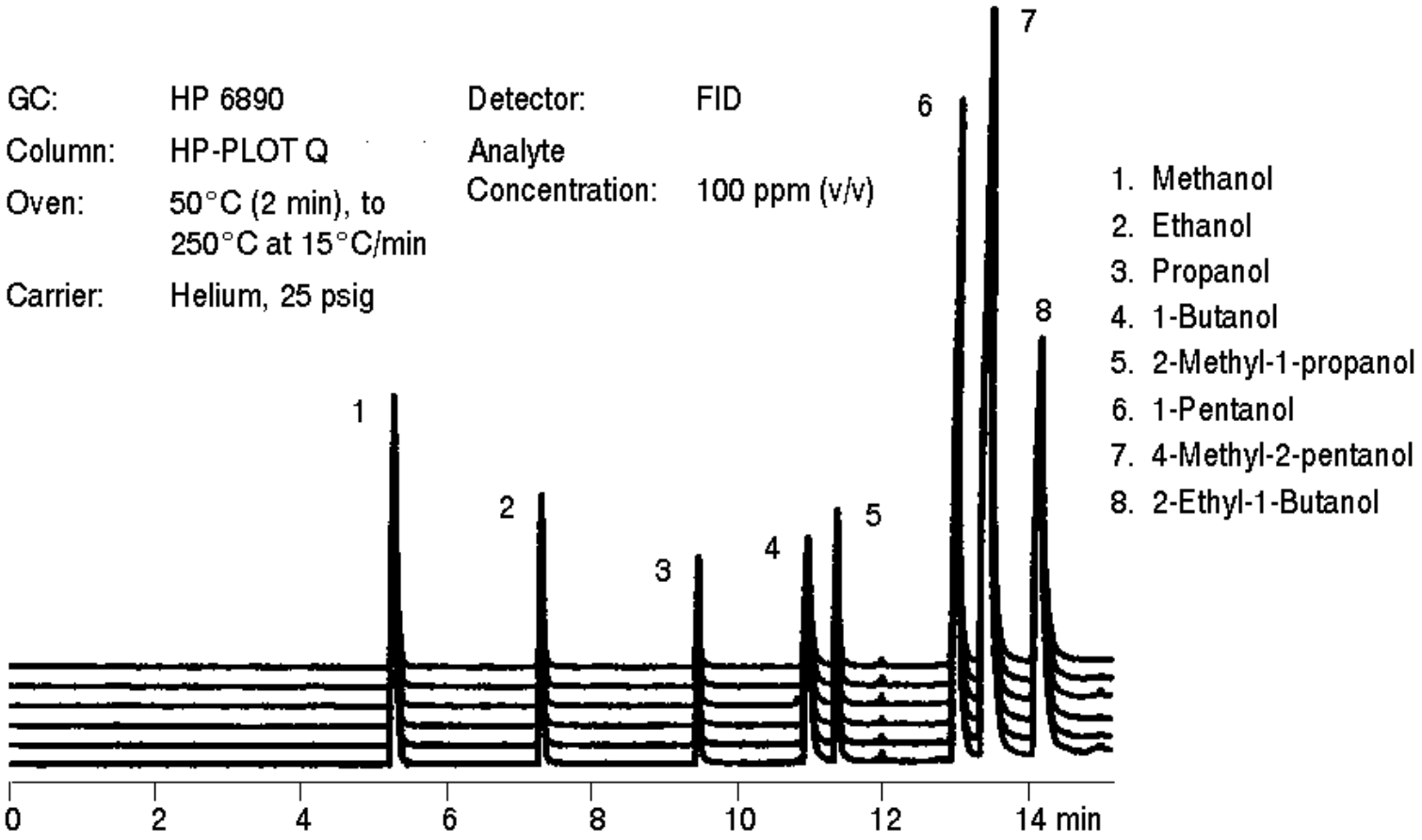
HP PLOT U: Divinylbenzene/ethylene glycol methacrylate- based

- resistant to water & alcohols

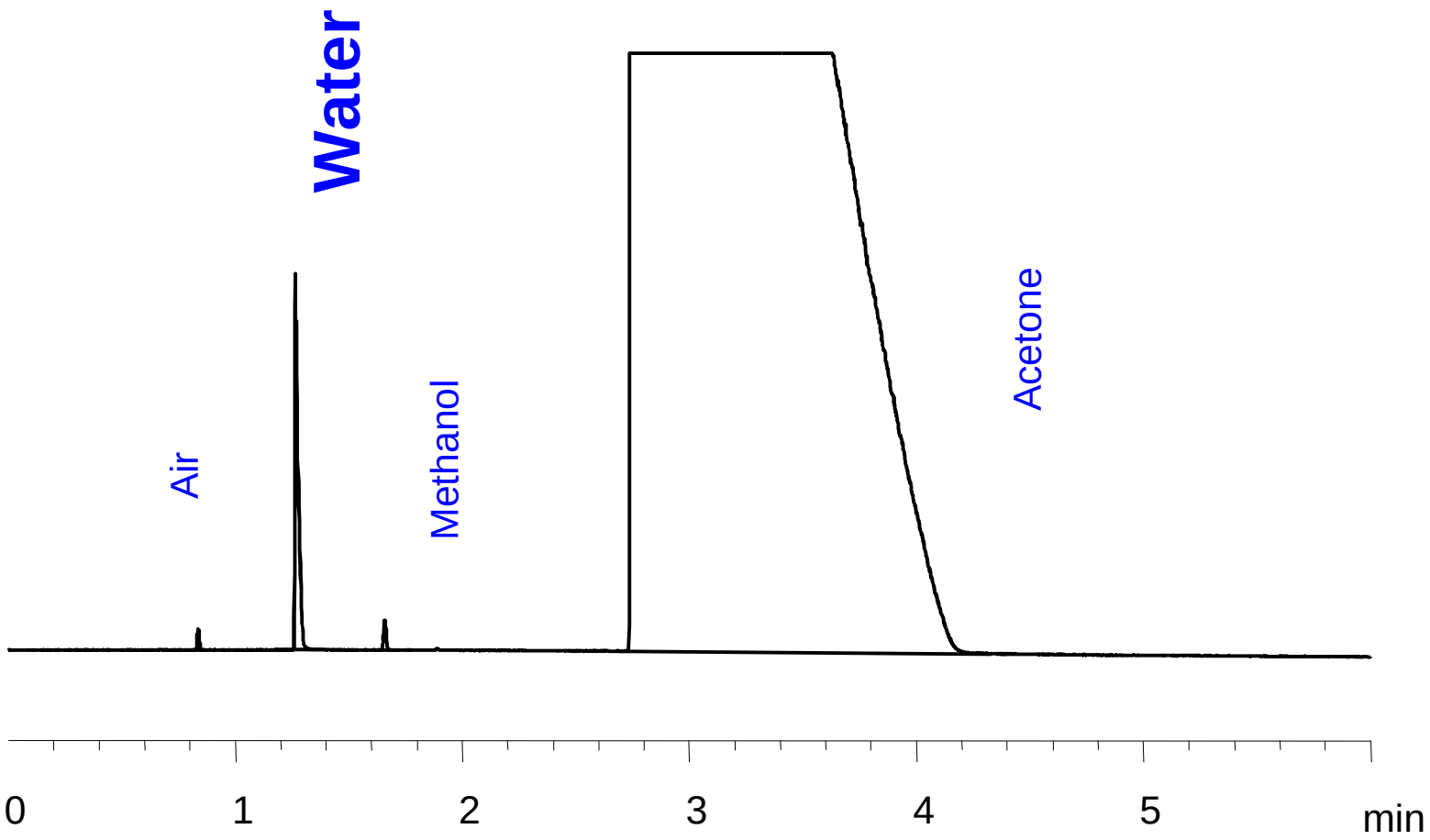
- can quantitate water and alcohols

- rinseable

Column Stability/ Reproducibility: Alcohol Injections



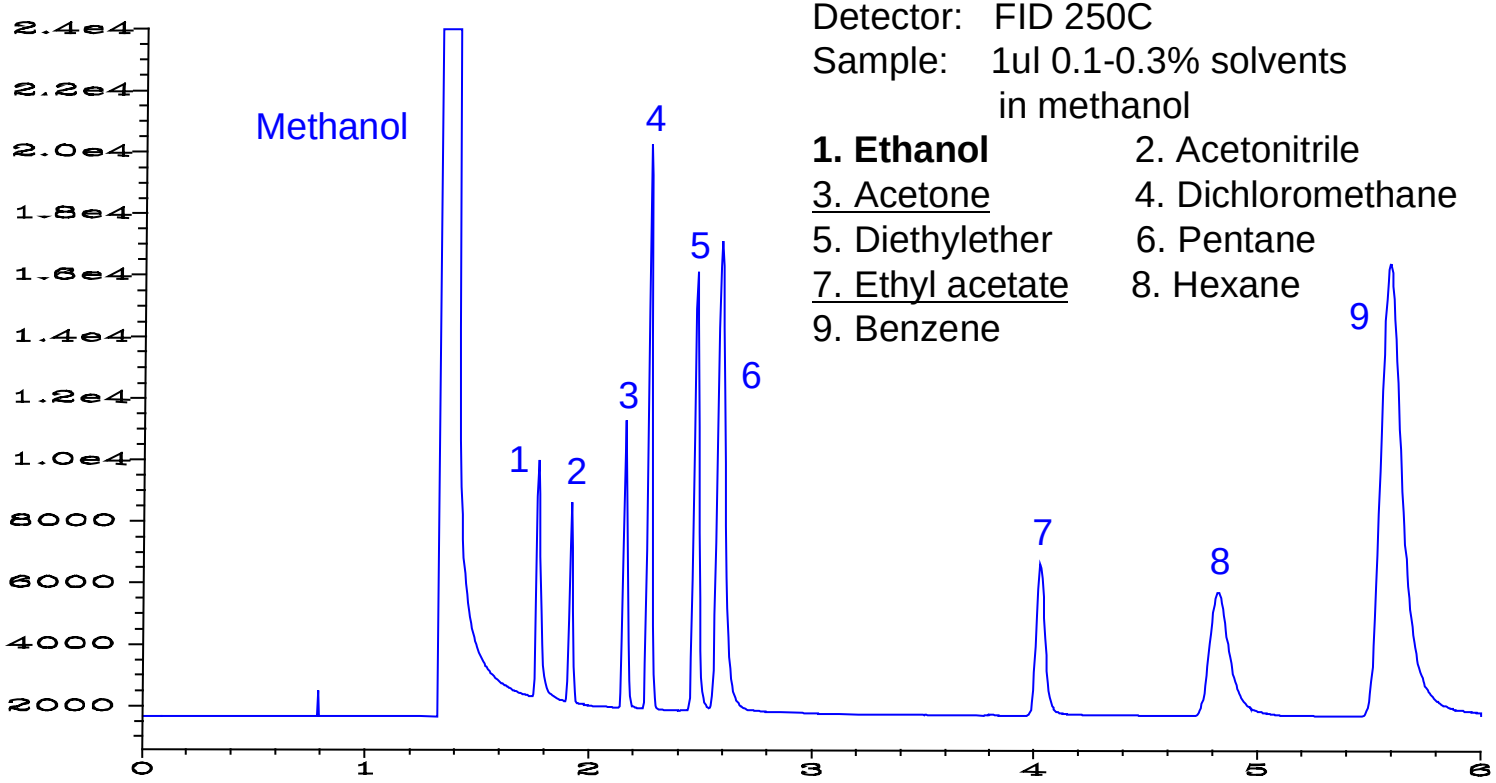
Analysis of Acetone on HP PLOT U



Selectivity comparison: PLOT Q vs U

Column: 0.53mm x 30m HP-PLOT/Q
Oven: 150°C
Carrier: Hydrogen 9ml/min
Injection: 250C Split mode(12:1)
Detector: FID 250C
Sample: 1ul 0.1-0.3% solvents in methanol

1. Ethanol 2. Acetonitrile
3. Acetone 4. Dichloromethane
5. Diethylether 6. Pentane
7. Ethyl acetate 8. Hexane
9. Benzene



Time (min)

Dial 1-816-650-0621 for e-Seminar Audio

Selectivity comparison: PLOT Q vs U

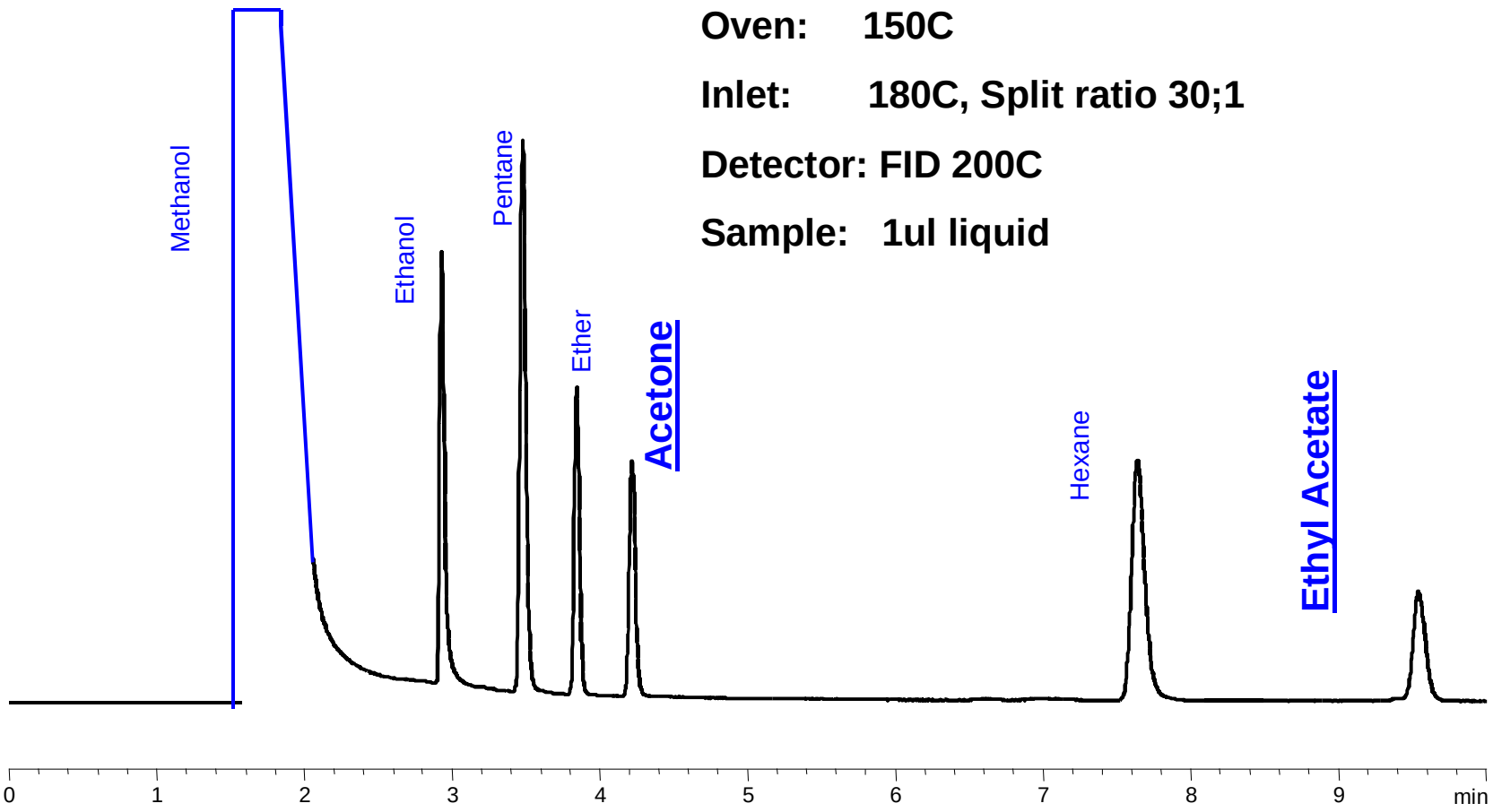
Column: HP-PLOT U 0.32mm x 30m x 10µm

Oven: 150C

Inlet: 180C, Split ratio 30;1

Detector: FID 200C

Sample: 1ul liquid



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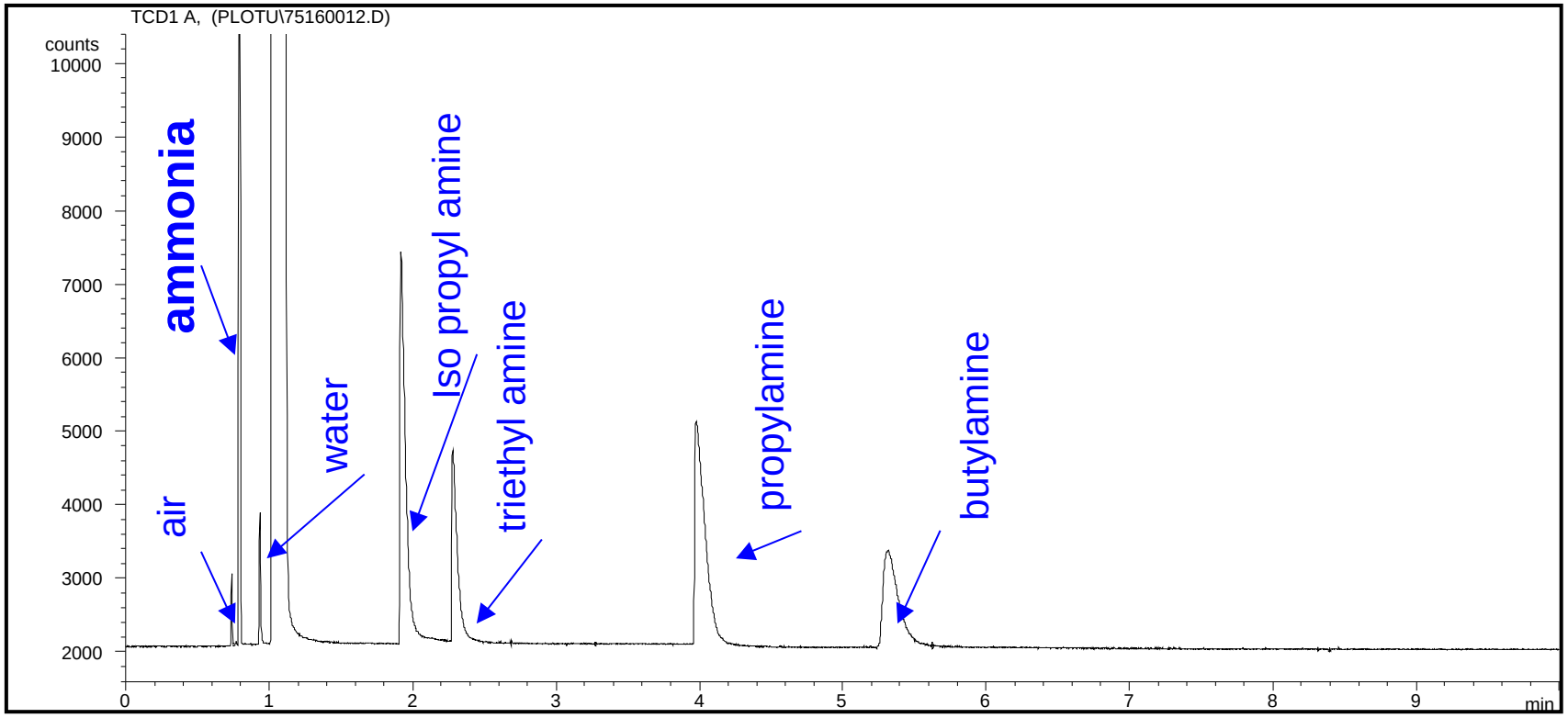
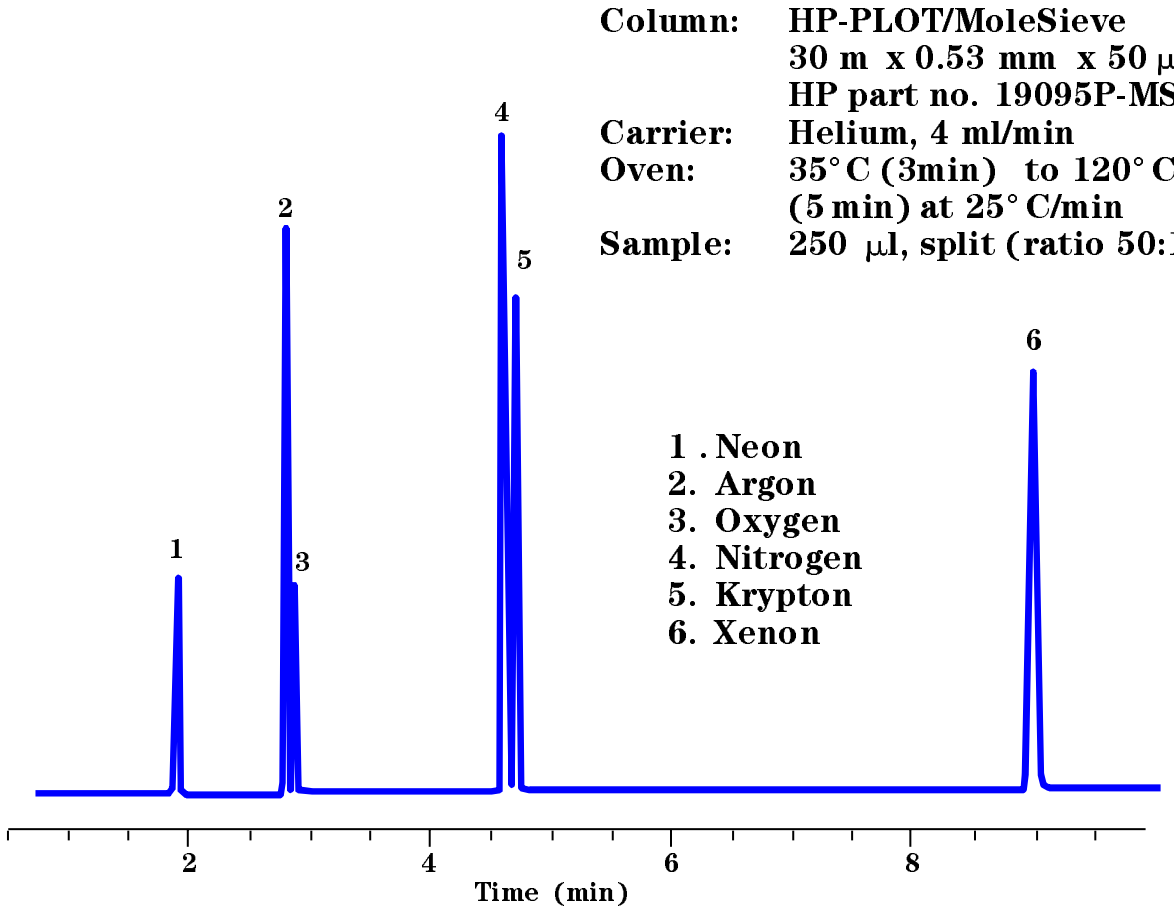
Volatile Primary Amines



Column: HP-PLOT U 0.53mm x 30m x 20um. Oven:150C(1min) 10C/min to 190C (5min). Carrier: Hydrogen, 7ml/min. Inlet: 180C, Split ratio 30;1. Detector: TCD 200C. Sample: 2ul amines in methanol, 1-10%.

Analysis of Noble & Fixed Gases Using HP PLOT MoleSieve



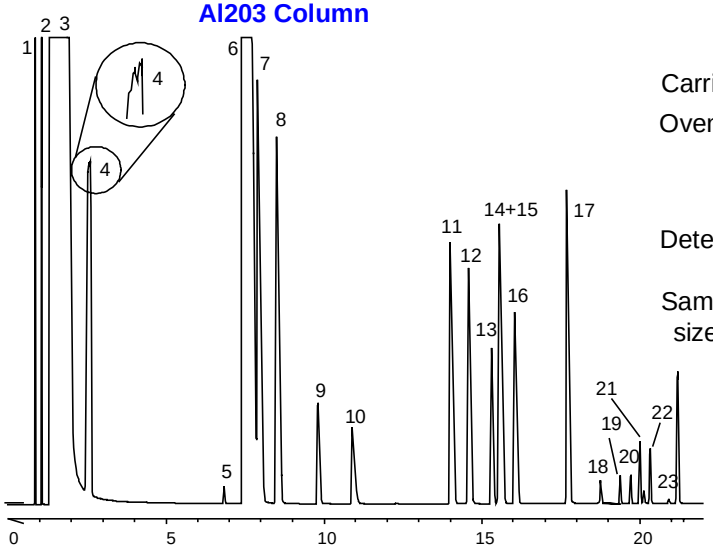
HP Plot Al2O3

Three types, "S" "M" and KCL deactivated- will resolve hydrocarbon isomers.

- **"S" and "M" are excellent general use columns. Baseline resolution of C1-C6; optimized for resolution of C2-C4 isomers.**
- **Design goal for "S" & "M": RI for ethylene & propylene as close to midpoint of flanking peaks as possible.**
- **"S" best for resolving acetylene from butane & propylene from isobutane**
- **"M" best for resolving cyclopropane from propylene (otherwise, "S" & "M" interchangeable)**
- **"KCL" best for dienes**

Comparison of PLOT Al2O3 Columns

Ethylene+Proplyene on Competitive Al203 Column



Carrier: He, constant flow

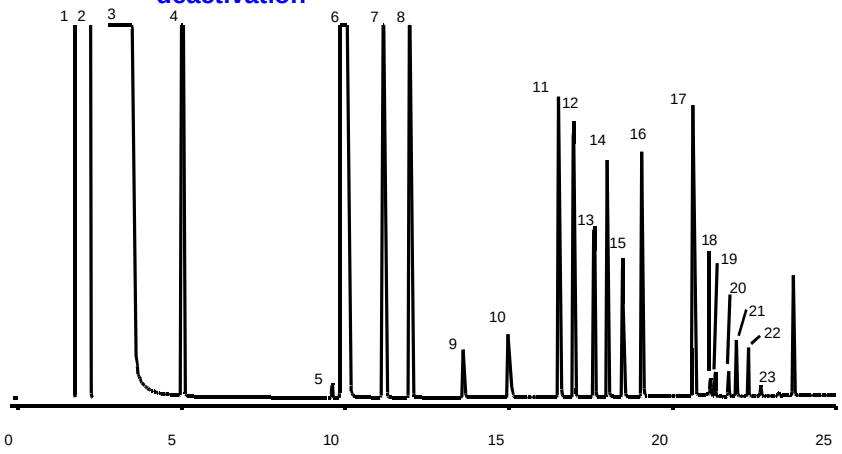
Oven: TP1=35°C (2 min), 5°C/min to 100°C, 10°C/min to 180°C (5 min)

Detector: FID (250°C)

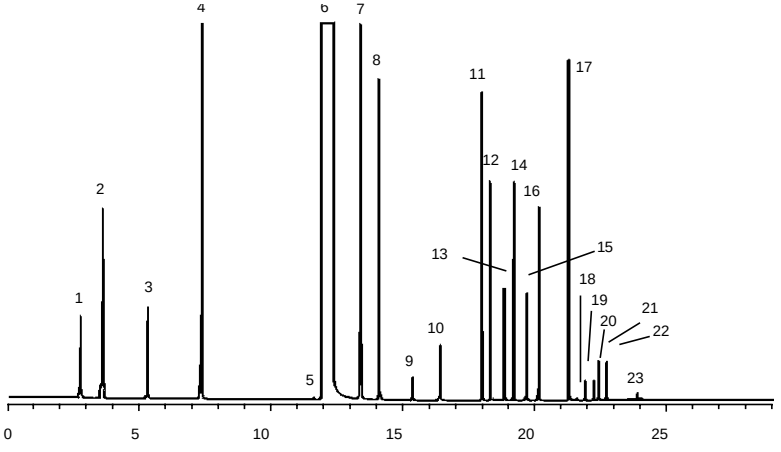
Sample size: Overload Conditions

- Methane
- Ethane
- Ethylene
- Propane
- Cyclopropane
- Propylene
- iso-Butane
- n-Butane
- Propadiene
- Acetylene
- trans-2-Butene
- Butene-1
- 13. iso-Butylene
- 14. cis-2-Butene
- 15. Iso-Pentane
- 16. n-Pentane
- 17. 1,3-Butadiene
- 18. Propyne
- 19. trans-2-Pentene
- 20. 2-Methyl-2-butene
- 21. Pentene-1
- 22. cis-2-Pentene
- 23. n-Hexane

Ethylene on HP Plot Al203 "S" deactivation



Propylene on HP Plot Al203 "M" deactivation



Agilent Technologies

Dial 1-816-650-0621 for e-Seminar Audio

GS-GasPro

- Silica-based PLOT column
- “Bonded” stationary phase
- Unique selectivity
- Highly inert to reactive compounds
- Retention stability uneffected by water
- Mass Spec friendly PLOT column

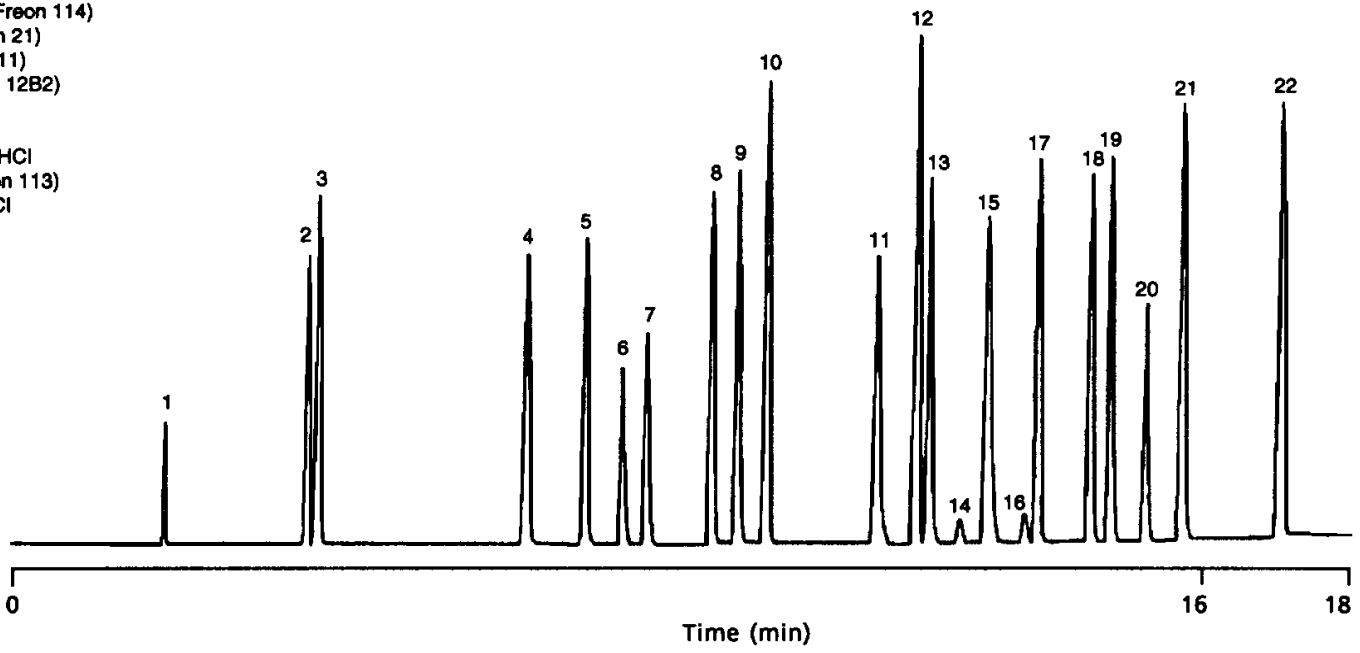
GS-GasPro

Fantastic for Freons

Halocarbons

Column: **GS-GasPro**
30 m x 0.32 mm I.D.
J&W P/N: **113-4332**
Carrier: Helium at 30 cm/sec
Oven: 130°C for 4 min
130-225°C at 10°/min
225°C Hold
Injector: Split 1:67, 1 µL, 250°C
Detector: FID, 250°C

1. CH_4
2. $CHClF_2$ (Freon 22)
3. CCl_2F_2 (Freon 12)
4. $ClCF_2CF_2Cl$ (Freon 114)
5. $CHCl_2F$ (Freon 21)
6. CCl_3F (Freon 11)
7. CF_2Br_2 (Freon 12B2)
8. CH_3I
9. CH_2Cl_2
10. *trans*-ClCH=CHCl
11. CF_3CCl_3 (Freon 113)
12. *cis*-ClCH=CHCl
13. $CHCl_3$
14. ? from CCl_4
15. CCl_4
16. ? from CCl_4
17. CH_3CH_2I
18. CH_2Br_2
19. $CHCl_2Br$
20. C_4F_9I
21. $CHClBr_2$
22. $CH_3CH_2CH_2I$



C532

Agilent Technologies

Dial 1-816-650-0621 for e-Seminar Audio

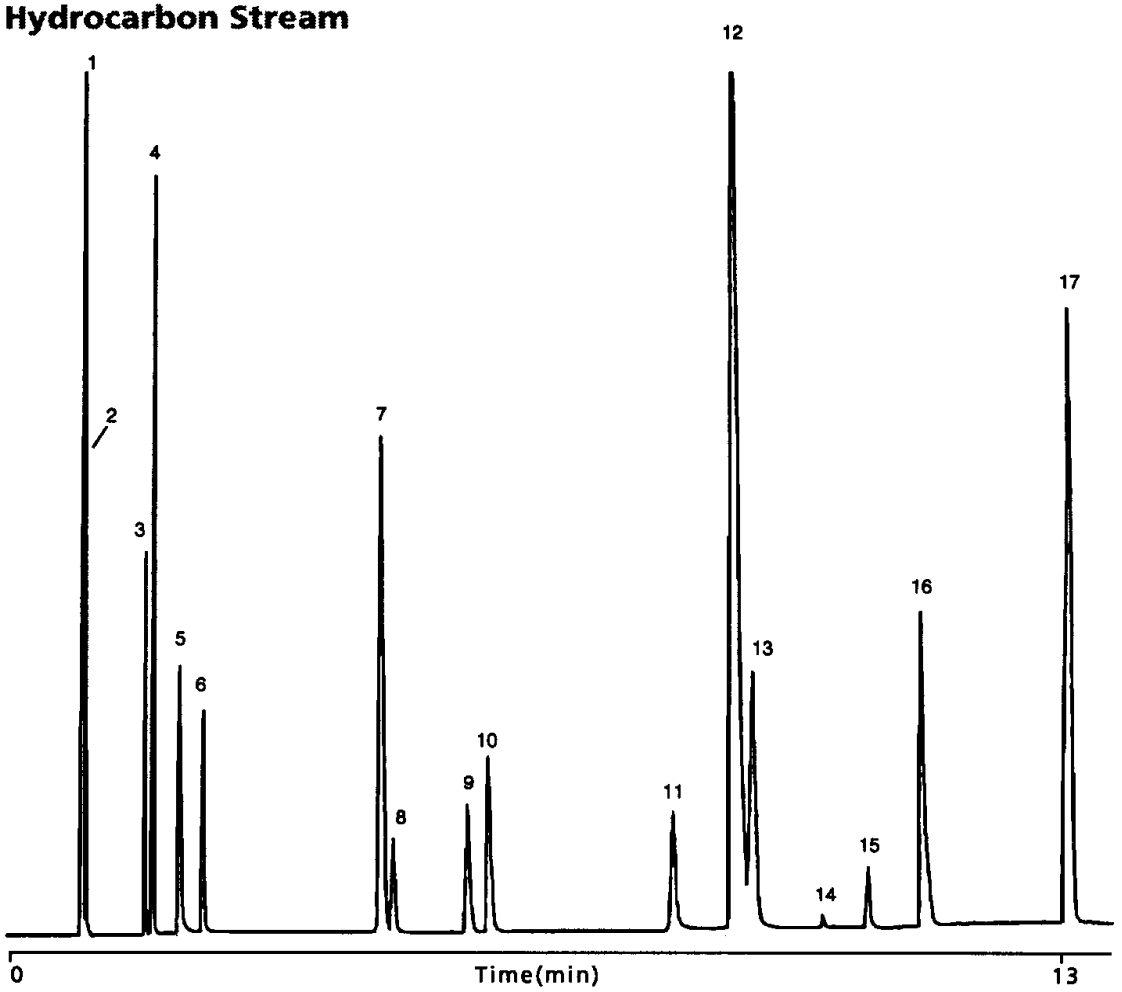
GS-GasPro

Excellent sensitivity for sulfur gases!

Sulfur Gases in Light Hydrocarbon Stream

Column: **GS-GasPro**
30 m x 0.32 mm I.D.
J&W P/N: **113-4332**
Carrier: Helium at 53 cm/sec
Oven: 25°C for 4 min
25 - 200°C at 10°/min
200°C Hold
Injector: 200 µL
Detector: TCD

1. Nitrogen
2. Methane
3. Ethane
4. CO_2
5. SF_6
6. Ethylene
7. COS
8. Acetylene
9. Propane
10. H_2S
11. Ethylene oxide/cyclopropane
12. Propylene
13. Propadiene
14. Isobutane
15. Butane
16. SO_2
17. Methyl acetylene



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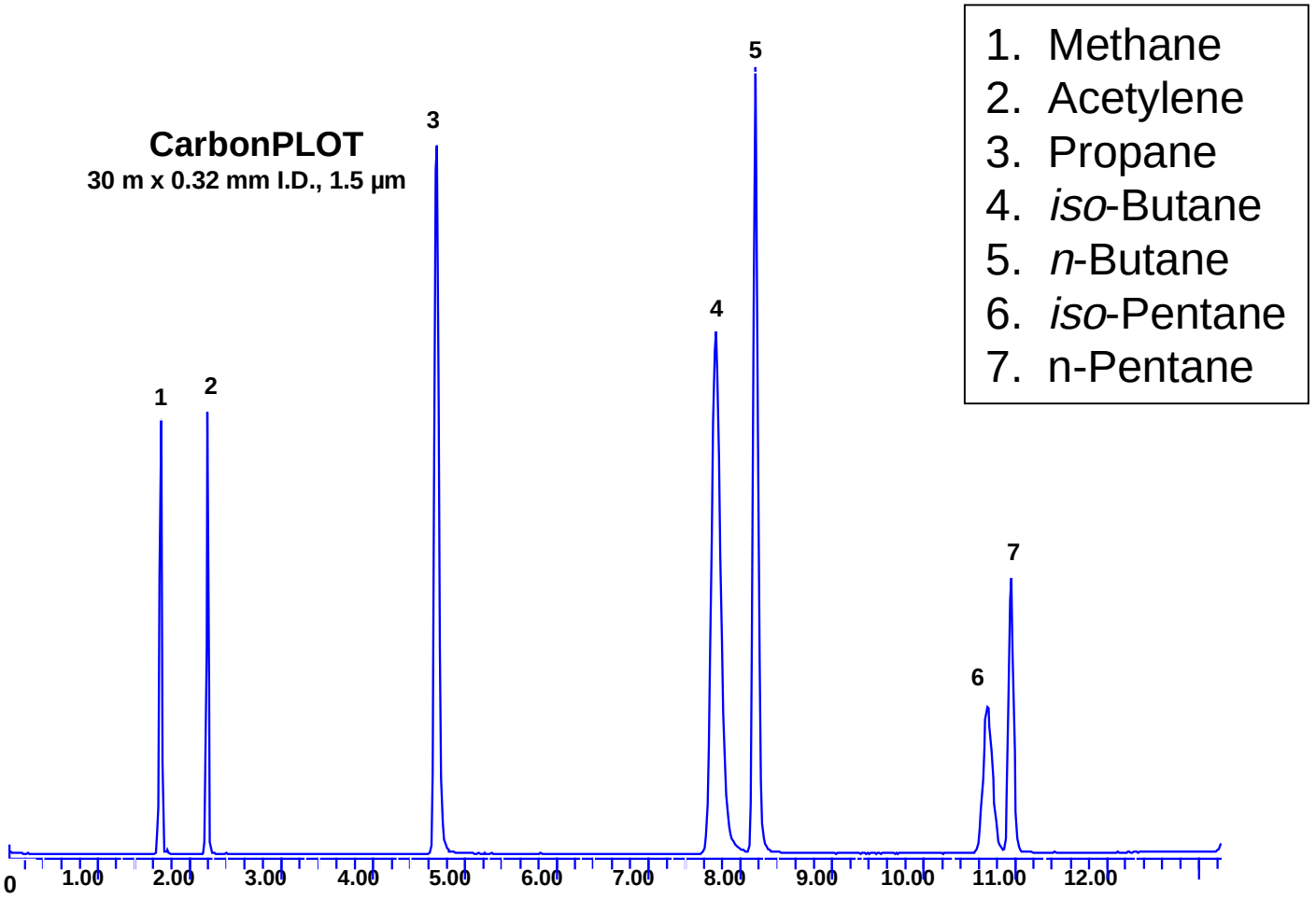
Dial 1-816-650-0621 for e-Seminar Audio

GS-CarbonPLOT

- Monolithic carbon molecular sieve
- Phase formed in situ-no particles
- Extended temperature limit of 360°C
- Unique selectivity
- Mass Spec friendly
- Better price

Natural Gas Mixture



1. Methane
2. Acetylene
3. Propane
4. *iso*-Butane
5. *n*-Butane
6. *iso*-Pentane
7. n-Pentane

Carbon-PLOT

Dial 1-816-650-0621 for e-Seminar Audio

Break Number 2

For Questions and Answers

Press *1 on Your Phone to

Ask a Question

New Selectivities and Application Specific Columns

- **HP Fast Residual Solvent Column**
- **DB-ALC1 & DB-ALC2; Blood Alcohols**
- **DB-MTBE; Resolves MTBE from the Methylpentanes**
- **DB-VRX; *The* Volatiles Column**
- **DB-HT SimDis; “Boiling Point” phase with 430C MAOT**
- **DB-TPH; Total Petroleum Hydrocarbons**
- **DB-Petro; PONA, PIANO and PNA analysis**
- **DB-Dioxin; dioxin analysis, resolves toxic congeners**
- **Chiral Columns**

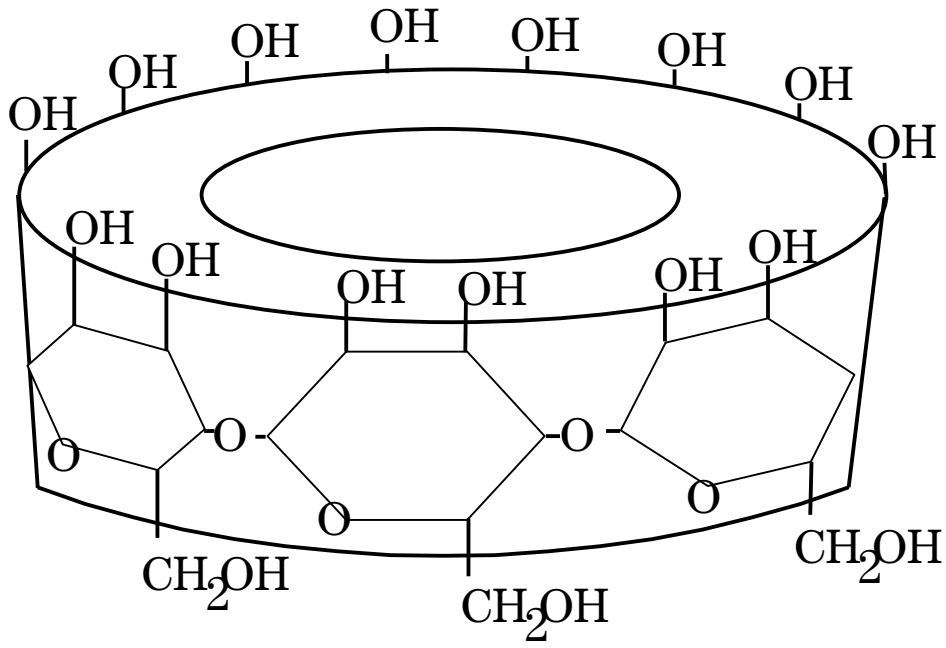
Chiral Columns

- **It is nearly impossible to predict success of separation of enantiomers on any given column**
- **CycloSil-B is a good general purpose column (“DB-5” of chiral columns)**
- **Trial and Error: We have money-back guarantee if column doesn’t do separation**

Chiral Columns

- We have two different, but similar, types of chiral stationary phases. Both are derivatized beta-cyclodextrins
- CycloSil-B: silane modified
- Cyclodex-B: permethylated
- HP Chiral -10 and -20 ß: permethylated

Structure and Properties of ß- Cyclodextrin



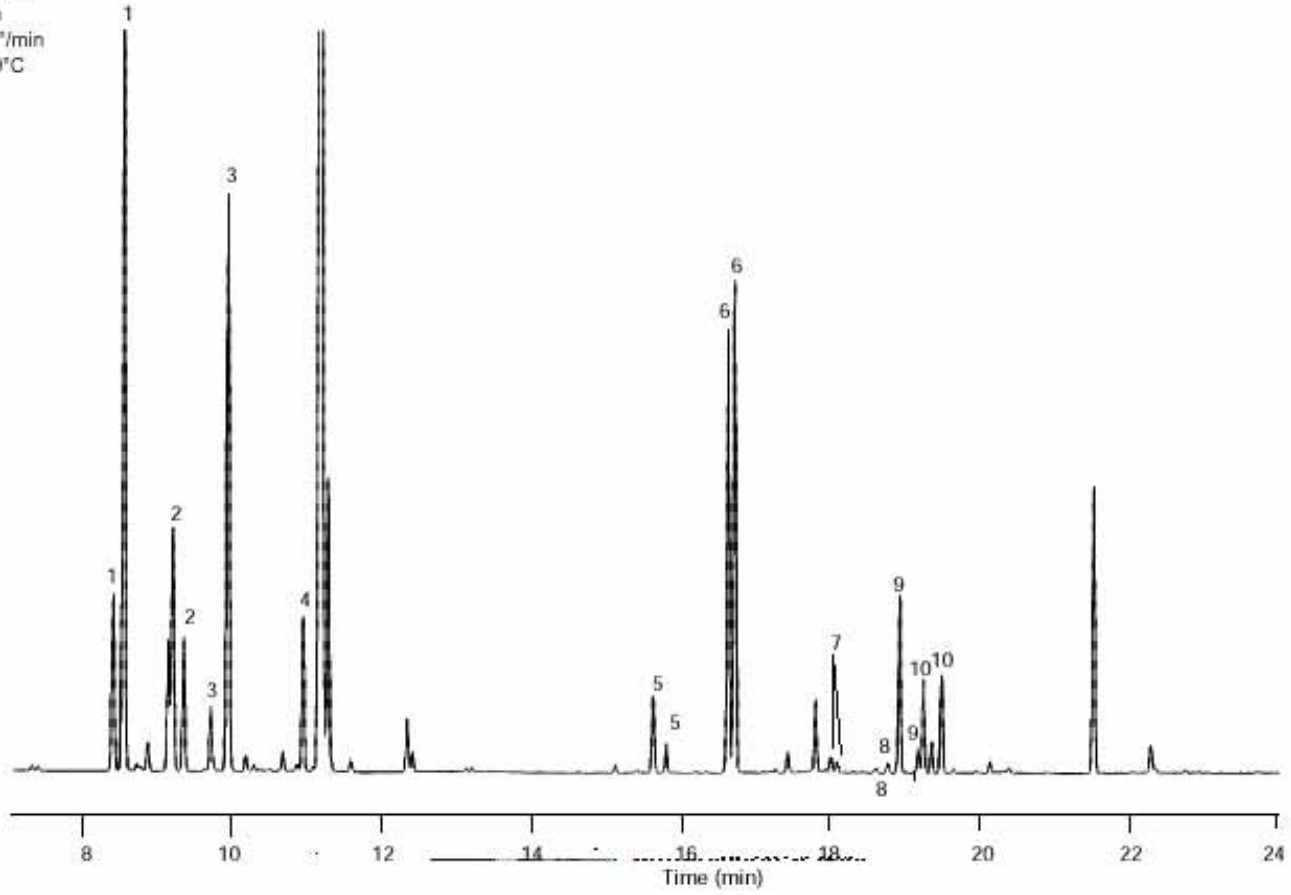
7 Glucose molecules joined through 1,4-glycosidic linkages
Primary hydroxyl groups partially block the base
Cavity size is about 6-6.5 Å in diameter
Hydroxy groups are peralkylated

CycloSil-B

Rosemary Oil

Column: **CycloSil-B**
30 m x 0.25 mm I.D., 0.25 µm
J&W P/N: **122-6632**
Carrier: Hydrogen at 40 cm/sec, measured at 60°C
Oven: 55°C for 1 min
55-180°C at 5°/min
Injector: Split 50:1, 250°C
Detector: FID, 340°C

1. (+/-) α-Pinene
2. (+/-) Camphene
3. (+/-) β-Pinene
4. (+/-) Limonene
5. (+/-) Linalool
6. (+/-) Camphor
7. (+/-) Terpinene-4-ol
8. (+/-) Isoborneol
9. (+/-) Borneol
10. (+/-) α-Terpineol



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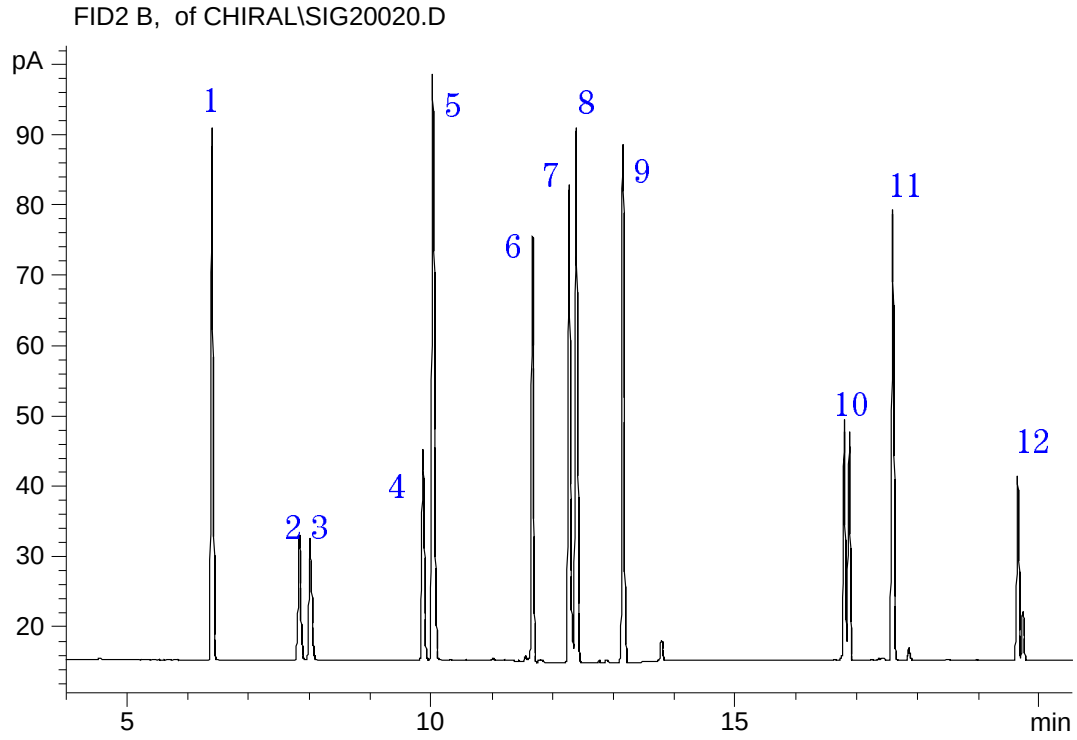
Chiral Separation- Oils & Fragrances



Carrier: **Hydrogen, 36 cm/sec, Constant pressure**

Oven: **50 C (2 min) to 143 C at 5 C/min**
Injection: **Split (ratio 30:1), 1 µl, Inj Temp 250 C**
Detection: **FID, Det Temp 300 C**

Sample: **0.25 ng/µl each analyte in Hexane**

HP Chiral-20 β

30m X 0.25mm X 0.25cm

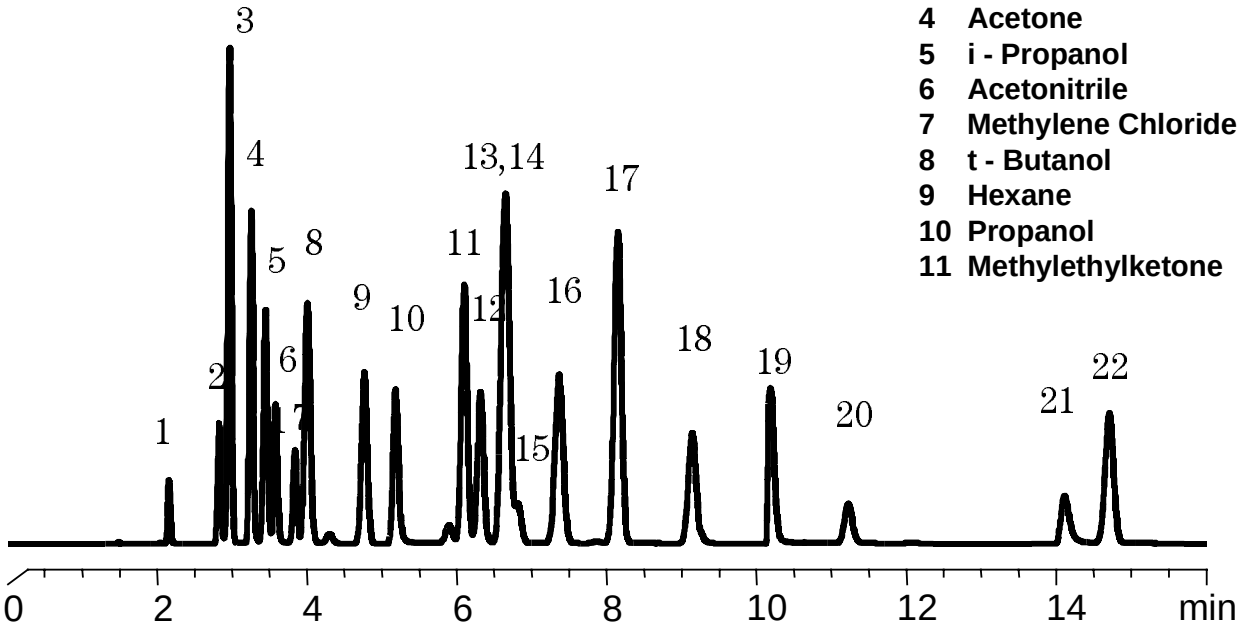
P/N 19091G-B233

Components:

1. nonane
2. (+) 3,3-Dimethyl-2-butanol
3. (-) 3,3-Dimethyl-2-butanol
4. (1S)-(-)-alpha-pinene
5. (1R)-(+)-alpha-pinene
6. α–Terpinene
7. (S)-(-)-Limonene
8. (R)-(+)-Limonene
9. γ–Terpinene
10. (+/-)-Linalool
11. (-)-Menthone
12. (+/–)–α–Terpinen-4-ol

Dial 1-816-650-0621 for e-Seminar Audio

Headspace Analysis of Common Solvents on HP-624



1 Methanol
2 Ethanol
3 Ether
4 Acetone
5 i - Propanol
6 Acetonitrile
7 Methylene Chloride
8 t - Butanol
9 Hexane
10 Propanol
11 Methylethylketone
12 Ethylacetate
13 Tetrahydrofuran
14 s - Butanol
15 Chloroform
16 Cyclohexane
17 Benzene
18 Heptane
19 Trichloroethylene
20 1,4 - Dioxane
21 Pyridine
22 Toluene

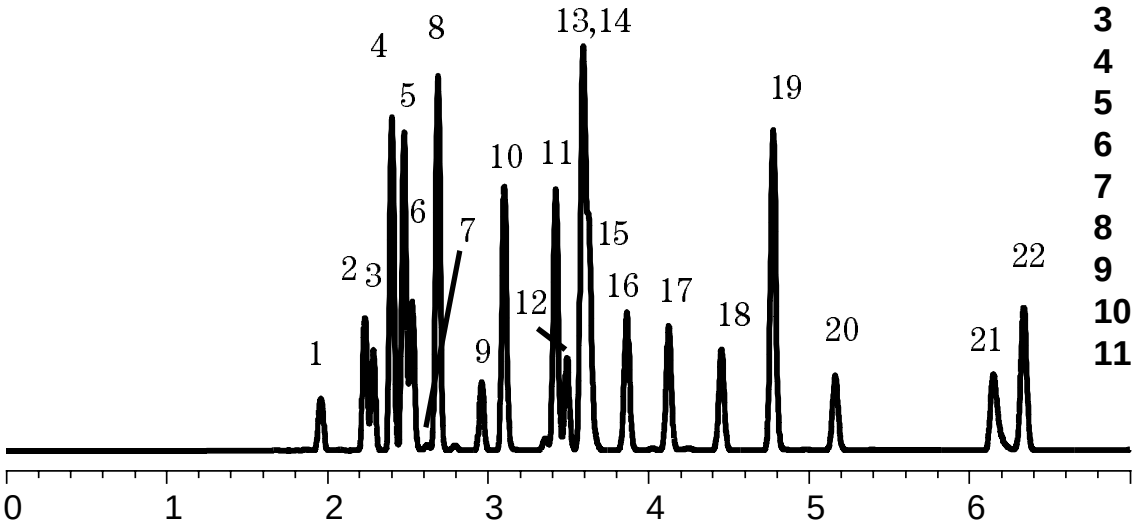
Column: HP-624, 30 m x 0.53 mm x 3.0 um (HP Part No. 19095V-423)
Carrier: Helium, 35 cm/sec, Constant Flow
Oven: 40 C (5 min) to 90 C at 2 C/min
90 C to 250 C at 30 C/min
Injection: Headspace, 180 C, Split 7/1
Detector: FID, 260 C

Headspace Conditions:
Carrier Gas Pressure: 3.5 psi
Oven Temp: 85 C
Loop Temp: 95 C
Transfer Line Temp: 110 C
Vial Pressure: 10 psi

Vial Equilibration Time: 10 min
Pressurization Time: 0.2 min
Loop Fill Time: 0.15 min
Loop Equilibration Time: 0.05 min
Injection Time: 1.00 min

Dial 1-816-650-0621 for e-Seminar Audio

Headspace Analysis of Common Solvents on Fast Residual Solvent Column



1	Methanol	12	Ethylacetate
2	Ethanol	13	Tetrahydrofuran
3	Ether	14	s-Butanol
4	Acetone	15	Chloroform
5	i-Propanol	16	Cyclohexane
6	Acetonitrile	17	Benzene
7	Methylene Chloride	18	Heptane
8	t-Butanol	19	Trichloroethylene
9	Hexane	20	1,4-Dioxane
10	Propanol	21	Pyridine
11	Methylethylketone	22	Toluene

GC: 6890
Column: HP-Fast Residual Solvent Column (HP Part No. 19095V-420)
Carrier: Helium, 30 cm/sec, Constant Flow
Oven: 40 C (1.7 min) to 90 C at 6 C/min
90 C to 250 C at 30 C/min
Injection: Headspace, 180 C, Split 7/1
Detector: FID, 260 C

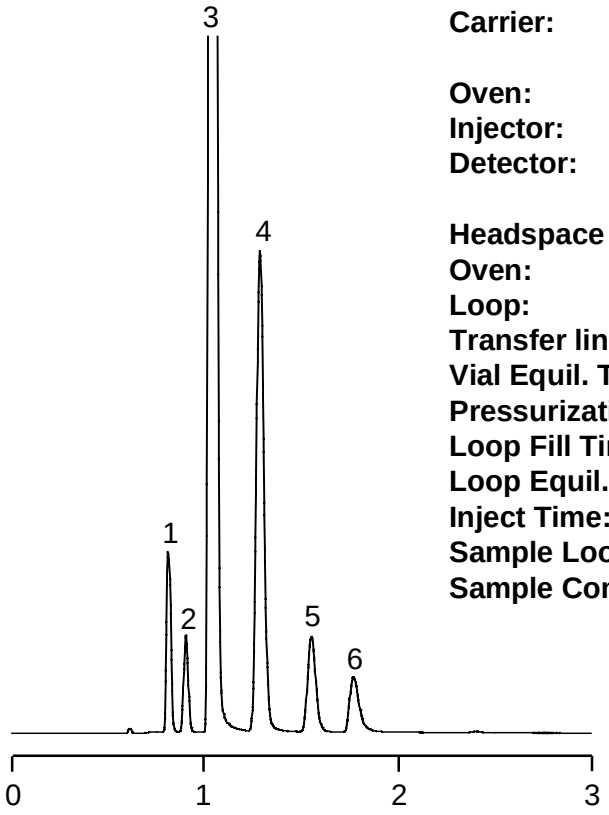
Headspace Conditions:
Carrier Gas Pressure: 3.5 psi
Oven Temp: 85 C
Loop Temp: 95 C
Transfer Line Temp: 110 C
Vial Pressure: 10 psi

Vial Equilibration Time: 10 min
Pressurization Time: 0.2 min
Loop Fill Time: 0.15 min
Loop Equilibration Time: 0.05 min
Injection Time: 1.00 min

Dial 1-816-650-0621 for e-Seminar Audio

DB-ALC1 & DB-ALC2

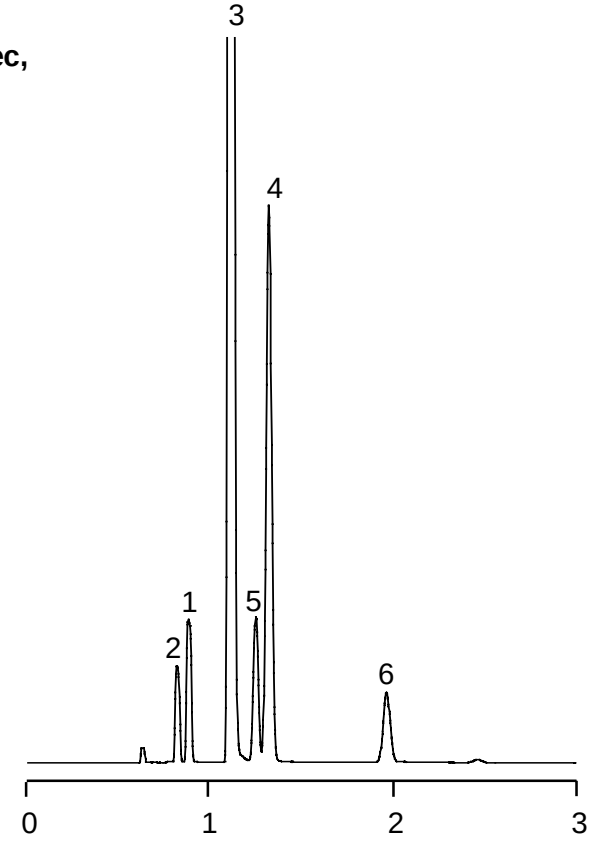
Analysis of Blood Alcohols in 2 minutes!



DB-ALC1
30m x 0.53mm I.D., 3µm

GC Conditions	
Carrier:	Helium at 80 cm/sec, measured at 40°C
Oven:	40°C Isothermal
Injector:	Split 1:10, 250°C
Detector:	FID, 300°C
Headspace Conditions	
Oven:	70°C
Loop:	80°C
Transfer line:	90°C
Vial Equil. Time:	10 min
Pressurization Time:	0.20 min
Loop Fill Time:	0.20 min
Loop Equil. Time:	0.05 min
Inject Time:	0.2 min
Sample Loop Size:	1.0 mL
Sample Composition:	0.1% ethanol, 0.001% others

1. Methanol
2. Acetaldehyde
3. Ethanol
4. Isopropanol
5. Acetone
6. 1-propanol



DB-ALC2
30m x 0.53mm I.D., 2µm

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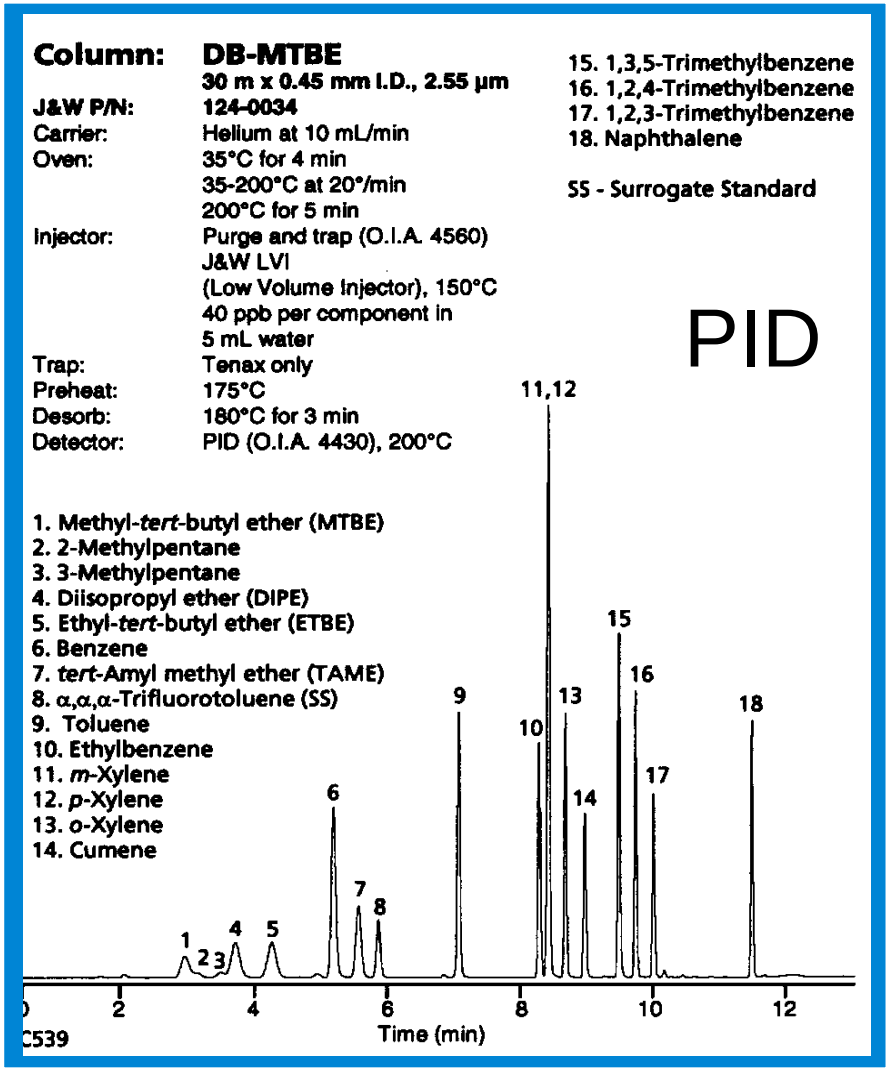
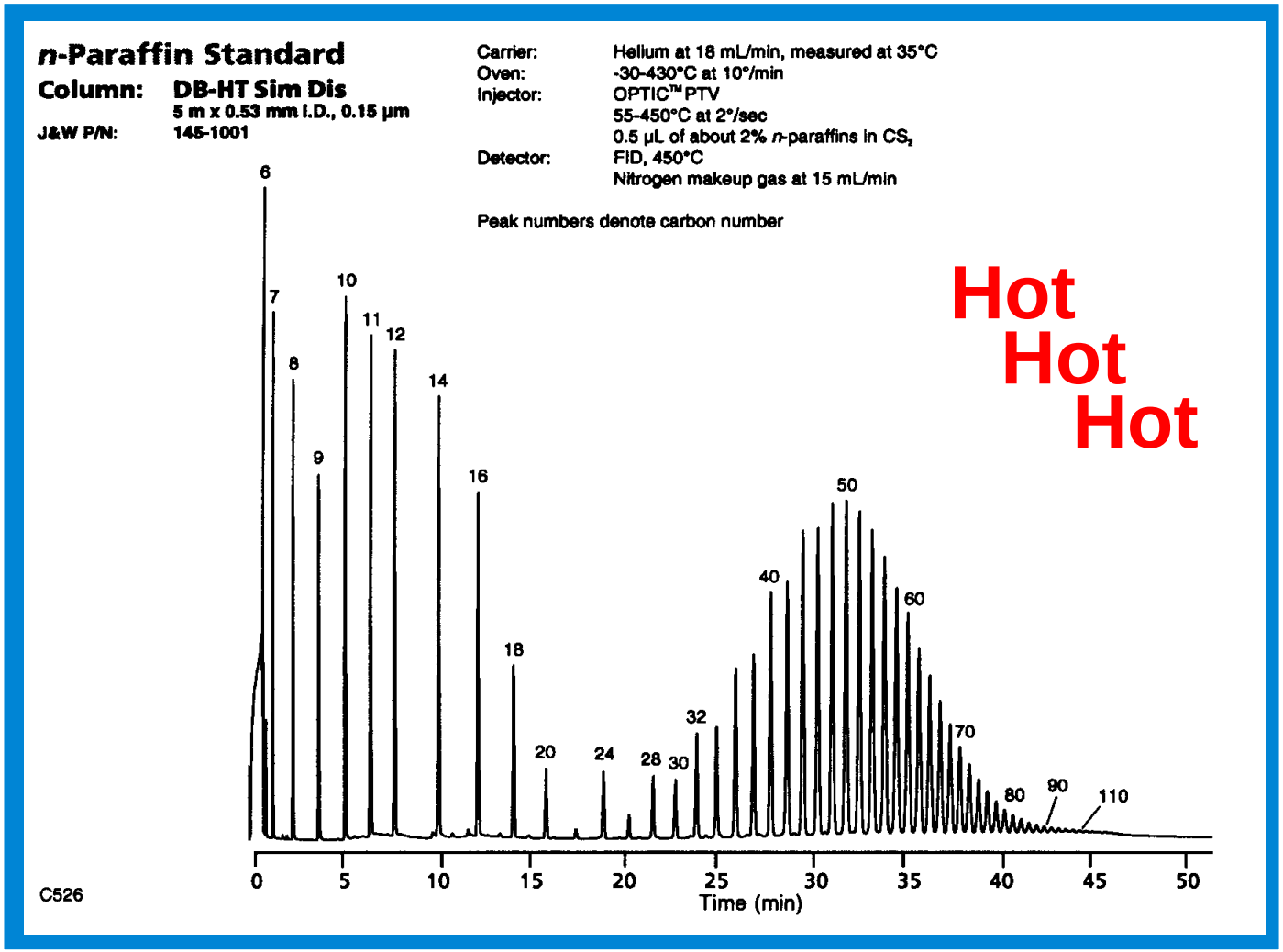
DB-MTBE



Resolves the Pentanes from MTBE!

DB-HT Sim Dis


n-Paraffin Standard
Column: DB-HT Sim Dis
5 m x 0.53 mm I.D., 0.15 µm
J&W P/N: 145-1001
Carrier: Helium at 18 mL/min, measured at 35°C
Oven: -30-430°C at 10°/min
Injector: OPTIC™ PTV
55-450°C at 2°/sec
0.5 µL of about 2% n-paraffins in CS2
Detector: FID, 450°C
Nitrogen makeup gas at 15 mL/min
Peak numbers denote carbon number
Hot
Hot
Hot
6
7
8
9
10
11
12
14
16
18
20
24
28
30
32
40
50
60
70
80
90
110
0
5
10
15
20
25
30
35
40
45
50
Time (min)
C526

DB-VRX: The Volatiles Column

Column: **DB-VRX**

75 m x mm.45 mm I.D., 2.55 µm

J&W P/N: **124-1574**

Carrier: Helium at 9 mL/min, measured at 35°C

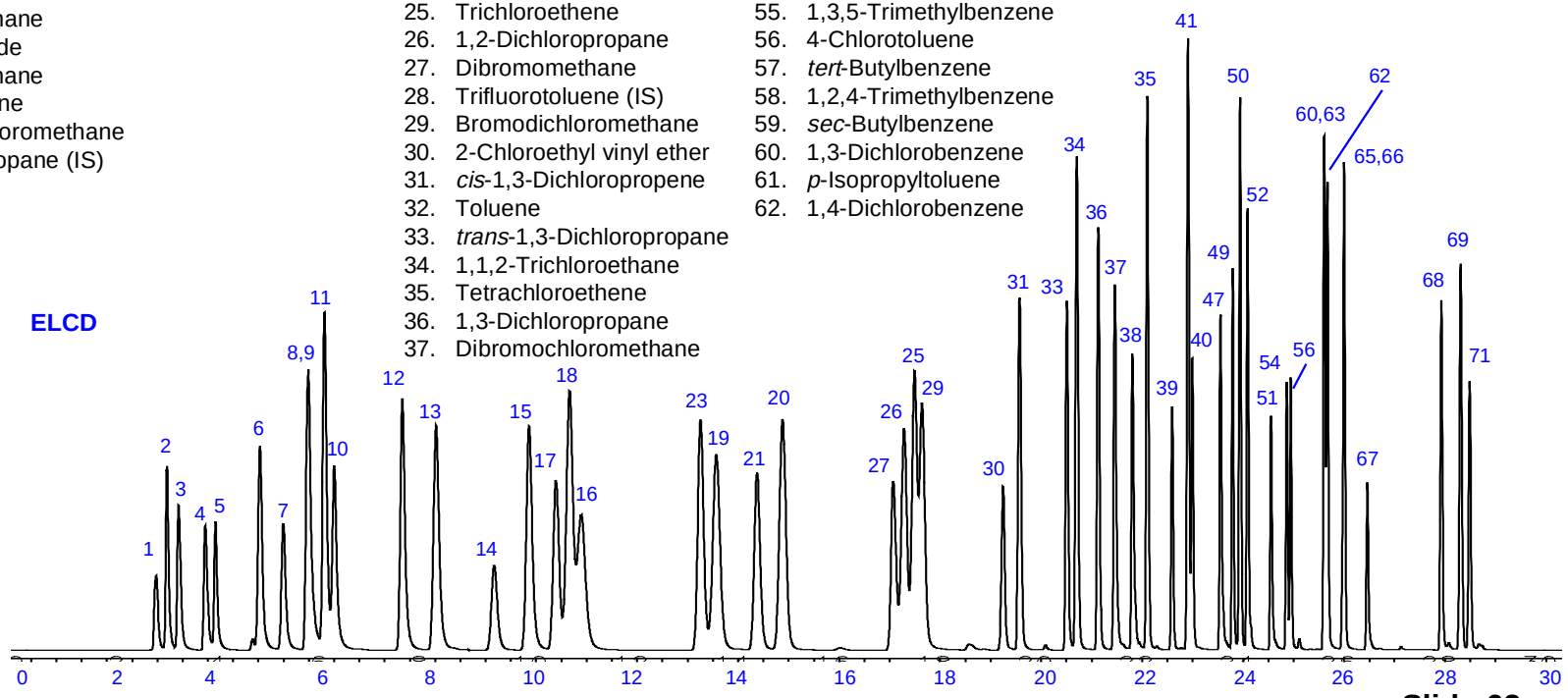
Oven: 35°C for 12 min
35-60°C at 5°/min
60°C for 1 min
60-200°C at 17°/min
200°C for 5 min

Injector: Purge and trap (O.I.A 4560)
J&W LVI, 150°C
20 ppb per component in 5 mL water

Trap: VOCARB™3000

Detector: ELCD (O.I.A. 4430), with NiCat™ reaction tube in the halogen mode, 950°C reactor temperature

1. Dichlorodifluoromethane
2. Chloromethane
3. Vinyl chloride
4. Bromomethane
5. Chloroethane
6. Trichlorofluoromethane
7. 2-Chloropropane (IS)
8. 1,1-Dichloroethene
9. Iodomethane
10. Allyl chloride
11. Methylene chloride
12. *trans*-1,2-Dichloroethene
13. 1,1-Dichloroethane
14. Chloroprene
15. *cis*-1,2-Dichloropropane
16. 2,2-Dichloropropane
17. Bromochloromethane
18. Chloroform
19. 1,1,1-Trichloroethane
20. Carbon tetrachloride
21. 1,1-Dichloropropene
22. Benzene
23. 1,2-Dichloroethane
24. Fluorobenzene (IS)
25. Trichloroethene
26. 1,2-Dichloropropane
27. Dibromomethane
28. Trifluorotoluene (IS)
29. Bromodichloromethane
30. 2-Chloroethyl vinyl ether
31. *cis*-1,3-Dichloropropene
32. Toluene
33. *trans*-1,3-Dichloropropane
34. 1,1,2-Trichloroethane
35. Tetrachloroethene
36. 1,3-Dichloropropane
37. Dibromochloromethane
38. 1,2-Dibromoethane
39. 1-Chloro-3-fluorobenzene (IS)
40. Chlorobenzene
41. 1,1,1,2-Tetrachloroethane
42. Ethylbenzene
43. *m*-Xylene
44. *p*-Xylene
45. Styrene
46. *o*-Xylene
47. Bromoform
48. Isopropylbenzene
49. *cis*-1,4-Dichlorobutene
50. 1,1,2,2-Tetrachloroethane
51. Bromobenzene
52. 1,2,3-Trichloropropane
53. *n*-Propylbenzene
54. 2-Chlorotoluene
55. 1,3,5-Trimethylbenzene
56. 4-Chlorotoluene
57. *tert*-Butylbenzene
58. 1,2,4-Trimethylbenzene
59. *sec*-Butylbenzene
60. 1,3-Dichlorobenzene
61. *p*-Isopropyltoluene
62. 1,4-Dichlorobenzene
63. Benzyl chloride
64. *n*-Butylbenzene
65. 1,2-Dichlorobenzene
66. *Bis* (2-Chloroisopropyl) ether
67. 1,2-Dibromo-3-chloropropane
68. 1,2,4-Trichlorobenzene
69. Hexachlorobutadiene
70. Naphthalene
71. 1,2,3-Trichlorobenzene



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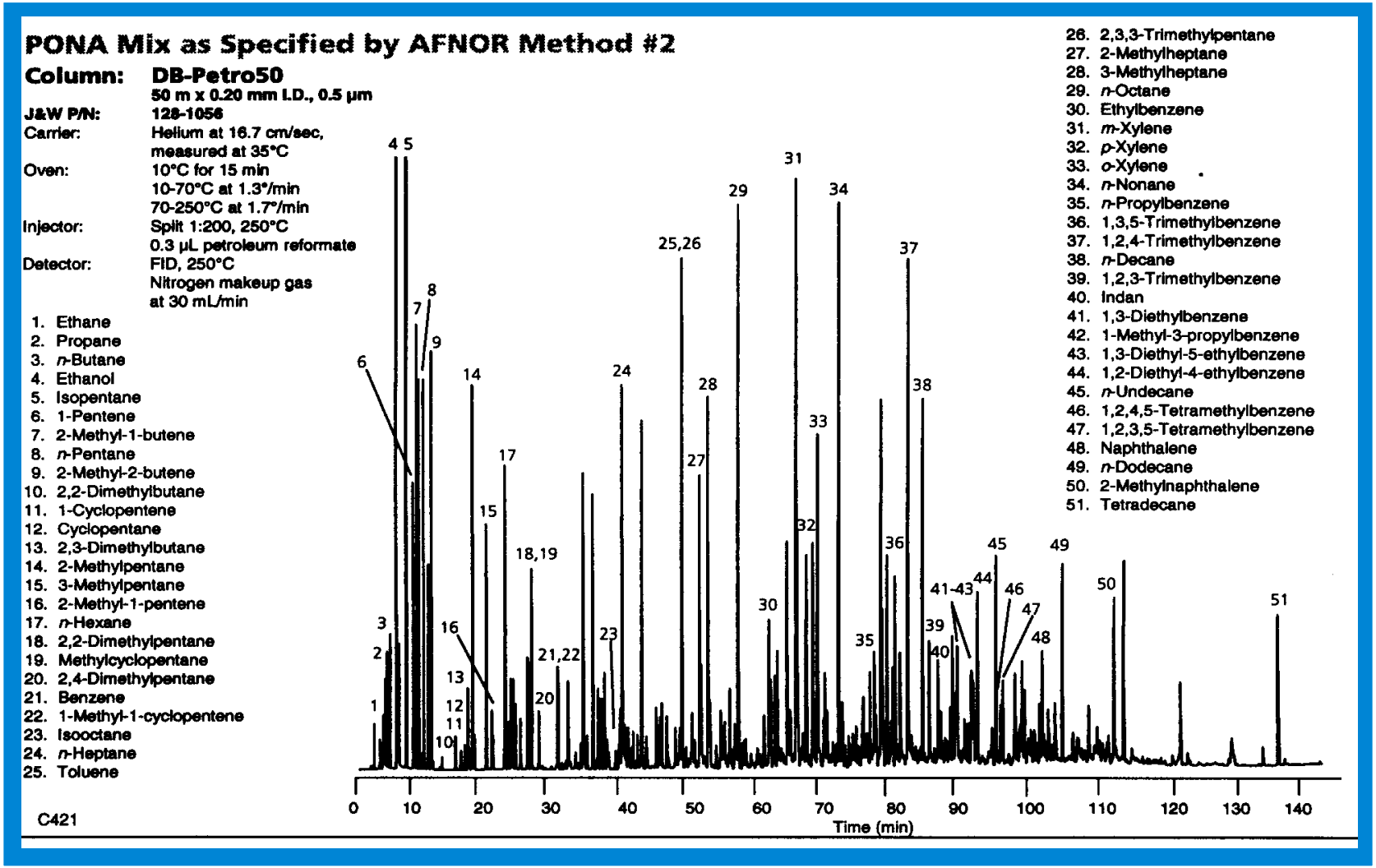
DB-Petro50

Exceeds all ASTM and AFNOR requirements for PONA analysis



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Dial 1-816-650-0621 for e-Seminar Audio

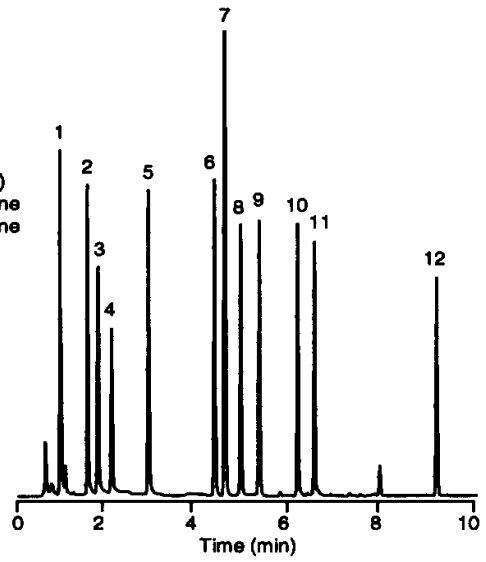
DB-TPH

High Throughput TPH Screening

Purge and Trap of BTEX Standard using FID

Column:	**DB-TPH**
	30 m x 0.45 mm I.D., 1.0 µm
J&W P/N:	**124-1632**
Carrier:	Helium at 67 cm/sec, measured at 40°C
Oven:	40°C for 2 min
	40-260°C at 12°/min
Injector:	Purge and trap (O.I.A. 4560)
	J&W Low Volume Injector (LVI)
Purge:	15 min at 85°C
Trap:	BTEX (Supelco) at 50°C during purge
Desorb:	2 min at 260°C
Detector A:	FID, 250°C

1. 2-Methylpentane
2. Benzene
3. Isooctane
4. Trifluorotoluene (IS)
5. Toluene
6. Ethylbenzene
7. *m,p*-Xylene
8. *o*-Xylene
9. Isopropylbenzene (IS)
10. 1,3,5-Trimethylbenzene
11. 1,2,4-Trimethylbenzene
12. Naphthalene



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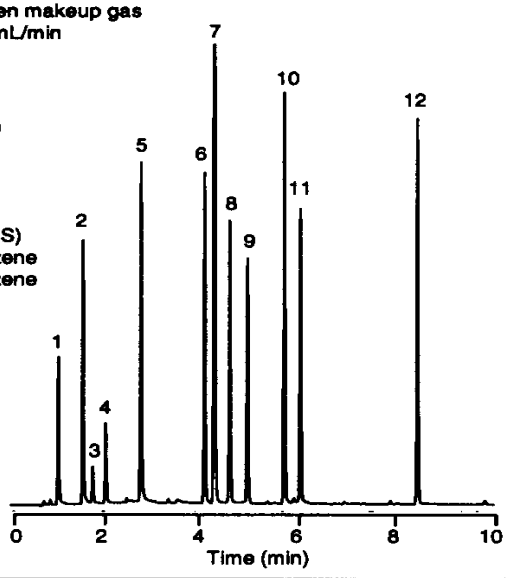
Purge and Trap of BTEX Standard using PID

Column:	**DB-TPH**
	30 m x 0.45 mm I.D., 1.0 µm
J&W P/N:	**124-1632**
Carrier:	Helium at 67 cm/sec, measured at 40°C
Oven:	40°C for 2 min
	40-260°C at 12°/min
Injector:	Purge and trap (O.I.A. 4560)
	J&W Low Volume Injector (LVI)
Purge:	15 min at 85°C
Trap:	BTEX (Supelco) at 50°C during purge
Desorb:	2 min at 260°C
Detector B:	PID, 200°C
	Nitrogen makeup gas
	at 30 mL/min

1. 2-Methylpentane
2. Benzene
3. Isooctane
4. Trifluorotoluene (IS)
5. Toluene
6. Ethylbenzene
7. *m,p*-Xylene
8. *o*-Xylene
9. Isopropylbenzene (IS)
10. 1,3,5-Trimethylbenzene
11. 1,2,4-Trimethylbenzene
12. Naphthalene



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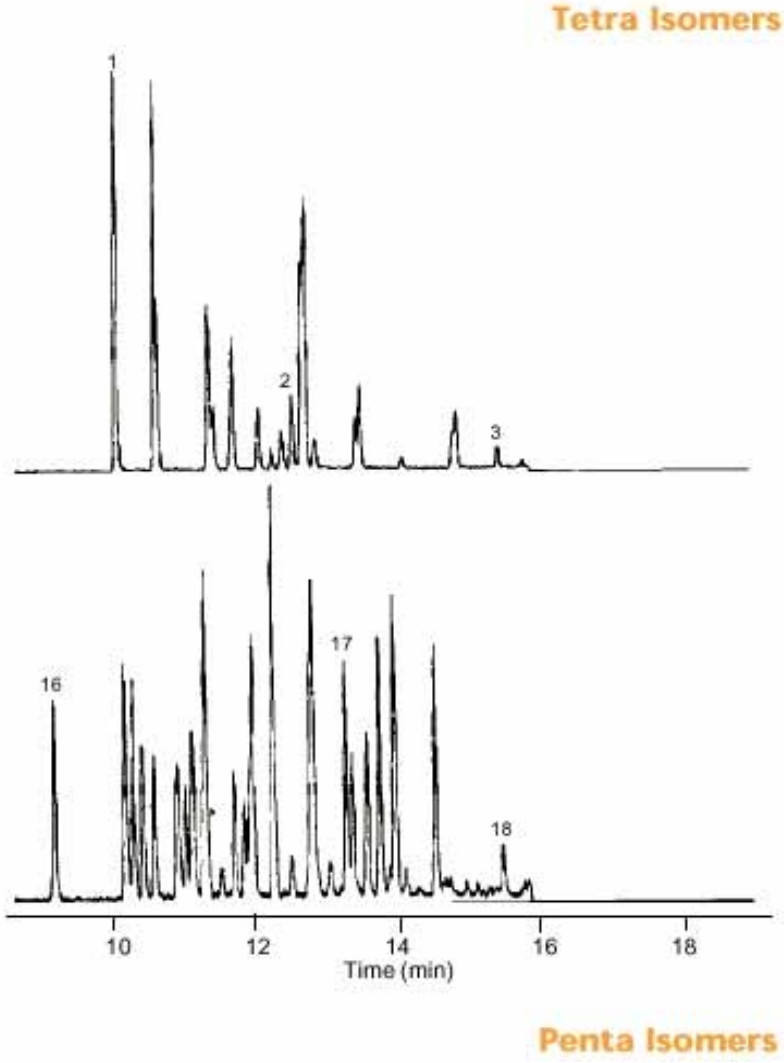
Dial 1-816-650-0621 for e-Seminar Audio

DB-Dioxin

Dioxins and Furans

Column: **DB-Dioxin**
60 m x 0.25 mm I.D., 0.15 µm
J&W P/N: **122-2461**
Carrier: Helium at 34.3 cm/sec, measured at 250°C
Oven: 180°C for 1 min
180-270°C at 2.5°/min
270°C for 40 min

1. 1,3,6,8-TCDD
2. 2,3,7,8-TCDD
3. 1,2,8,9-TCDD
4. 1,2,4,6,8-/1,2,4,7,9-PeCDD
5. 1,2,3,7,8 + unknown-PeCDD
6. 1,2,4,8,9-PeCDD
7. 1,2,4,6,7,9-/1,2,4,6,8,9-HeCDD
8. 1,2,3,4,7,8-HeCDD
9. 1,2,3,4,6,9-HeCDD
10. 1,2,3,6,7,8-HeCDD
11. 1,2,3,7,8,9-HeCDD
12. 1,2,3,4,6,7-HeCDD
13. 1,2,3,4,6,7,9-HpCDD
14. 1,2,3,4,6,7,8-HpCDD
15. OcCDD
16. 1,3,6,8-TCDF
17. 2,3,7,8-TCDF
18. 1,2,8,9-TCDF
19. 1,3,4,6,8-PeCDF
20. 1,2,3,4,8-PeCDF
21. 1,2,3,7,8-PeCDF
22. 1,2,3,4,6-PeCDF
23. 2,3,4,7,8-PeCDF
24. 1,2,3,8,9-PeCDF
25. 1,3,4,6,7,9-HeCDF
26. 1,2,3,4,7,8/1,2,4,6,8,9-HeCDF
27. 1,2,3,6,7,8-HeCDF
28. 2,3,4,6,7,8-HeCDF
29. 1,2,3,7,8,9-HeCDF
30. 1,2,3,4,8,9-HeCDF
31. 1,2,3,4,6,7,8-HpCDF
32. 1,2,3,4,7,8,9-HpCDF
33. OcCDF



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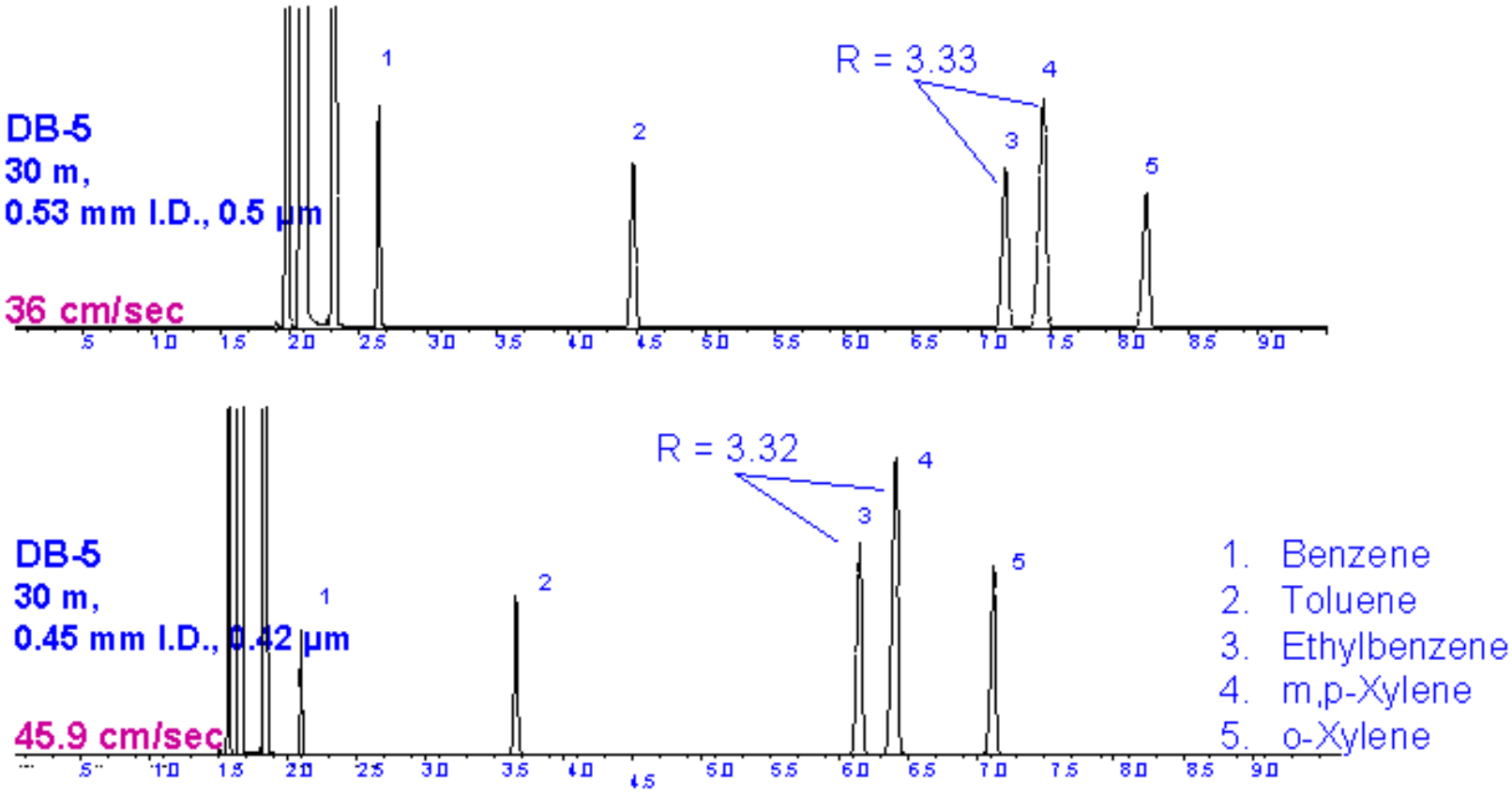
Dial 1-816-650-0621 for e-Seminar Audio

High Resolution Megabore

- **Same Outer Diameter as the Megabore**
- **No Special Hardware Required**
- **Smaller Inner Diameter (0.45mm)**
- **Maintain Phase Ratio (Beta)**
- **Methods are easy to translate!**

High Resolution Megabore
Same Resolution - Faster Analysis!



BTEX
Carrier: Helium
Oven : 40°C for 3 min, 5°/min to 100°C

Dial 1-816-650-0621 for e-Seminar Audio

Summary

- **Column deactivation chemistries improved.**
  - **enhanced acidic and basic analyte sensitivities**
  - **column chemistries optimized for specific applications**

- **Stationary phases optimized to extend max temp limit & lower bleed, extend minimum temperature limits, and improve physical & chemical stability.**

- **New selectivities/ applications**

Wrap-up E-Seminar Questions

Thank you for attending Agilent e-Seminars. Our e-Seminar schedule is expanding every week. Please check our website frequently at:

www.agilent.com