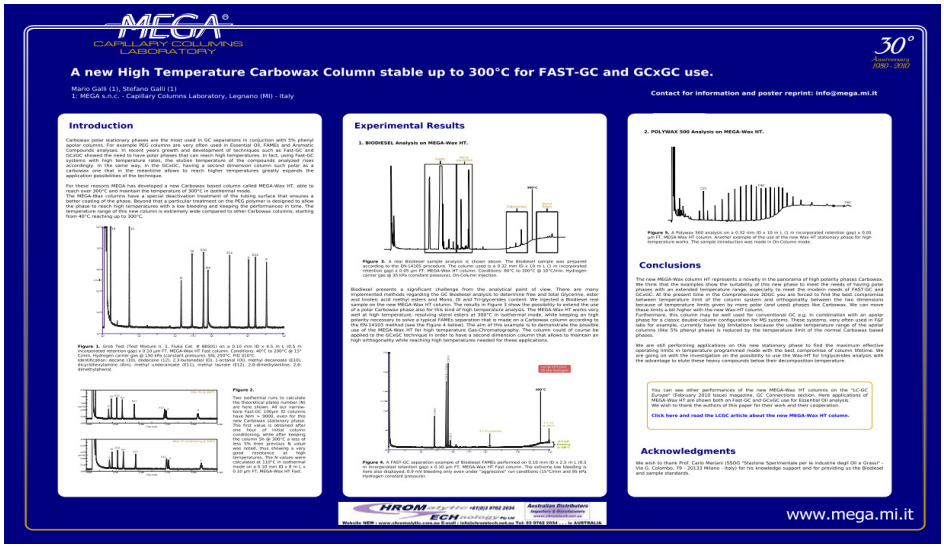
MEGA Columns 2014

MEGA WAX-HT
300degC Max



- *MEGA 2012 Chromatograms*
- 2014 MEGA Catalog

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new

mega 5-MS Xil™

improve Your GC-MS analysis

since 1980

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Grob Test

The new MEGA-5 MS Xil is a new low-bleeding stationary phase ideal for GC-MS applications.

The MEGA-5 MS Xil is a low polar phase with a selectivity equivalent to the 5% diphenyl - 95% methylpolysiloxane available columns, developed to assure the minimal bleeding at high temperatures.

mega 5-MS Xil™
ultra-low bleeding column

Extremely low-bleeding, outstanding inertness, high long-term performances are the main features of this new column.

For over 30 years, MEGA has guaranteed excellent quality and high reproducibility. We produce and test one by one every single column using the original Grob Test mix as quality assurance test.

The new MEGA-5 MS Xil is available in the most classical GC-MS dimensions but also in the new configuration with the 0.15mm I.D. tubing, one of the best compromise between resolution power and faster GC analysis.
As with all our other products, you can ask us to make the MEGA-5 MS Xil phase with completely custom dimensions and configurations. Please contact us at info@mega.mi.it.

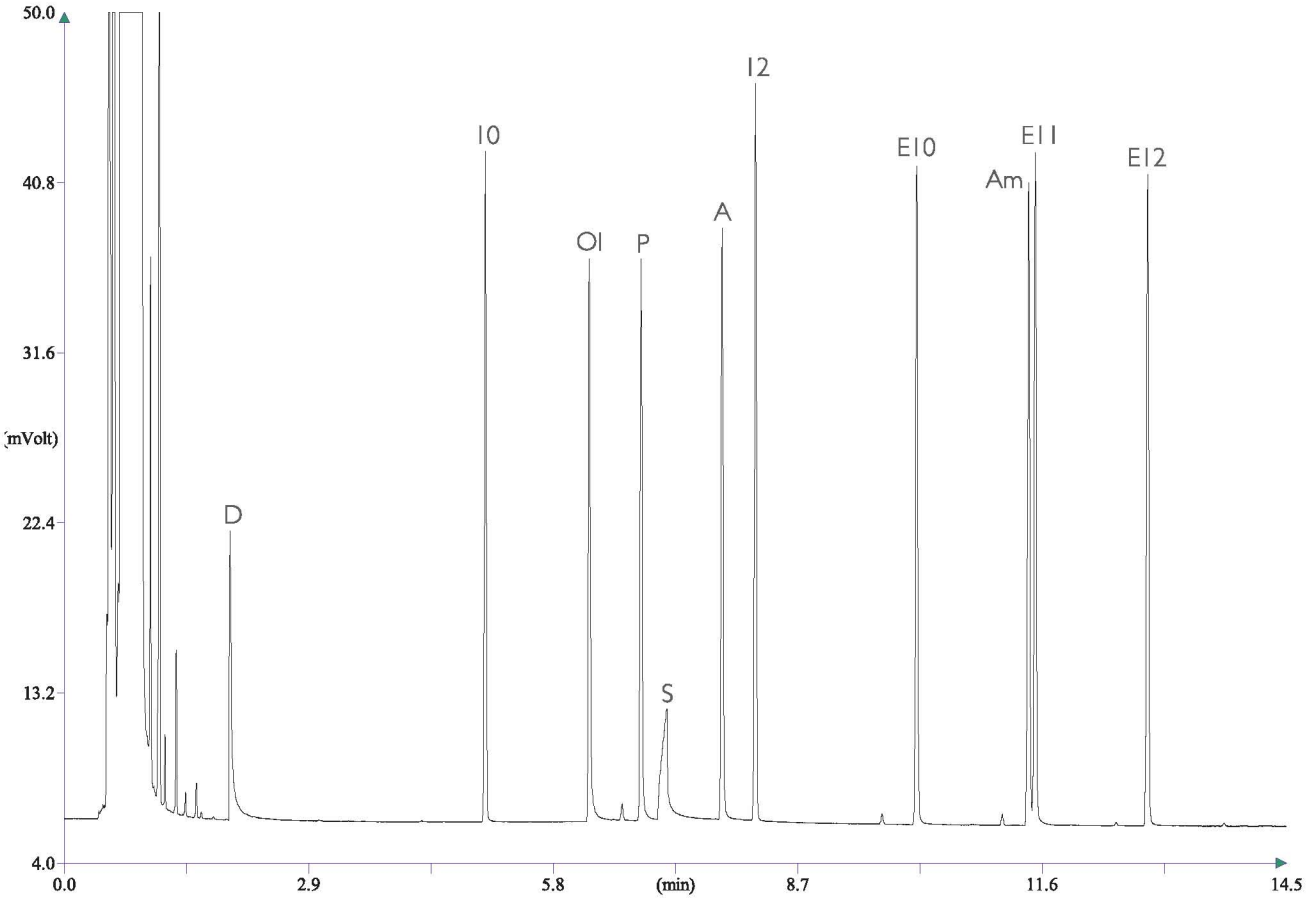

Figure 1. Grob Test chromatogram performed with the new MEGA-5 MS Xil 0.25mm, 0.25µm, 30m.
The test conditions were: 40°C - 200°C @ 10°C/min, Hydrogen carrier gas @ 80kPa (constant pressure), Split injector (250°C) with split ratio 1:20, 1µL injection volume, FID detector (250°C).
Grob Test Mix (Fluka cat. # 86501) composition: 2,3-Butanediol (D), Decane (10), 1-Octanol (Ol), 2,6-Dimethylphenol (P), 2-Ethylcaproic acid (S), 2,6-Dimethylaniline (A), Dodecane (12), methyl Decanoate (E10), Dicyclohexylamine (Am), methyl Undecanoate (E11), methyl Laurate (E12).

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Bleeding

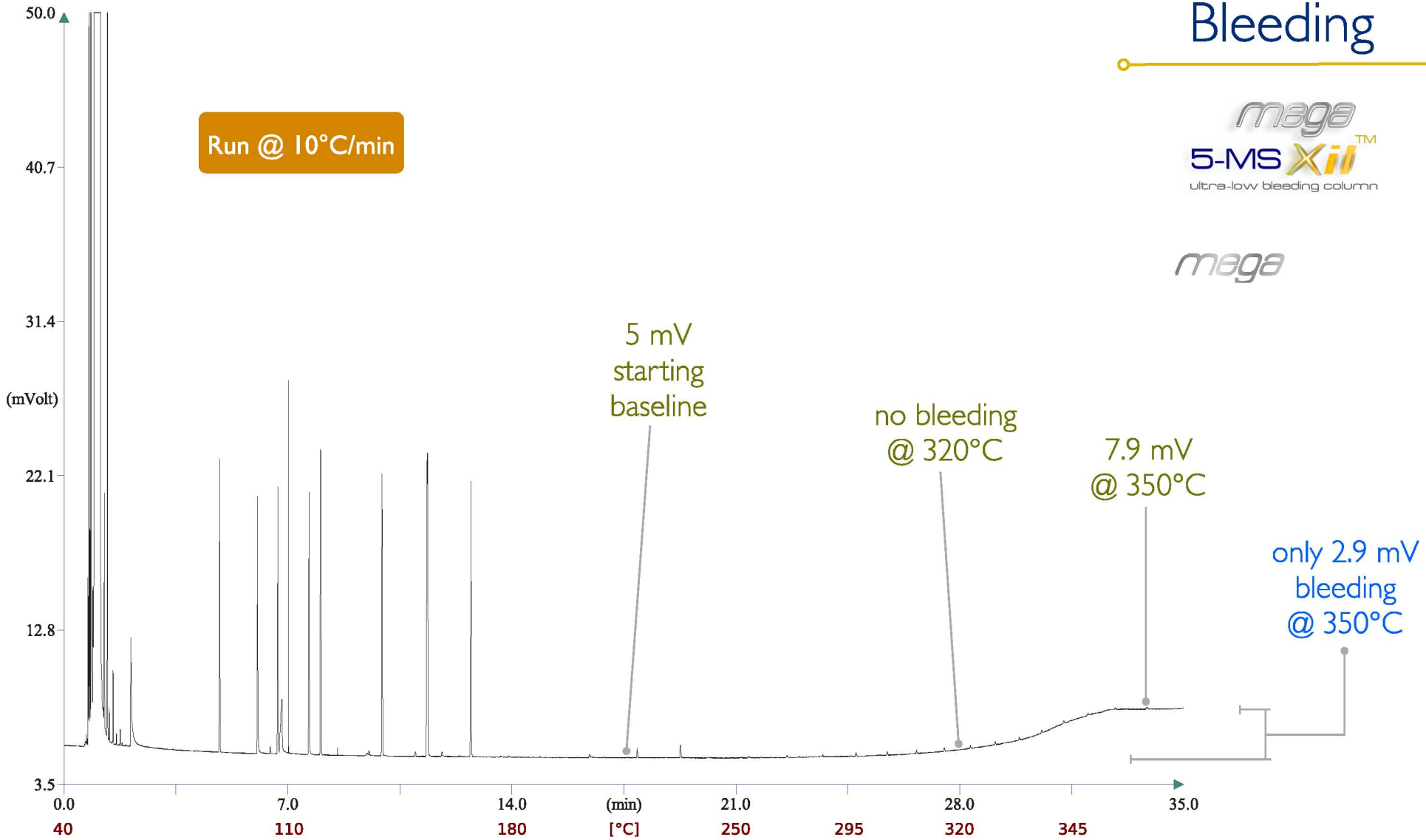

Figure 2. A Grob Test run performed on the new MEGA-5 MS Xil 0.25mm, 0.25µm, 30m is shown to highlight the bleeding level. Even with a temperature rate of 10°C/min (from 40°C to 350°C) the bleeding remains extremely low. The chromatogram shows a very flat baseline with no bleeding at 320°C and a minimal growth of the signal at the end of the analysis at high temperature (350°C).

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POCs

mega 5-MS Xil™ ultra-low bleeding column

1. Etridiaziole
2. Chloroneb
3. Propachlor
4. Trifluralin
5. *alpha*-HCH
6. HCB
7. Dicloran
8. Quintozene
9. *beta*-HCH
10. *gamma*-HCH
11. Chlorotalonil
12. *delta*-HCH
13. Heptachlor
14. DCPA
15. Aldrin
16. Isodrin
17. Heptachlor-epoxide
18. Captan
19. *gamma*-Chlordane
20. *alpha*-Chlordane
21. Endosulfan-I
22. *t*-Nonachlor
23. pp-DDE
24. Dieldrin
25. Endrin
26. Perthane
27. Chlorobenzilate
28. Endosulfan-II
29. cis-Nonachlor
30. pp-DDD
31. Endrin aldehyde
32. Carbophenothion
33. Endosulfan sulfate
34. pp-DDT
35. Endrin ketone
36. Methoxychlor
37. Mirex
38. *c*-Permethrin
39. *t*-Permethrin

Accustandard mix M-680P, M508P-B-R and M-617-2 (1ng/µL each compound).

mega

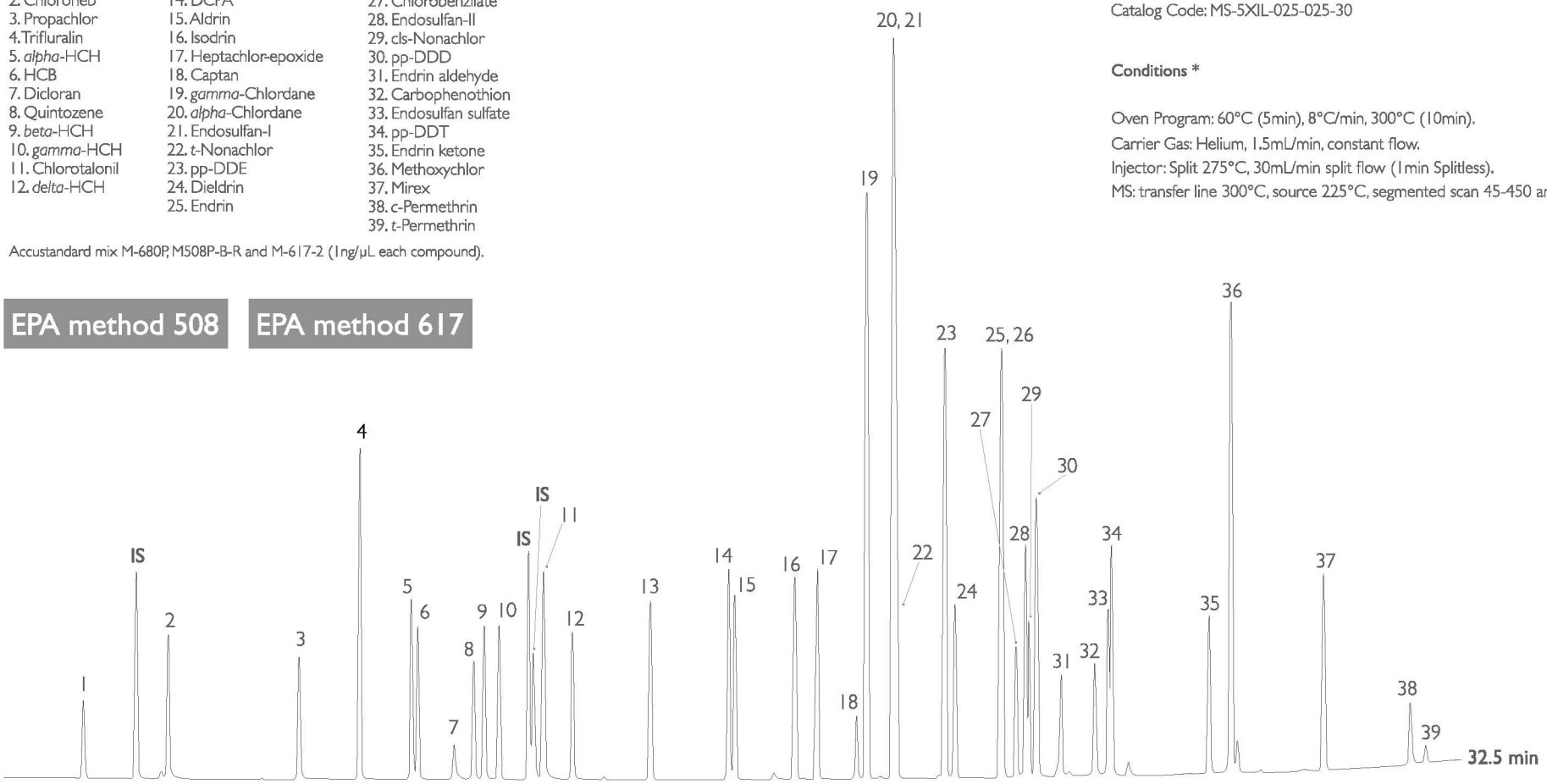
Column: **MEGA-5 MS Xil - 0.25mm, 0.25µm, 30m**

Catalog Code: MS-5XIL-025-025-30

Conditions *

Oven Program: 60°C (5min), 8°C/min, 300°C (10min).
Carrier Gas: Helium, 1.5mL/min, constant flow.
Injector: Split 275°C, 30mL/min split flow (1min Splitless).
MS: transfer line 300°C, source 225°C, segmented scan 45-450 amu.

EPA method 508 EPA method 617



TIC MS

Acknowledgement: **Cromlab S.L.**, Acer 30-32, 08038 Barcelona.

*: conditions used are not optimized for separations but are standard conditions used for a round-robin comparison.

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POFs

mega 5-MS Xil™ ultra-low bleeding column

1. Dichlorvos
2. Mevinphos
3. Demeton-S
4. Ethoprop
5. Naled
6. Sulfotep
7. Phorate
8. Demeton-O
9. Dimethoate
10. Dioxathion
11. Terbufos
12. Fonophos
13. Diazinon
14. Disulfoton
15. Dichlorofenthion
16. Chlorpyrifos-methyl
17. Parathion-methyl
18. Fenchlorphos
19. Fenitrothion
20. Aspon
21. Malathion
22. Chlorpyrifos-ethyl
23. Fenthion
24. Trichloronate
25. Parathion-ethyl
26. Chlorfenvinphos
27. Merphos
28. Crotoxyphos
29. Tetrachlorvinphos
30. Tokuthion
31. Tribuphos
32. Fensulfothion
33. Ethion
34. Sulprophos
35. Famphur
36. Carbophenothion
37. Phosmet
38. EPN
39. Leptophos
40. Azinphos-methyl
41. Azinphos-ethyl
42. Coumaphos

EPA method 8140, 8141

mega

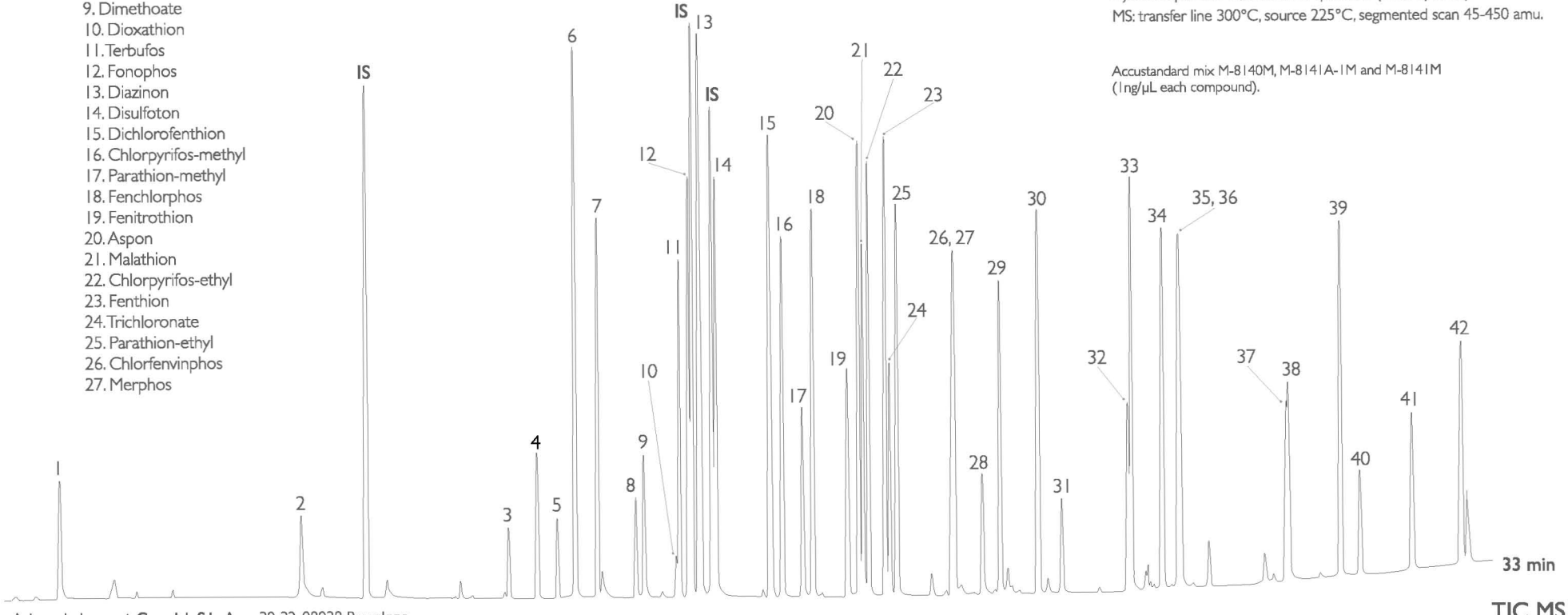
Column: **MEGA-5 MS Xil - 0.25mm, 0.25µm, 30m**

Catalog Code: MS-5XIL-025-025-30

Conditions *

Oven Program: 60°C (5min), 8°C/min, 300°C (10min).
Carrier Gas: Helium, 1.5mL/min, constant flow.
Injector: Split 275°C, 30mL/min split flow (1min Splitless).
MS: transfer line 300°C, source 225°C, segmented scan 45-450 amu.

Accustandard mix M-8140M, M-8141A-1M and M-8141M (1ng/µL each compound).



TIC MS

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Triazines

mega 5-MS Xil™ ultra-low bleeding column

mega

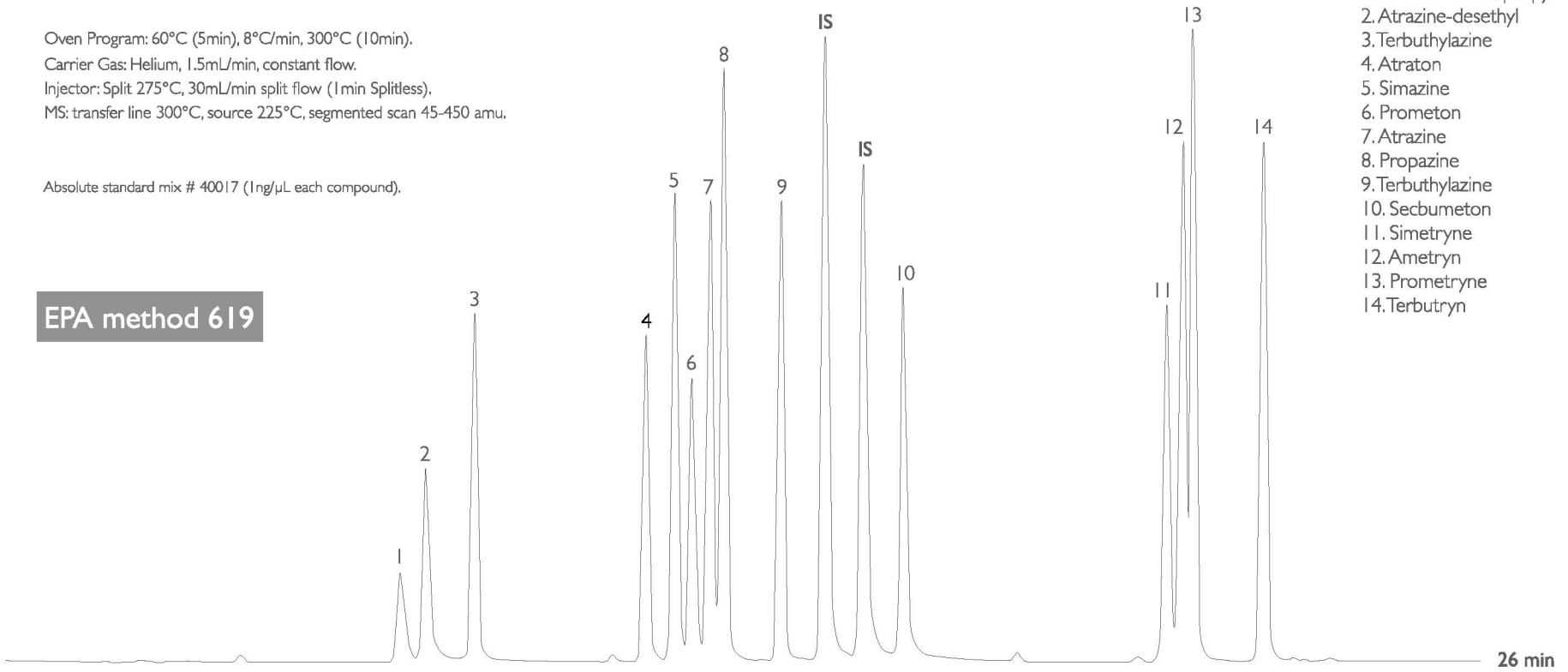
Column: **MEGA-5 MS Xil - 0.25mm, 0.25µm, 30m**
Catalog Code: MS-5XIL-025-025-30

Conditions *

Oven Program: 60°C (5min), 8°C/min, 300°C (10min).
Carrier Gas: Helium, 1.5mL/min, constant flow.
Injector: Split 275°C, 30mL/min split flow (1min Splitless).
MS: transfer line 300°C, source 225°C, segmented scan 45-450 amu.

Absolute standard mix # 40017 (1ng/µL each compound).

EPA method 619



1. Atrazine-desisopropyl
2. Atrazine-desethyl
3. Terbuthylazine
4. Atraton
5. Simazine
6. Prometon
7. Atrazine
8. Propazine
9. Terbuthylazine
10. Secbumeton
11. Simetryne
12. Ametryn
13. Prometryne
14. Terbutryn

Acknowledgement: **Cromlab S.L.**, Acer 30-32, 08038 Barcelona.

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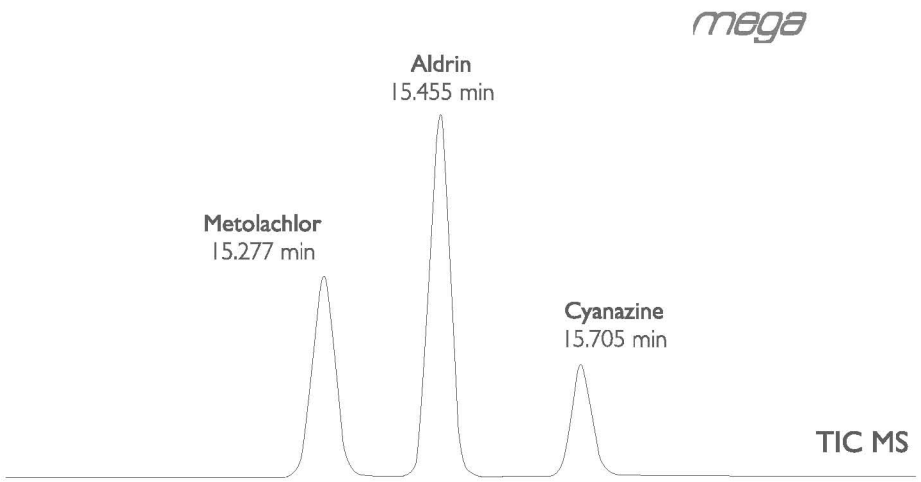
Other Separations

mega 5-MS Xil™ ultra-low bleeding column

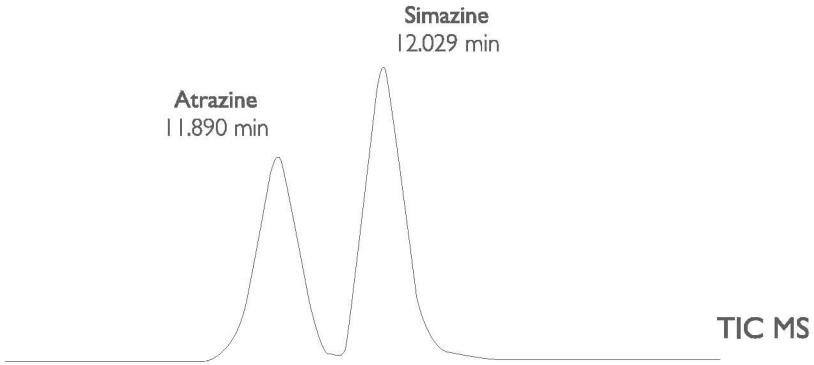
Column: **MEGA-5 MS Xil - 0.25mm, 0.25µm, 30m**
Catalog Code: MS-5XIL-025-025-30

Conditions *

Oven Program: 45°C (2min), 50°C/min, 160°C (1min), 6°C/min, 320°C (2min).
Carrier Gas: Helium, 1.0mL/min, constant flow.
Injector: Split 250°C, 50mL/min split flow, 1µL injection volume.
MS: full scan mode.



EPA method 525.2 mix



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Grob Test

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mega 5-MS Xil™
ultra-low bleeding column

Extremely low-bleeding, outstanding inertness, high long-term performances are the main features of this new column.

For over 30 years, MEGA has guaranteed excellent quality and high reproducibility. We produce and test one by one every single column using the original Grob Test mix as quality assurance test.

The new MEGA-5 MS Xil is available in the most classical GC-MS dimensions but also in the new configuration with the 0.15mm I.D. tubing, one of the best compromises between resolution power and faster GC analysis.
As with all our other products, you can ask us to make the MEGA-5 MS Xil phase with completely custom dimensions and configurations. Please contact us at info@mega.mi.it.

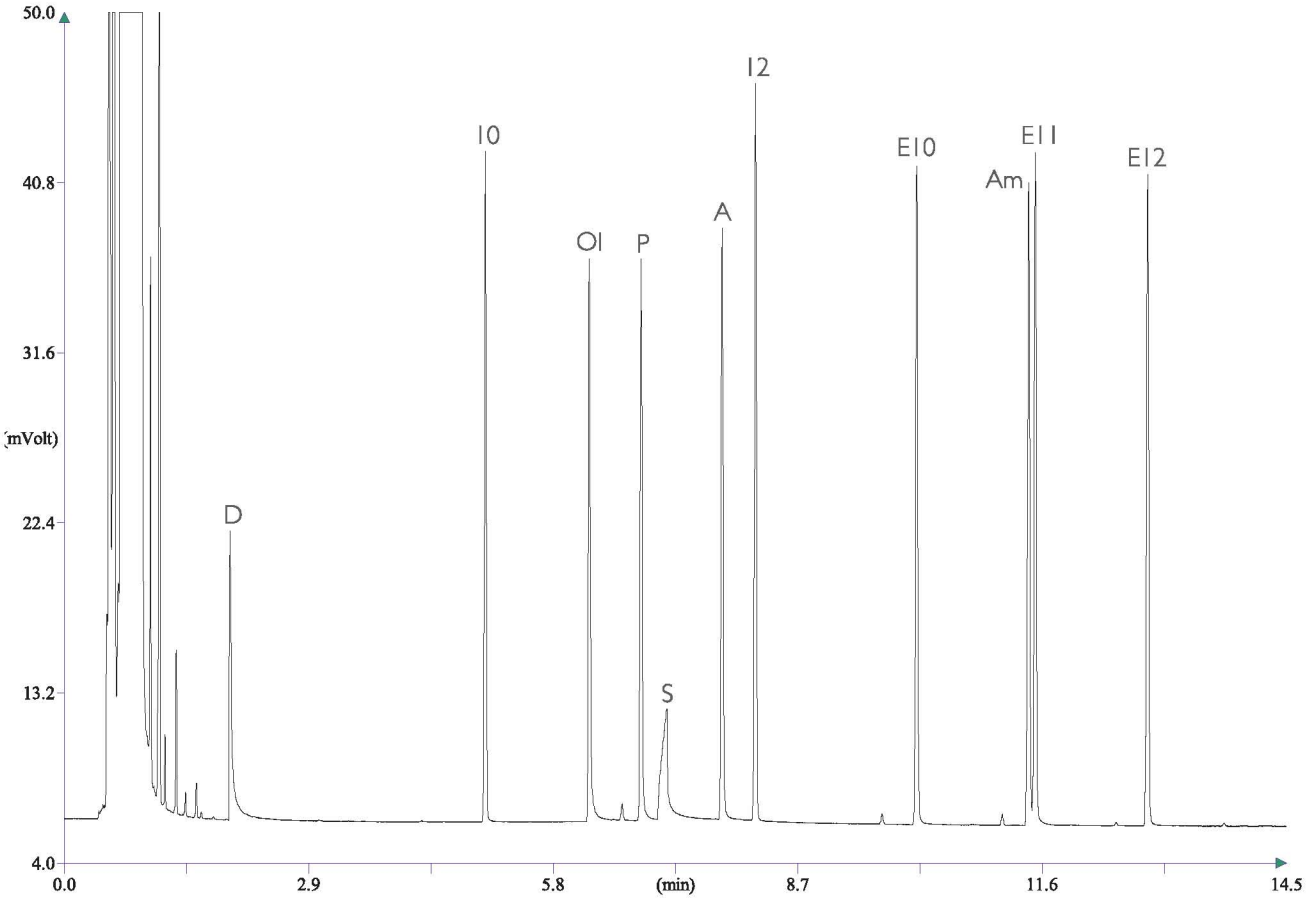

Figure 1. Grob Test chromatogram performed with the new MEGA-5 MS Xil 0.25mm, 0.25µm, 30m.
The test conditions were: 40°C - 200°C @ 10°C/min, Hydrogen carrier gas @ 80kPa (constant pressure), Split injector (250°C) with split ratio 1:20, 1µL injection volume, FID detector (250°C).
Grob Test Mix (Fluka cat. # 86501) composition: 2,3-Butanediol (D), Decane (10), 1-Octanol (Ol), 2,6-Dimethylphenol (P), 2-Ethylcaproic acid (S), 2,6-Dimethylaniline (A), Dodecane (12), methyl Decanoate (E10), Dicyclohexylamine (Am), methyl Undecanoate (E11), methyl Laurate (E12).

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Bleeding

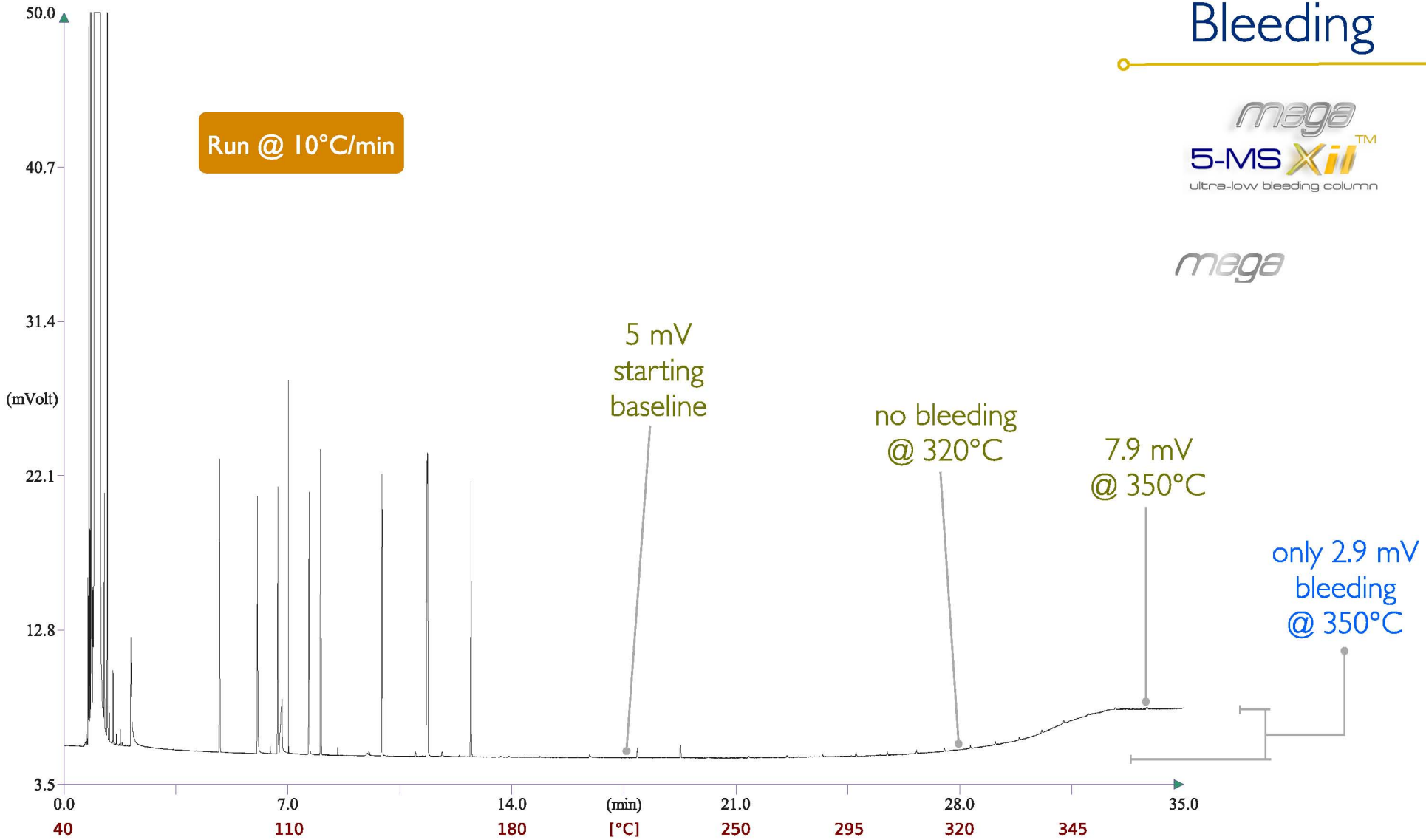

Figure 2. A Grob Test run performed on the new MEGA-5 MS Xil 0.25mm, 0.25µm, 30m is shown to highlight the bleeding level. Even with a temperature rate of 10°C/min (from 40°C to 350°C) the bleeding remains extremely low. The chromatogram shows a very flat baseline with no bleeding at 320°C and a minimal growth of the signal at the end of the analysis at high temperature (350°C).

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Dioxins and Furans Analysis

mega 5-MS Xil™ ultra-low bleeding column

What are Dioxins ?

Dioxins and PCBs belong to the group of compounds known as Persistent Organic Pollutants (POPs). They are known to bio accumulate due to their lipophilic nature and, therefore, have health implications. As a result their emission into the environment and food chain is strictly controlled. Samples that are analysed, amongst others, are foodstuffs like fish, fish feed, and stack emissions from waste incineration sites. Limits are published by the World Health Organisation (WHO) and local authorities. As a consequence, low levels of contamination have to be detected, providing a challenge to sample preparation and detection systems.

The term 'Dioxin' covers a wide range of halogenated aromatic compounds, including polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDDs and PCDFs). These compounds are formed as a result of incomplete combustion of hydrocarbons in the presence of chlorine e.g. metal processing, domestic waste incineration, etc. They have high melting points and are stable to acids and bases; these characteristics make them very persistent in the environment. PCDD/Fs can be found in many environmental matrices such as soils, sediments, air, and water.

In this work we present the use of our new GC-MS column, the MEGA-5 MS Xil, with a 0.15mm ID, 30m configuration, that will provide enhanced separation of almost all highly toxic 2,3,7,8-PCDD/Fs from other isomers, while also significantly speeding up the GC-HRMS analysis of Dioxins and Furans, with exceptional peak shape thank to our unsurpassed inertness of our surface treatment.

Abbreviatons:

PCDDs	Polychlorinated Dibenzo-p-dioxins
PCDFs	Polychlorinated Dibenzofurans
TCDD	Tetrachloro Dibenzo-p-dioxin
HRMS	High Resolution Mass Spectrometry

MEGA-5 MS Xil GC column meets the USP G27 and G36 requirements

Accredited Methods:

EPA Method 1613b
EPA Method 1668
EPA Method 8280, 8290

EN 1948-1
EN 1948-2
EN 1948-3

JSA JIS K 0311:2005
JSA JIS K 0312

PCDDs & PCDFs isomers

mega 5-MS Xil™ ultra-low bleeding column

mega

Click on each part of the chromatogram to zoom in.

Column: **MEGA-5 MS Xil - 0.15mm, 0.10µm, 30m**
Catalog Code: MS-5XIL-015-010-30

Retention Gap: **DPTMDS 0.25mm, 2.5m**
Catalog Code: RETG-DPTMDS-025-2-5

Connector: **Press-Fit Union**
Catalog Code: PFITUN-015-025-1

Conditions

Oven Program: 160°C, 10°C/min, 190°C, 2.5°C/min, 255°C, 4°C/min, 310°C.
Carrier Gas: Helium pressure programmed from 400kPa to 526kPa @ 3kPa/min.
Injector: direct deactivated glass liner, heated @ 260°C.

Sample

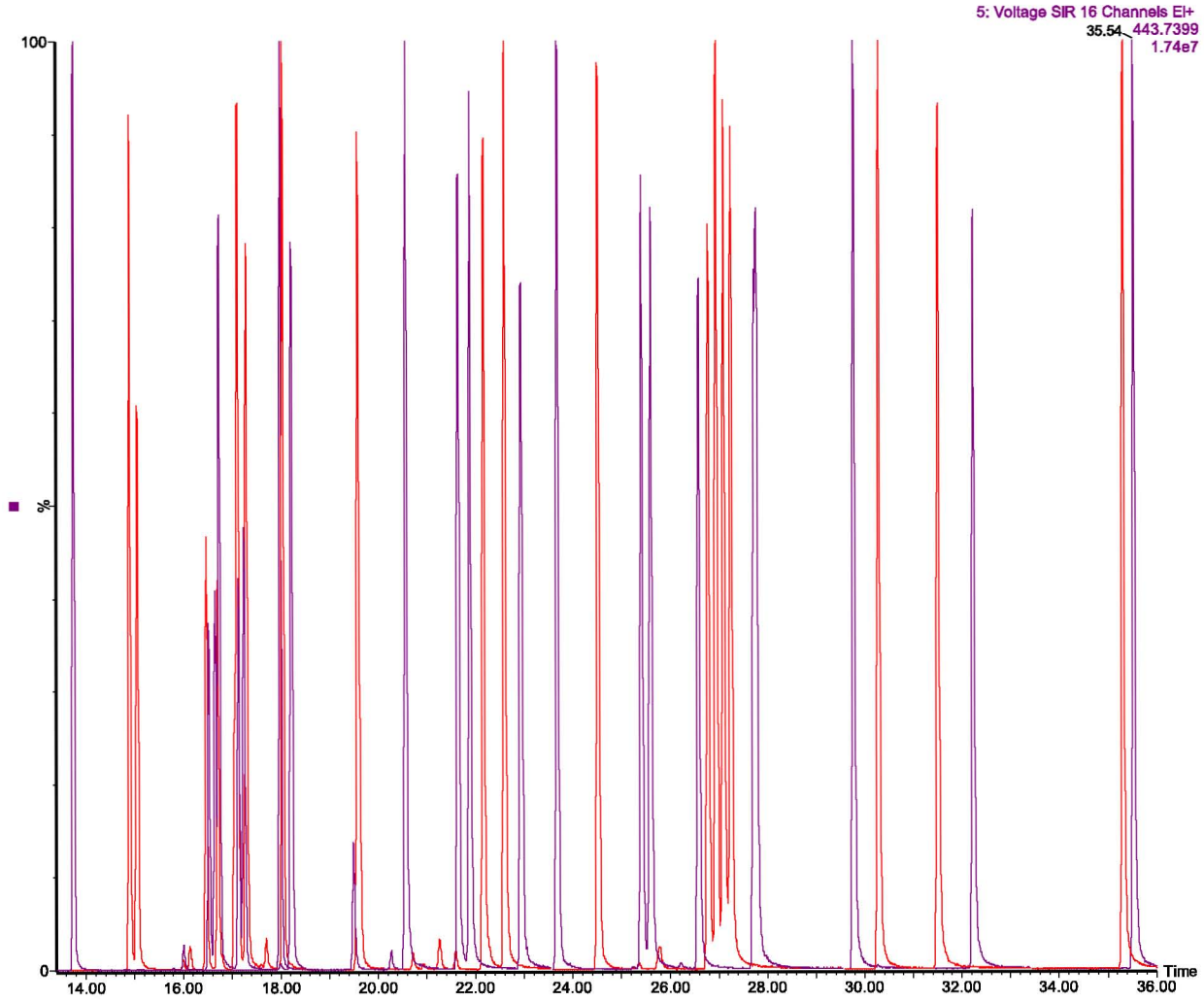
For all the chromatograms shown here, Wellington Laboratories capillary column performance test mixture (Wellington Labs. catalog code: TDTFWD) was used except where specified (see slide 10, 12 and 14).

Legend

Furans isomers (PCDFs)
Dioxins isomers (PCDDs)

Acknowledgement: **Dr. Paul H. Peterman, U.S. Geological Survey**, Columbia Environmental Research Center, 4200 New Haven Road - Columbia - Missouri - 65201 U.S.A.

PCDDs & PCDFs isomers



Column: **MEGA-5 MS Xil - 0.15mm, 0.10µm, 30m**
Catalog Code: MS-5XIL-015-010-30

Retention Gap: **DPTMDS 0.25mm, 2.5m**
Catalog Code: RETG-DPTMDS-025-2-5

Connector: **Press-Fit Union**
Catalog Code: PFITUN-015-025-1

Conditions

Oven Program: 160°C, 10°C/min, 190°C, 2.5°C/min, 255°C, 4°C/min, 310°C.
Carrier Gas: Helium pressure programmed from 400kPa to 526kPa @ 3kPa/min.
Injector: direct deactivated glass liner, heated @ 260°C.

This chromatogram represents an overlay of the SIM Groups projections of the previous slide.

Legend

Furans isomers (PCDFs)
Dioxins isomers (PCDDs)

Acknowledgement: **Dr. Paul H. Peterman, U.S. Geological Survey**, Columbia Environmental Research Center, 4200 New Haven Road - Columbia - Missouri - 65201 U.S.A.

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TCDDs & TCDFs isomers

Column: **MEGA-5 MS Xil - 0.15mm, 0.10µm, 30m**
Catalog Code: MS-5XIL-015-010-30

Retention Gap: **DPTMDS 0.25mm, 2.5m**
Catalog Code: RETG-DPTMDS-025-2-5

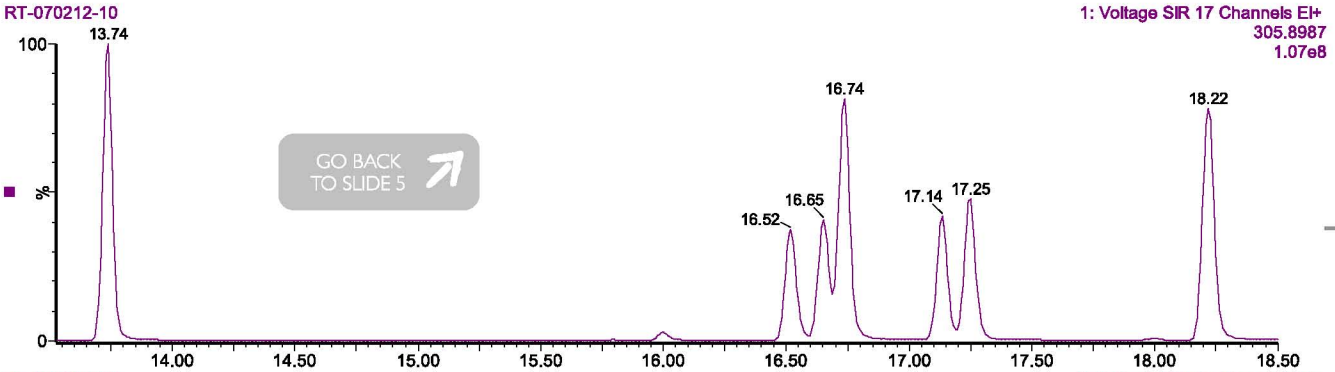
Connector: **Press-Fit Union**
Catalog Code: PFITUN-015-025-1

Conditions

Oven Program: 160°C, 10°C/min, 190°C, 2.5°C/min, 255°C, 4°C/min, 310°C.
Carrier Gas: Helium pressure programmed from 400kPa to 526kPa @ 3kPa/min.
Injector: direct deactivated glass liner, heated @ 260°C.

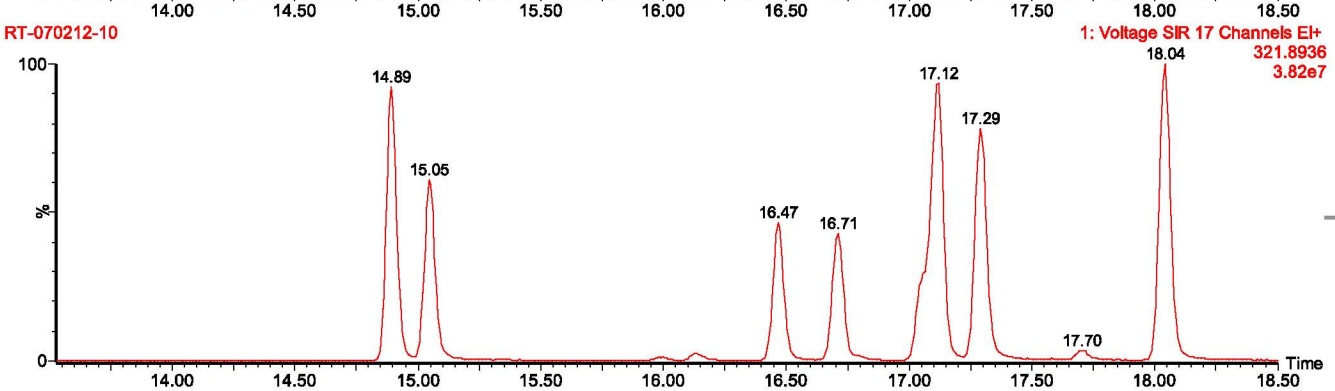
Legend

Tetra-Furans isomers (TCDFs)
Tetra-Dioxins isomers (TCDDs)



GO BACK TO SLIDE 5

13.74 - 1,3,6,8 - TCDF
16.52 - 2,3,4,7 - TCDF
16.65 - 2,3,4,8 - TCDF
16.74 - **2,3,7,8 - TCDF**
17.14 - 1,2,6,9 - TCDF
17.25 - 1,2,3,9 - TCDF
18.22 - 1,2,8,9 - TCDF



14.89 - 1,3,6,8 - TCDD
15.05 - 1,3,7,9 - TCDD
16.47 - 1,4,7,8 - TCDD
16.71 - 1,2,3,4 - TCDD
17.12 - 1,2,3,7 + 1,2,3,8 + 1,2,3,9 - TCDDs
17.29 - **2,3,7,8 - TCDD**
18.04 - 1,2,8,9 - TCDD

Acknowledgement: **Dr. Paul H. Peterman, U.S. Geological Survey**, Columbia Environmental Research Center, 4200 New Haven Road - Columbia - Missouri - 65201 U.S.A.

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TCDDs isomers

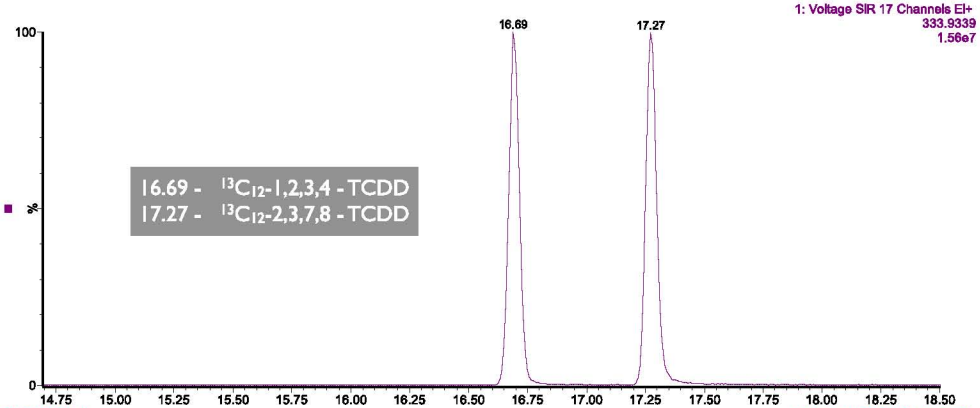
Conditions

Oven Program: 160°C, 10°C/min, 190°C, 2.5°C/min, 255°C, 4°C/min, 310°C.
Carrier Gas: Helium pressure programmed from 400kPa to 526kPa @ 3kPa/min.
Injector: direct deactivated glass liner, heated @ 260°C.

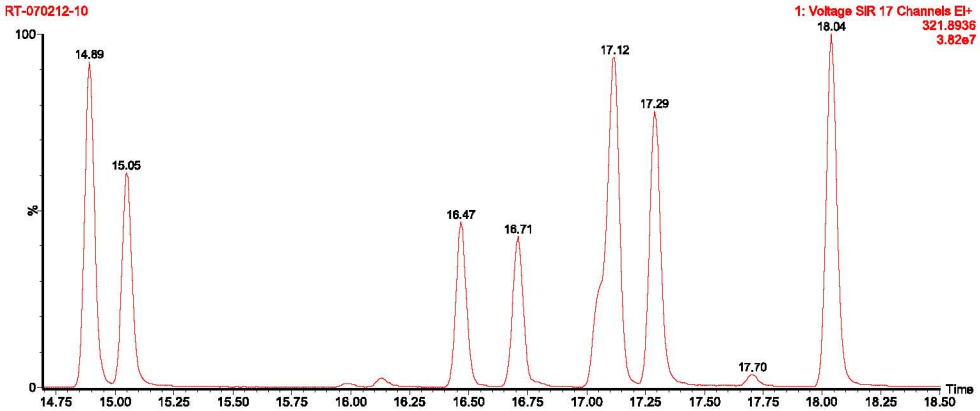
Column: **MEGA-5 MS Xil - 0.15mm, 0.10µm, 30m**
Catalog Code: MS-5XIL-015-010-30

Retention Gap: **DPTMDS 0.25mm, 2.5m**
Catalog Code: RETG-DPTMDS-025-2-5

Connector: **Press-Fit Union**
Catalog Code: PFITUN-015-025-1



meets and far exceeds the EPA method 8280 resolution criteria



14.89 - 1,3,6,8 - TCDD
15.05 - 1,3,7,9 - TCDD
16.47 - 1,4,7,8 - TCDD
16.71 - 1,2,3,4 - TCDD
17.12 - 1,2,3,7 + 1,2,3,8 + 1,2,3,9 - TCDDs
17.29 - **2,3,7,8 - TCDD**
18.04 - 1,2,8,9 - TCDD

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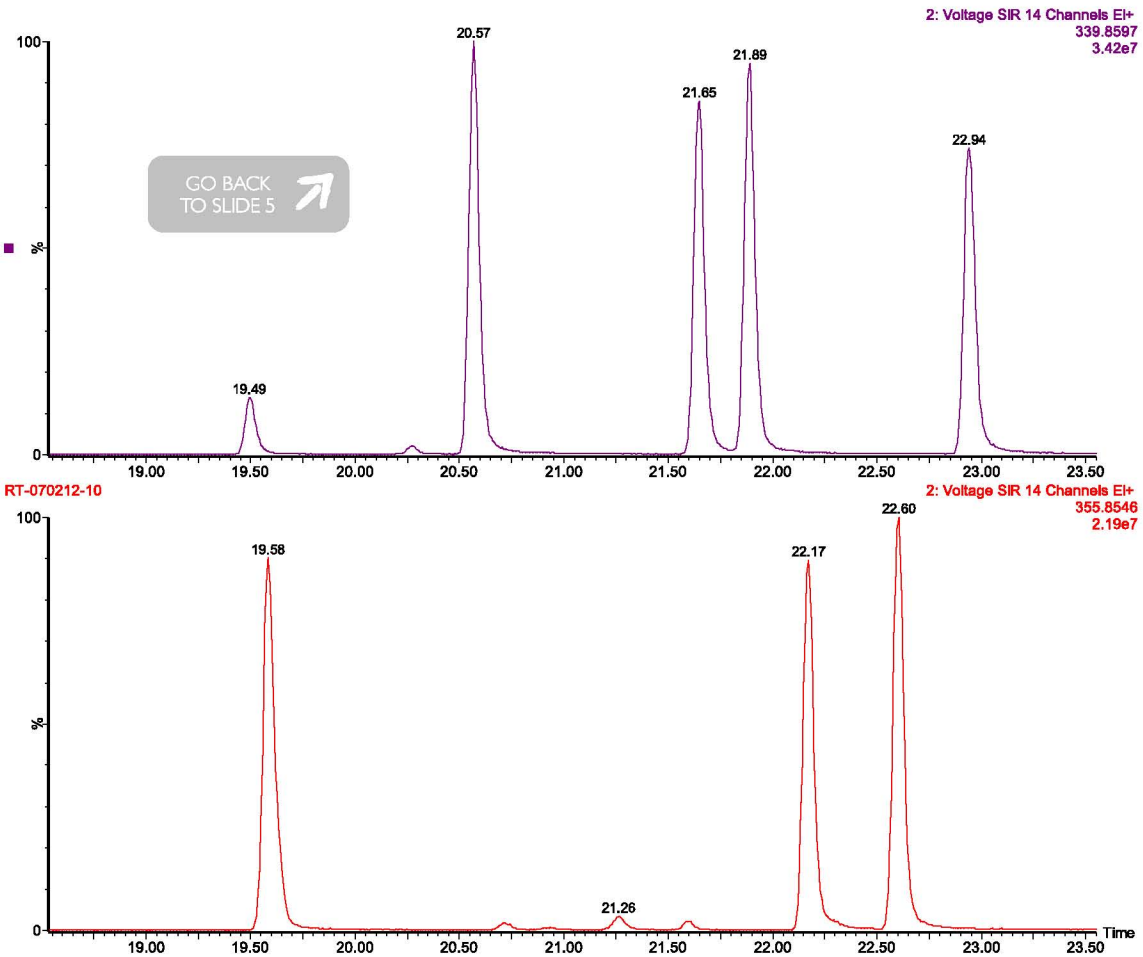
PeCDDs & PeCDFs isomers



GO BACK TO SLIDE 5

Column: **MEGA-5 MS Xil - 0.15mm, 0.10µm, 30m**
Catalog Code: MS-5XIL-015-010-30

Retention Gap: **DPTMDS 0.25mm, 2.5m**
Catalog Code: RETG-DPTMDS-025-2-5

Connector: **Press-Fit Union**
Catalog Code: PFITUN-015-025-1

Conditions

Oven Program: 160°C, 10°C/min, 190°C, 2.5°C/min, 255°C, 4°C/min, 310°C.
Carrier Gas: Helium pressure programmed from 400kPa to 526kPa @ 3kPa/min.
Injector: direct deactivated glass liner, heated @ 260°C.

19.49 - 1,2,3,6,8 - PeCDF
19.58 - 1,2,4,7,9 - PeCDD
20.57 - 1,2,3,7,8 - PeCDF
21.65 - 2,3,4,6,7 - PeCDF
21.89 - 2,3,4,7,8 - PeCDF
22.17 - 1,2,3,7,8 - PeCDD
22.60 - 1,2,3,8,9 - PeCDD
22.94 - 1,2,3,8,9 - PeCDF

Legend

Penta-Furans isomers (PeCDFs)
Penta-Dioxins isomers (PeCDDs)

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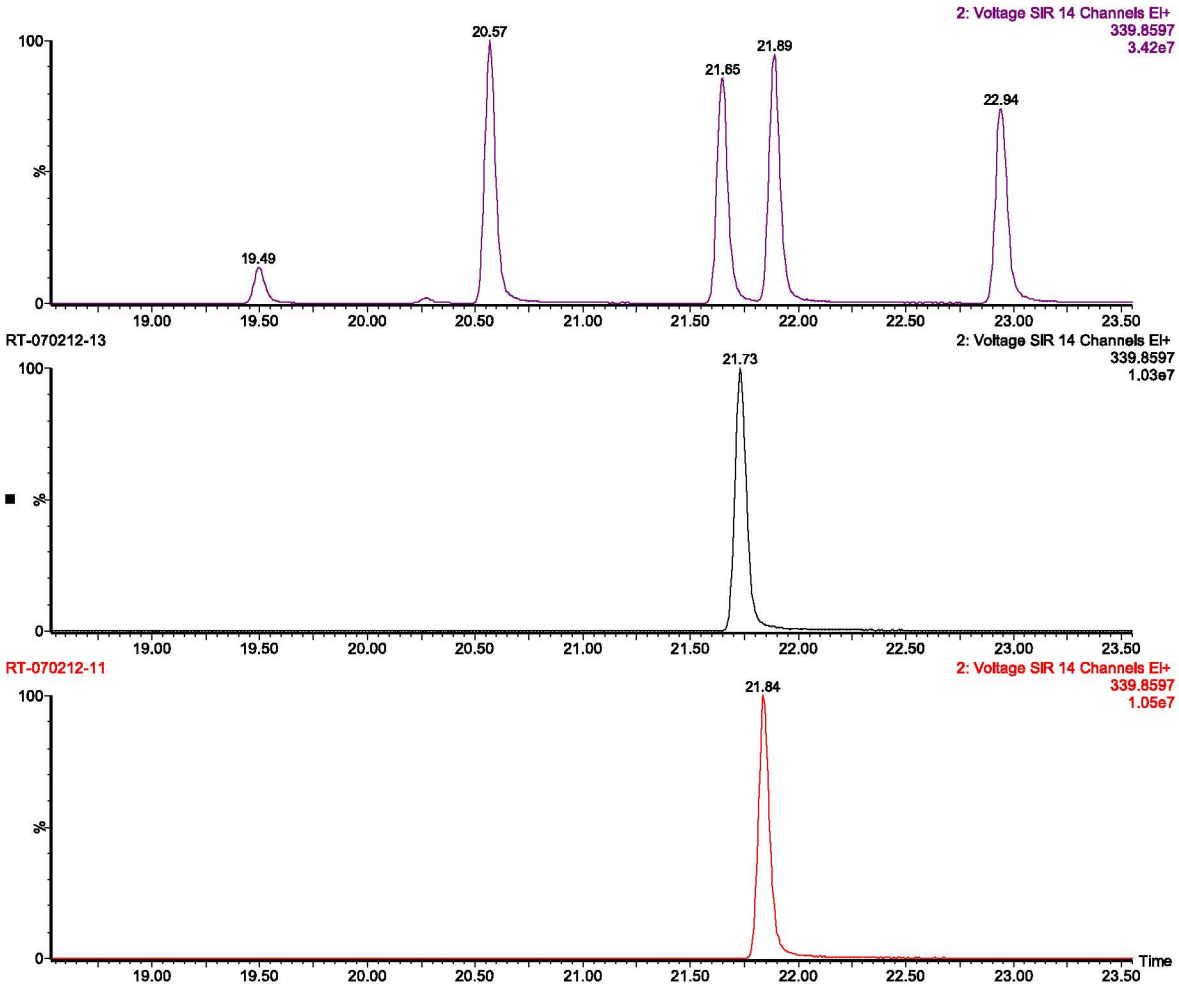
PeCDFs isomers



Column: **MEGA-5 MS Xil - 0.15mm, 0.10µm, 30m**
Catalog Code: MS-5XIL-015-010-30

Retention Gap: **DPTMDS 0.25mm, 2.5m**
Catalog Code: RETG-DPTMDS-025-2-5

Connector: **Press-Fit Union**
Catalog Code: PFITUN-015-025-1

Conditions

Oven Program: 160°C, 10°C/min, 190°C, 2.5°C/min, 255°C, 4°C/min, 310°C.
Carrier Gas: Helium pressure programmed from 400kPa to 526kPa @ 3kPa/min.
Injector: direct deactivated glass liner, heated @ 260°C.

19.49 - 1,2,3,6,8 - PeCDF
20.57 - 1,2,3,7,8 - PeCDF
21.65 - 2,3,4,6,7 - PeCDF
21.73 - 1,2,3,6,9 - PeCDF
21.84 - 1,2,4,8,9 - PeCDF
21.89 - 2,3,4,7,8 - PeCDF
22.94 - 1,2,3,8,9 - PeCDF

Sample

All TCDFs presents in Wellington Laboratories capillary column performance test mixture (Wellington Labs. catalog code: TDTFWD), except:

1,2,3,6,9 – PeCDF (@ 25 pg/uL in nonane)
1,2,4,8,9 – PeCDF (@ 25 pg/uL in nonane)

from Cambridge Isotope Labs.

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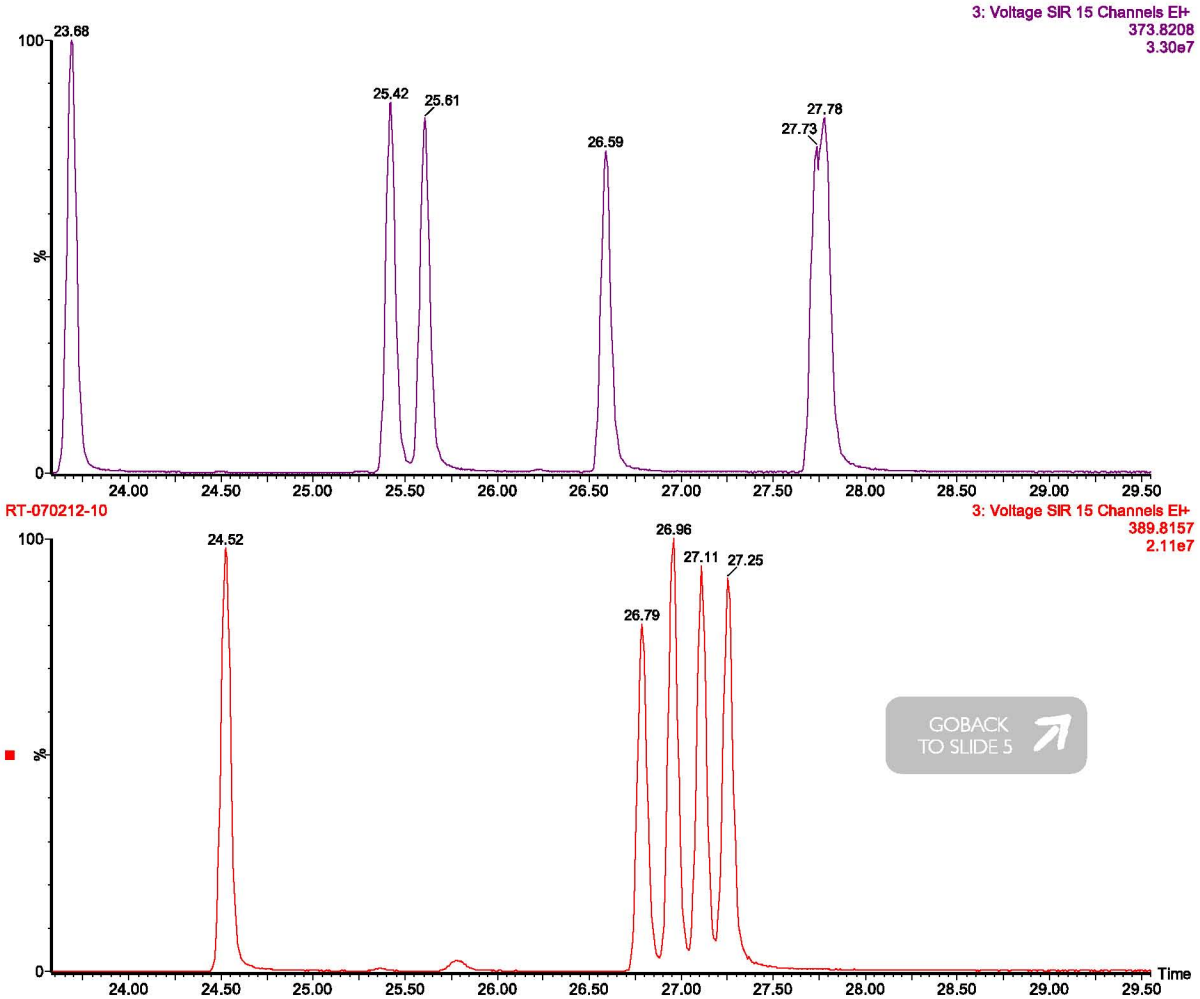
HxCDDs & HxCDFs isomers



GOBACK TO SLIDE 5

Column: **MEGA-5 MS Xil - 0.15mm, 0.10µm, 30m**
Catalog Code: MS-5XIL-015-010-30

Retention Gap: **DPTMDS 0.25mm, 2.5m**
Catalog Code: RETG-DPTMDS-025-2-5

Connector: **Press-Fit Union**
Catalog Code: PFITUN-015-025-1

Conditions

Oven Program: 160°C, 10°C/min, 190°C, 2.5°C/min, 255°C, 4°C/min, 310°C.
Carrier Gas: Helium pressure programmed from 400kPa to 526kPa @ 3kPa/min.
Injector: direct deactivated glass liner, heated @ 260°C.

23.68 - 1,2,3,4,6,8 - HxCDF
24.52 - 1,2,4,6,7,9 - HxCDD
25.42 - 1,2,3,4,7,8 - HxCDF
25.61 - 1,2,3,6,7,8 - HxCDF
26.59 - 2,3,4,6,7,8 - HxCDF
26.79 - 1,2,3,4,7,8 - HxCDD
26.96 - 1,2,3,6,7,8 - HxCDD
27.11 - 1,2,3,4,6,7 - HxCDD
27.25 - 1,2,3,7,8,9 - HxCDD
27.73 - 1,2,3,7,8,9 - HxCDF
27.78 - 1,2,3,4,8,9 - HxCDF

Legend

Hexa-Furans isomers (HxCDFs)
Hexa-Dioxins isomers (HxCDDs)

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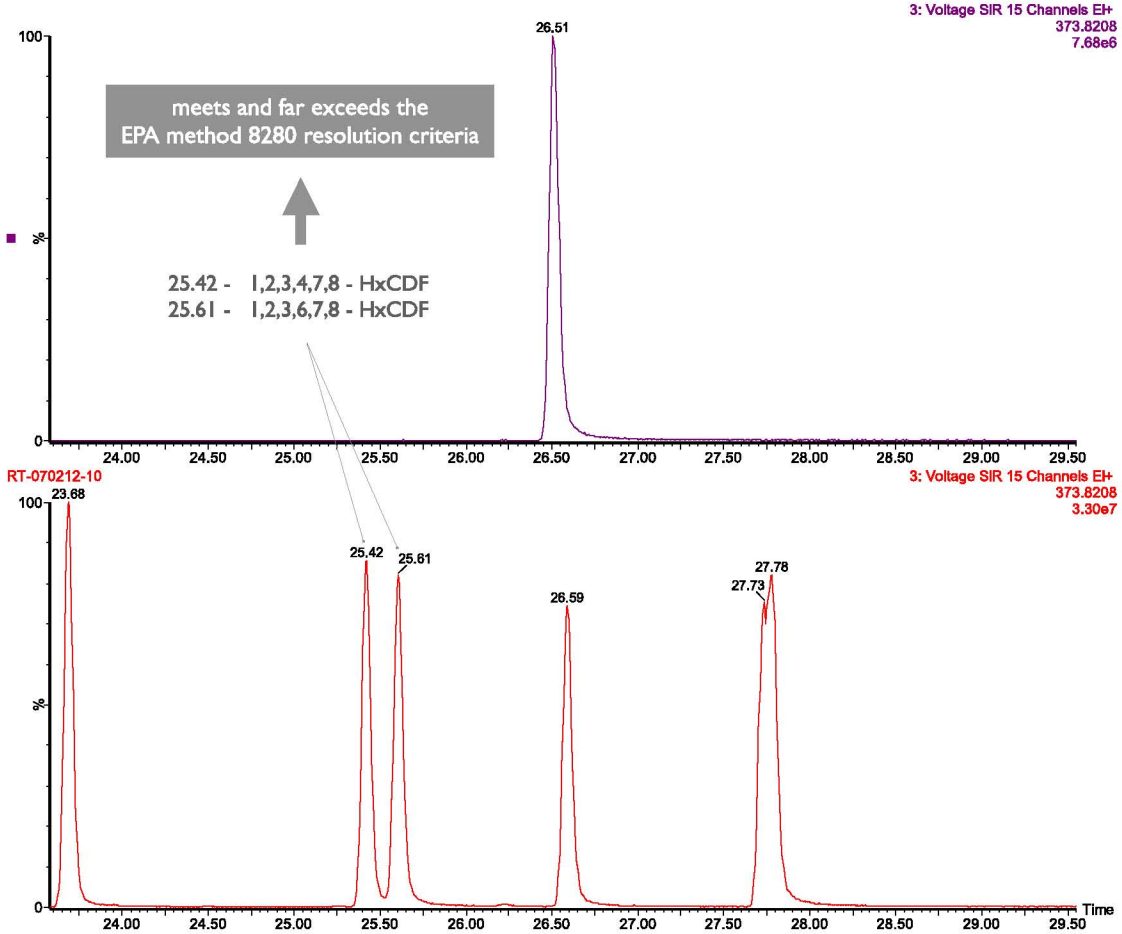
HxCDFs isomers



Column: **MEGA-5 MS Xil - 0.15mm, 0.10µm, 30m**
Catalog Code: MS-5XIL-015-010-30

Retention Gap: **DPTMDS 0.25mm, 2.5m**
Catalog Code: RETG-DPTMDS-025-2-5

Connector: **Press-Fit Union**
Catalog Code: PFITUN-015-025-1

Conditions

Oven Program: 160°C, 10°C/min, 190°C, 2.5°C/min, 255°C, 4°C/min, 310°C.
Carrier Gas: Helium pressure programmed from 400kPa to 526kPa @ 3kPa/min.
Injector: direct deactivated glass liner, heated @ 260°C.

23.68 - 1,2,3,4,6,8 - HxCDF
25.42 - 1,2,3,4,7,8 - HxCDF
25.61 - 1,2,3,6,7,8 - HxCDF
26.51 - 1,2,3,6,8,9 - HxCDF
26.59 - 2,3,4,6,7,8 - HxCDF
27.73 - 1,2,3,7,8,9 - HxCDF
27.78 - 1,2,3,4,8,9 - HxCDF

Sample

All TCDFs presents in Wellington Laboratories capillary column performance test mixture (Wellington Labs. catalog code: TDTFWD), except:

1,2,3,6,8,9 – HxCDF (@ 25 pg/uL in nonane)

from Cambridge Isotope Labs.

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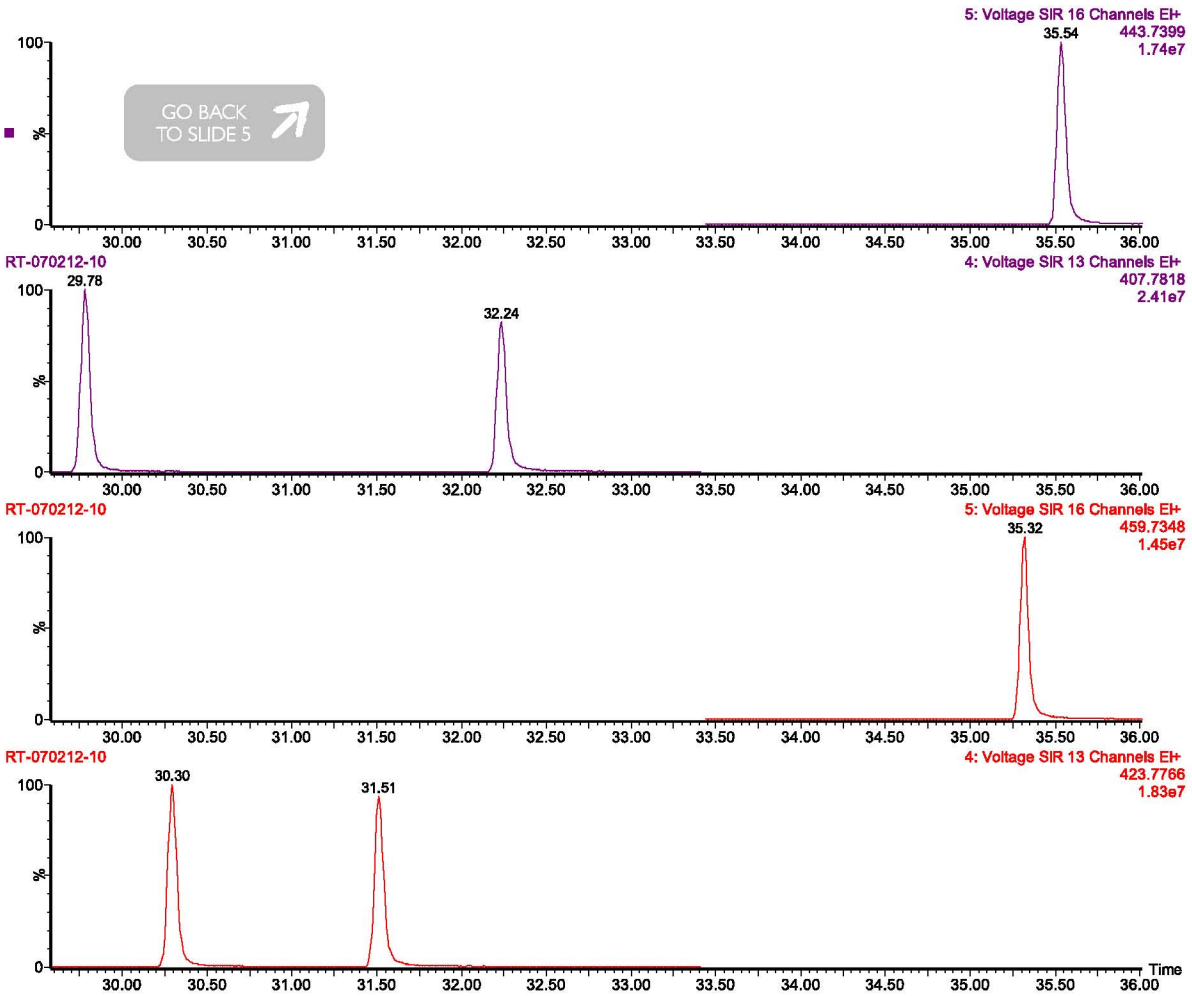
Hepta- & **Octa-** PCDDs & PCDFs isomers



Column: **MEGA-5 MS Xil - 0.15mm, 0.10µm, 30m**
Catalog Code: MS-5XIL-015-010-30

Retention Gap: **DPTMDS 0.25mm, 2.5m**
Catalog Code: RETG-DPTMDS-025-2-5

Connector: **Press-Fit Union**
Catalog Code: PFITUN-015-025-1

Conditions

Oven Program: 160°C, 10°C/min, 190°C, 2.5°C/min, 255°C, 4°C/min, 310°C.
Carrier Gas: Helium pressure programmed from 400kPa to 526kPa @ 3kPa/min.
Injector: direct deactivated glass liner, heated @ 260°C.

29.78 - 1,2,3,4,6,7,8 - HpCDF
30.30 - 1,2,3,4,6,7,9 - HpCDD
31.51 - 1,2,3,4,6,7,8 - HpCDD
32.24 - 1,2,3,4,7,8,9 - HpCDF
35.32 - OCDD
35.54 - OCDF

Legend

Furans isomers (HpCDFs & OCDF)
Dioxins isomers (HpCDDs & OCDD)

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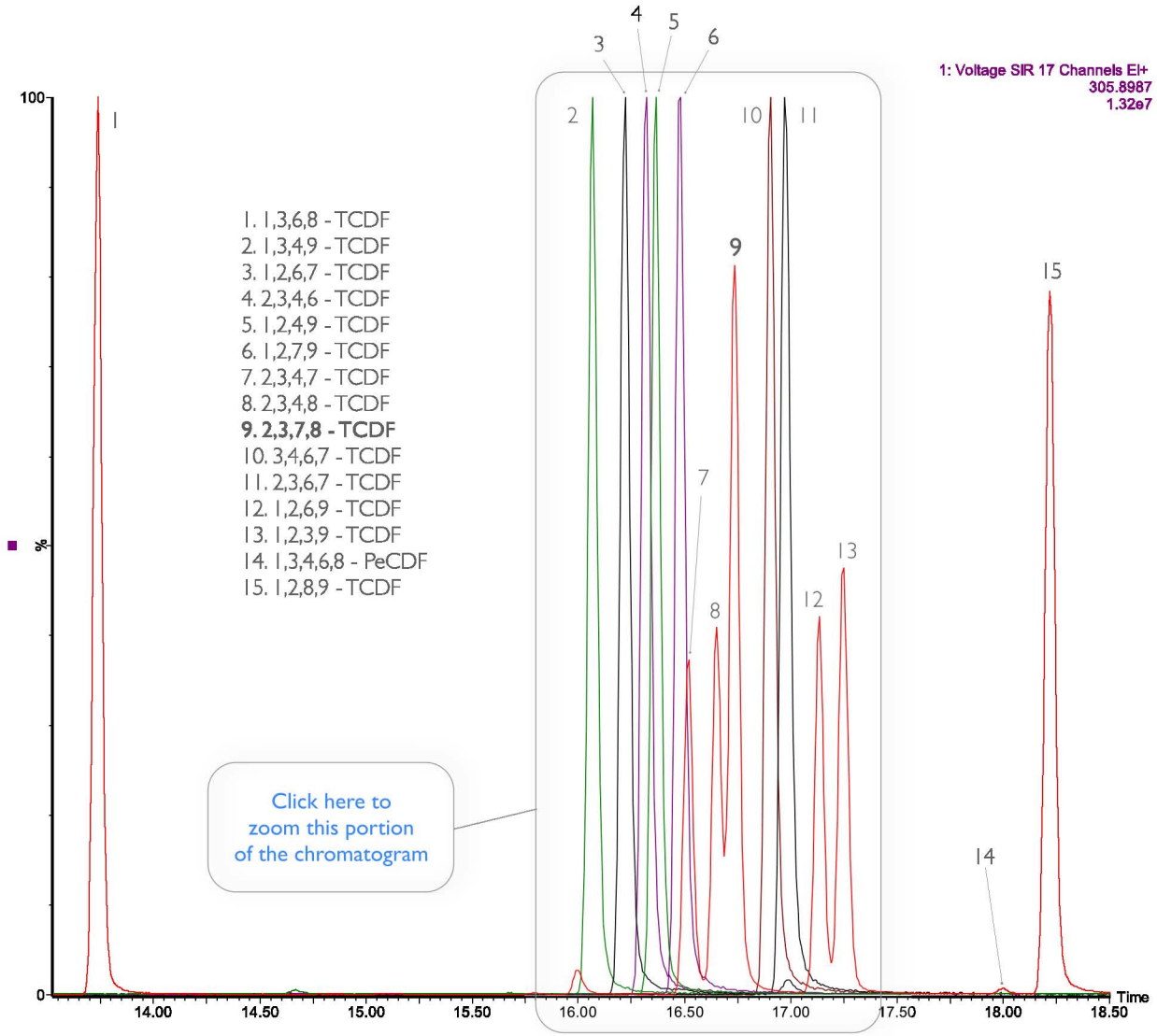
TCDFs



Column: **MEGA-5 MS Xil - 0.15mm, 0.10µm, 30m**
Catalog Code: MS-5XIL-015-010-30

Retention Gap: **DPTMDS 0.25mm, 2.5m**
Catalog Code: RETG-DPTMDS-025-2-5

Connector: **Press-Fit Union**
Catalog Code: PFITUN-015-025-1

Conditions

Oven Program: 160°C, 10°C/min, 190°C, 2.5°C/min, 255°C, 4°C/min, 310°C.
Carrier Gas: Helium pressure programmed from 400kPa to 526kPa @ 3kPa/min.
Injector: direct deactivated glass liner, heated @ 260°C.

Sample

All TCDFs presents in Wellington Laboratories capillary column performance test mixture (Wellington Labs. catalog code: TDTFWD), except:

2. 1,3,4,9 – TCDF (@ 25 pg/uL in nonane)
3. 1,2,6,7 – TCDF (@ 25 pg/uL)
4. 2,3,4,6 – TCDF (@ 25 pg/uL)
5. 1,2,4,9 – TCDF (@ 25 pg/uL)
6. 1,2,7,9 – TCDF (@ 25 pg/uL)
10. 3,4,6,7 – TCDF (@ 25 pg/uL)
11. 2,3,6,7 – TCDF (@ 25 pg/uL)

from Cambridge Isotope Labs.

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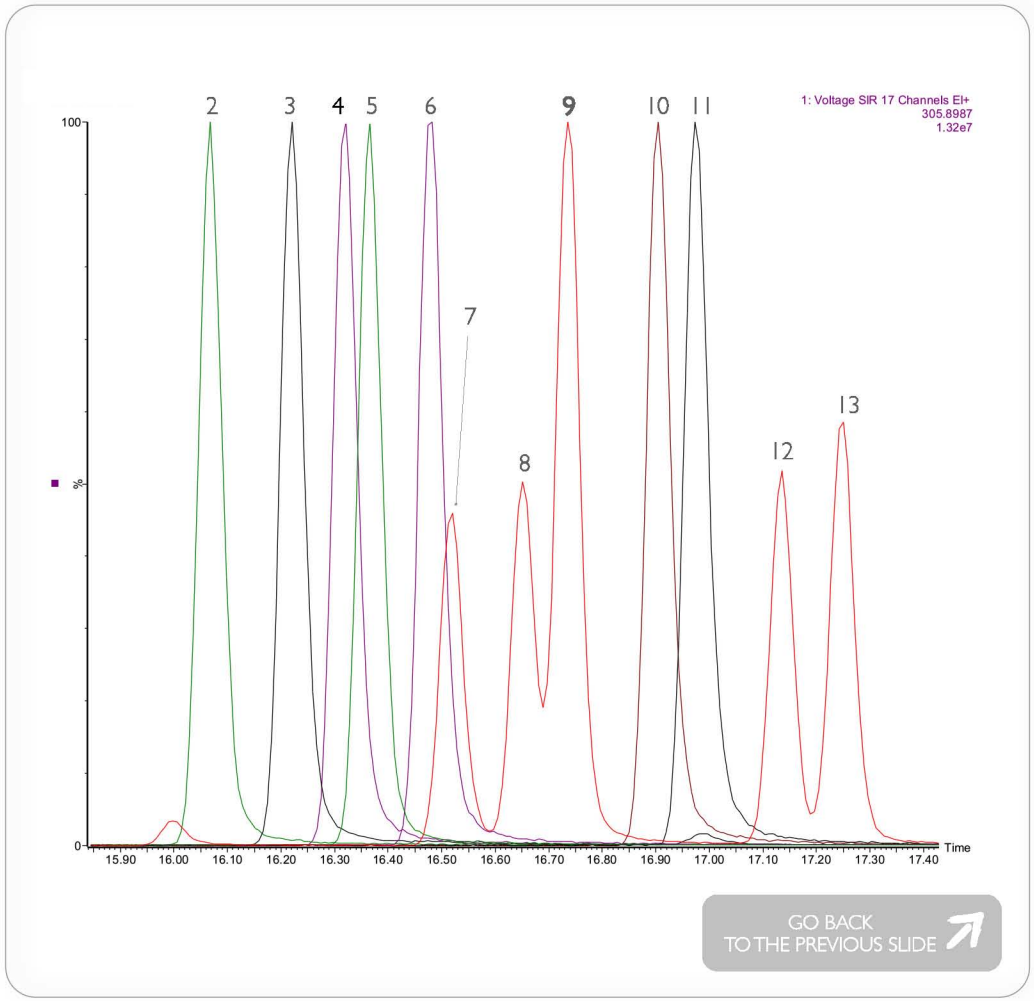
TCDFs



Column: **MEGA-5 MS Xil - 0.15mm, 0.10µm, 30m**
Catalog Code: MS-5XIL-015-010-30

Retention Gap: **DPTMDS 0.25mm, 2.5m**
Catalog Code: RETG-DPTMDS-025-2-5

Connector: **Press-Fit Union**
Catalog Code: PFITUN-015-025-1

Conditions

Oven Program: 160°C, 10°C/min, 190°C, 2.5°C/min, 255°C, 4°C/min, 310°C.
Carrier Gas: Helium pressure programmed from 400kPa to 526kPa @ 3kPa/min.
Injector: direct deactivated glass liner, heated @ 260°C.

2. 1,3,4,9 - TCDF
3. 1,2,6,7 - TCDF
4. 2,3,4,6 - TCDF
5. 1,2,4,9 - TCDF
6. 1,2,7,9 - TCDF
7. 2,3,4,7 - TCDF
8. 2,3,4,8 - TCDF
9. 2,3,7,8 - TCDF
10. 3,4,6,7 - TCDF
11. 2,3,6,7 - TCDF
12. 1,2,6,9 - TCDF
13. 1,2,3,9 - TCDF

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Acknowledgments

We would like to thank Dr. Paul Peterman (U.S. Geological Survey, Columbia Environmental Research Center, 4200 New Haven Road - Columbia - Missouri - 65201 U.S.A.) for his continuous support and of course for providing us all the chromatograms shown here. Without his enormous experience in this analytical field, this work would not have been possible.

Notes

All the analysis here reported were carried out with an AutoSpec Premier™ High Resolution Mass Spectrometer (HRMS) by Waters™ on an Agilent™ 6890N GC equipped with an Agilent™ 7683 autosampler.

A new High Temperature Carbowax Column stable up to 300°C for FAST-GC and GCxGC use.

Mario Galli (1), Stefano Galli (1)
1: MEGA s.n.c. - Capillary Columns Laboratory, Legnano (MI) - Italy
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Introduction

Carbowax polar stationary phases are the most used in GC separations in conjuction with 5% phenyl apolar columns. For example PEG columns are very often used in Essential Oil, FAMEs and Aromatic Compounds analyses. In recent years growth and development of techniques such as Fast-GC and GCxGC showed the need to have polar phases that can reach high temperatures. In fact, using Fast-GC systems with high temperature rates, the elution temperature of the compounds analyzed rises accordingly. In the same way, in the GCxGC, having a second dimension column such polar as a carbowax one that in the meantime allows to reach higher temperatures greatly expands the application possibilities of the technique.

For these reasons MEGA has developed a new Carbowax based column called MEGA-Wax HT, able to reach over 300°C and maintain the temperature of 300°C in isothermal mode.
The MEGA-Wax columns have a special deactivation treatment of the tubing surface that ensures a better coating of the phase. Beyond that a particular treatment on the PEG polymer is designed to allow the phase to reach high temperatures with a low bleeding and keeping the performances in time. The temperature range of this new column is extremely wide compared to other Carbowax columns, starting from 40°C reaching up to 300°C.

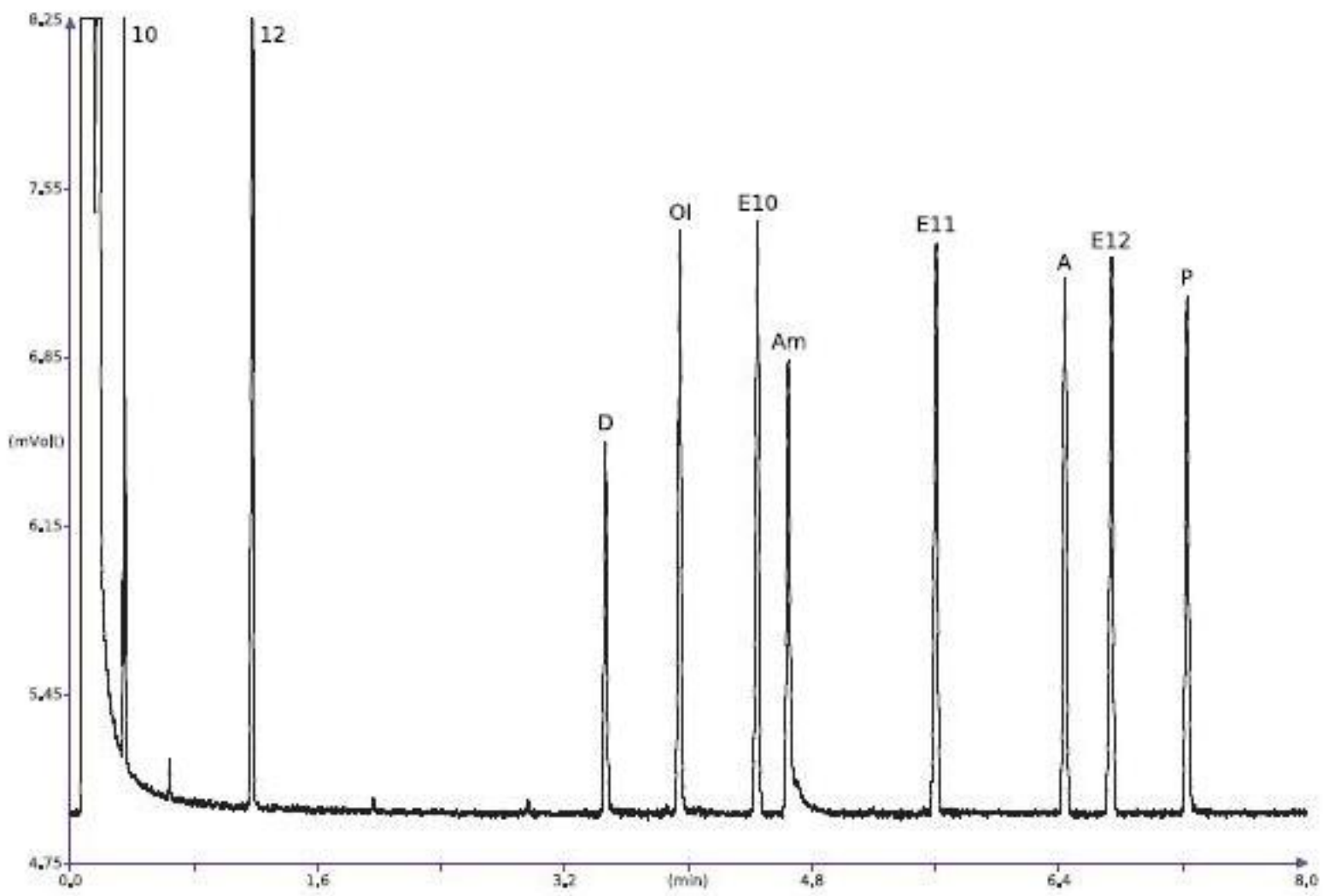

Figure 1. Grob Test (Test Mixture n. 2, Fluka Cat. # 86501) on a 0.10 mm ID x 4.5 m L (0.5 m incorporated retention gap) x 0.10 µm FT, MEGA-Wax HT Fast column. Conditions: 40°C to 200°C @ 15° C/min, Hydrogen carrier gas @ 150 kPa (constant pressure), SSL 250°C, FID 310°C.
Identification: decane (10), dodecane (12), 2,3-butanediol (D), 1-octanol (Ol), methyl decanoate (E10), dicyclohexylamine (Am), methyl undecanoate (E11), methyl laurate (E12), 2,6-dimethylaniline, 2,6-dimethylphenol.

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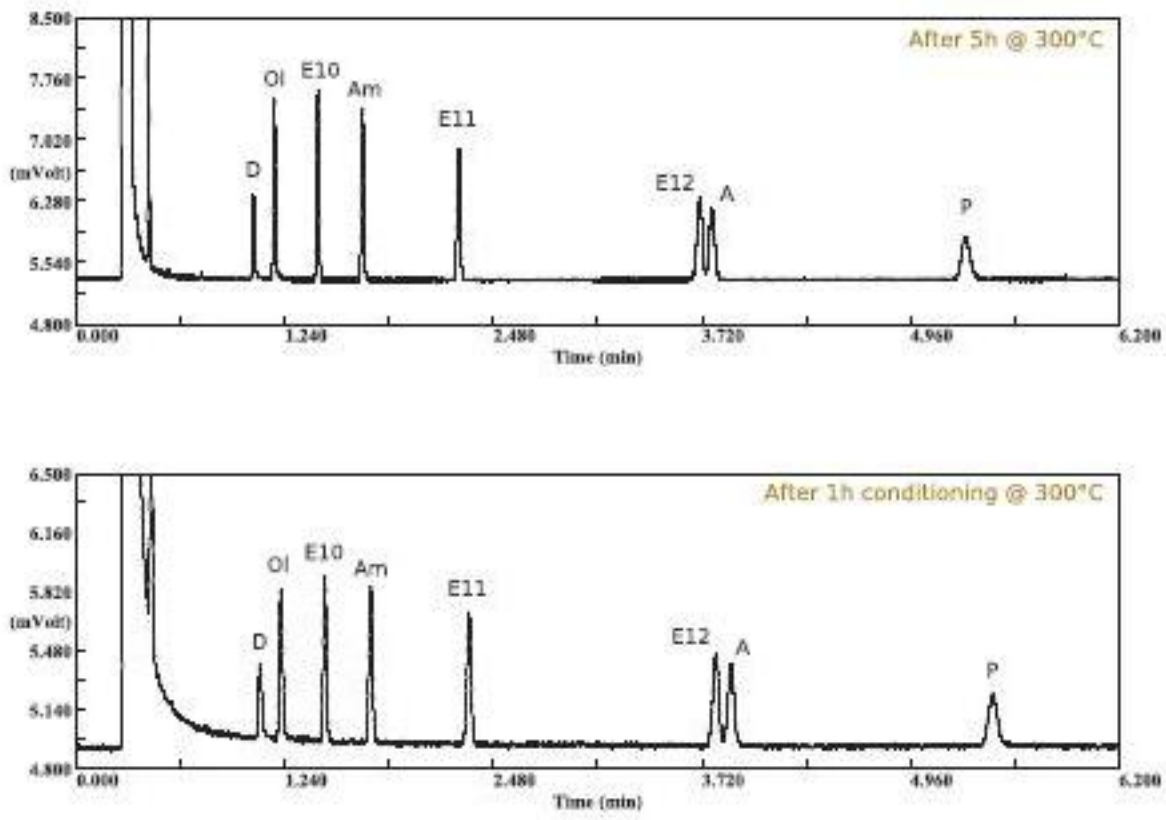

Figure 2.

Two isothermal runs to calculate the theoretical plates number (N) are here shown. All our narrow-bore Fast-GC 100µm ID columns have N/m > 9000, even for this new Carbowax stationary phase. The first value is obtained after one hour of initial column conditioning, while after keeping the column 5h @ 300°C a loss of less 5% then previous N value was noted, thus showing a very good resistance at high temperatures. The N values were calculated at 110°C in isothermal mode on a 0.10 mm ID x 8 m L x 0.10 µm FT, MEGA-Wax HT Fast.

Experimental Results

1. BIODIESEL Analysis on MEGA-Wax HT.

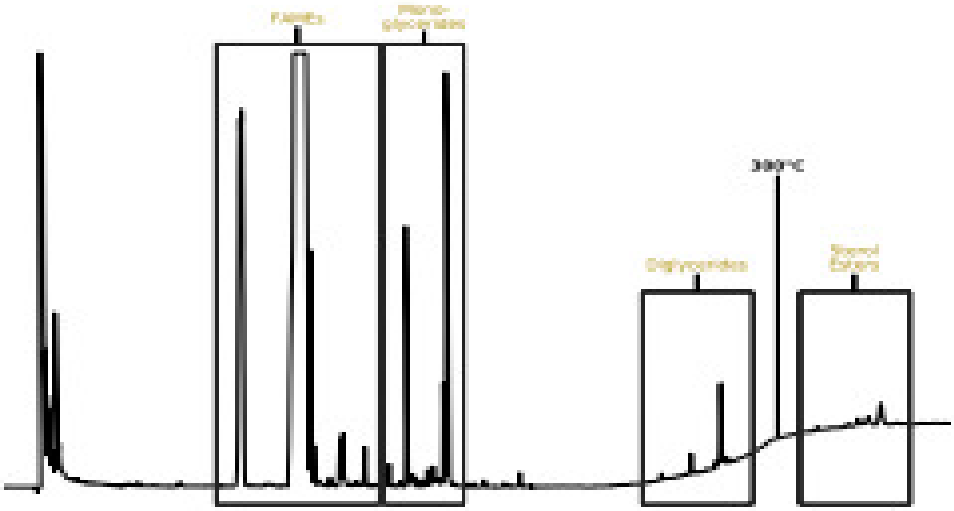

Figure 3. A real Biodiesel sample analysis is shown above. The Biodiesel sample was prepared according to the EN-14105 procedure. The column used is a 0.32 mm ID x 10 m L (1 m incorporated retention gap) x 0.05 µm FT, MEGA-Wax HT column. Conditions: 60°C to 300°C @ 10°C/min. Hydrogen carrier gas @ 35 kPa (constant pressure). On-Column injection.

Biodiesel presents a significant challenge from the analytical point of view. There are many implemented methods regarding the GC Biodiesel analysis to determine free and total Glycerine, ester and linoleic acid methyl esters and Mono, Di and Tri-glycerides content. We injected a Biodiesel real sample on the new MEGA-Wax HT column. The results in Figure 3 show the possibility to extend the use of a polar Carbowax phase also for this kind of high temperature analysis. The MEGA-Wax HT works very well at high temperature, resolving sterol esters at 300°C in isothermal mode, while keeping an high polarity necessary to solve a typical FAMEs separation that is made on a Carbowax column according to the EN-14103 method (see the Figure 4 below). The aim of this example is to demonstrate the possible use of the MEGA-Wax HT for high temperature Gas-Chromatography. The column could of course be applied to the GCxGC technique in order to have a second dimension column that allows to maintain an high orthogonality while reaching high temperatures needed for these applications.

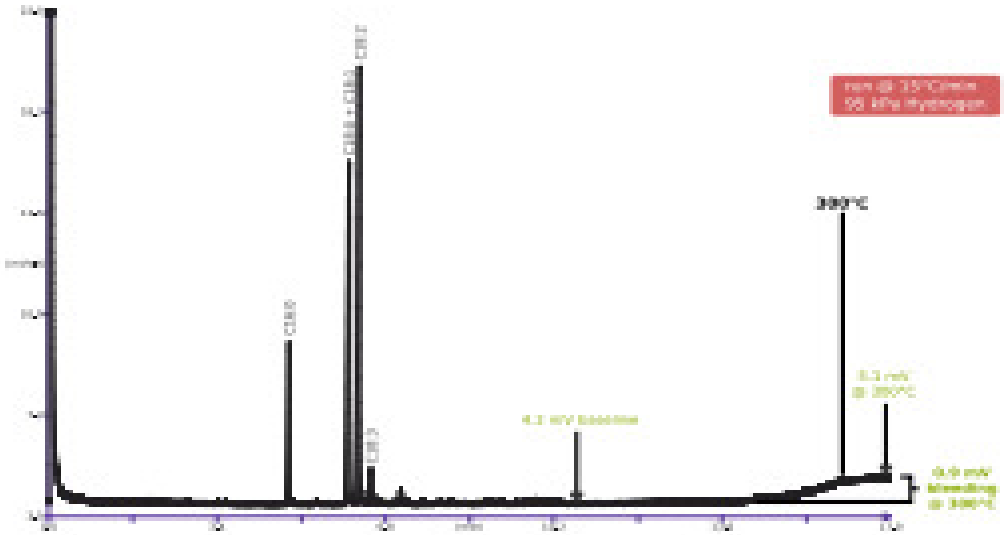

Figure 4. A FAST-GC separation example of Biodiesel FAMEs performed on 0.10 mm ID x 2.5 m L (0.5 m incorporated retention gap) x 0.10 µm FT, MEGA-Wax HT Fast column. The extreme low bleeding is here also displayed: 0.9 mV bleeding only even under "aggressive" run conditions (15°C/min and 95 kPa Hydrogen constant pressure).

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Mario Galli (1), Stefano Galli (1)
1: MEGA s.n.c. - Capillary Columns Laboratory, Legnano (MI) - Italy
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2. POLYWAX 500 Analysis on MEGA-Wax HT.

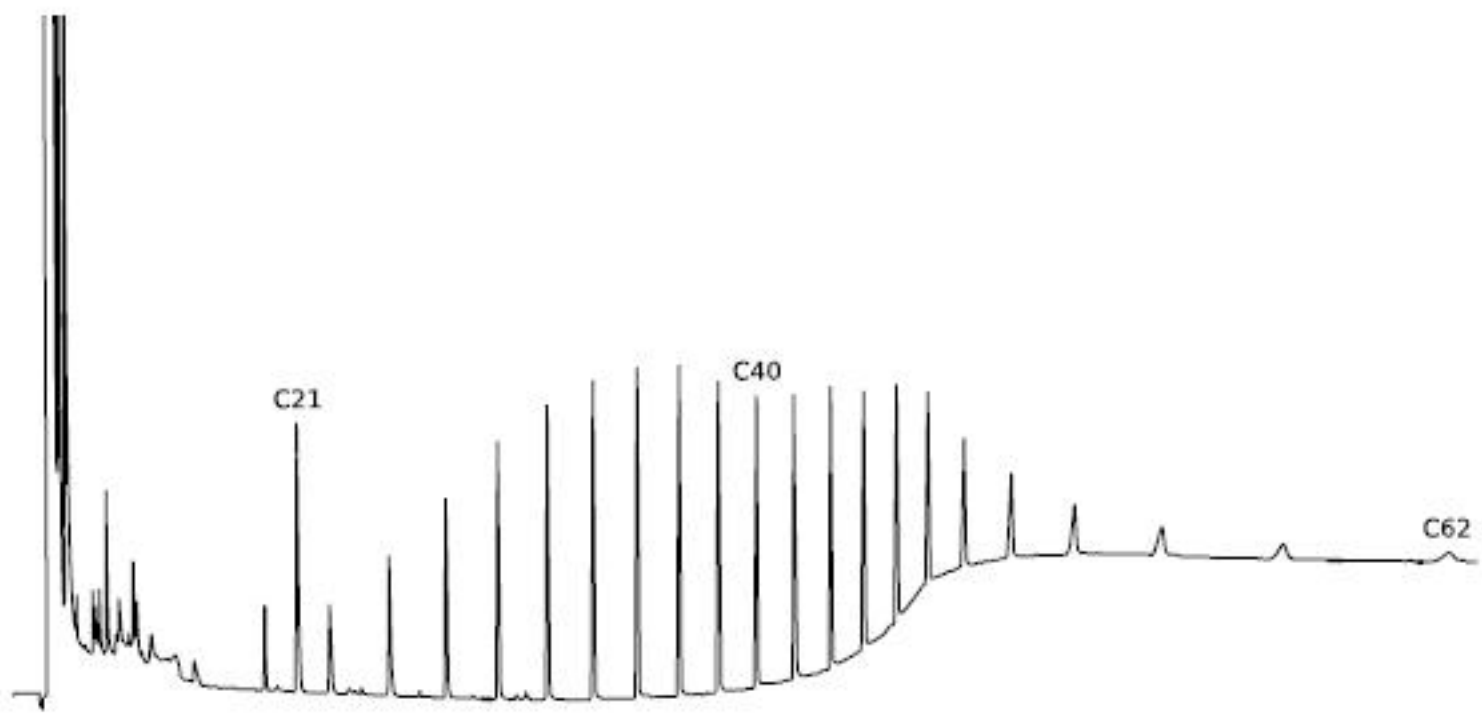

Figure 5. A Polywax 500 analysis on a 0.32 mm ID x 10 m L (1 m incorporated retention gap) x 0.05 µm FT, MEGA-Wax HT column. Another example of the use of the new Wax HT stationary phase for high temperature works. The sample introduction was made in On-Column mode.

Conclusions

The new MEGA-Wax column HT represents a novelty in the panorama of high polarity phases Carbowax. We think that the examples show the suitability of this new phase to meet the needs of having polar phases with an extended temperature range, especially to meet the modern needs of FAST-GC and GCxGC. At the present time in the Comprehensive 2DGC you are forced to find the best compromise between temperature limit of the column system and orthogonality between the two dimensions because of temperature limits given by more polar (and used) phases like Carbowax. We can move these limits a bit higher with the new Wax-HT column.
Furthermore, this column may be well used for conventional GC e.g. in combination with an apolar phase for a classic double-column configuration for MS systems. These systems, very often used in F&F labs for example, currently have big limitations because the usable temperature range of the apolar columns (like 5% phenyl phase) is reduced by the temperature limit of the normal Carbowax based phases.

We are still performing applications on this new stationary phase to find the maximum effective operating limits in temperature programmed mode with the best compromise of column lifetime. We are going on with the investigation on the possibility to use the Wax-HT for triglycerides analysis with the advantage to elute these heavy compounds below their decomposition temperature.

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You can see other performances of the new MEGA-Wax HT columns on the "*LC-GC Europe*" (February 2010 Issue) magazine, GC Connections section. Here applications of MEGA-Wax HT are shown both on Fast-GC and GCxGC use for Essential Oil analysis.
We wish to thank the authors of this paper for their work and their cooperation.

Click here and read the LCGC article about the new MEGA-Wax HT column.

Acknowledgments

We wish to thank Prof. Carlo Mariani (SSOG "Stazione Sperimentale per le industrie degli Oli e Grassi" - Via G. Colombo, 79 - 20133 Milano - Italy) for his knowledge support and for providing us the Biodiesel and sample standards.

Selection of Columns for GCxGC Analysis of Essential Oils

A capillary column coated with a high-temperature stable wax stationary phase for gas chromatography, with a recommended maximum oven temperature of 300 °C, was installed as part of a comprehensive two-dimensional gas chromatography (GC×GC) column ensemble and the suitability of this column set-up for essential oil analysis was investigated. The separation of kunzea essential oil (Kunzea ambigua), which is known for its antibacterial activity, is used to demonstrate the suitability of the new stationary..

Feb 1, 2010
By: Robert A. Shellie, Paul D. Morrison, Philip Mariott, Samuel D.H. Poynter
LCGC EUROPE
Volume 2, Issue 23, pp. 76-81

Introduction

Multidimensional separations are performed by combining single analytical separation columns in such a way to greatly enhance peak capacity for the separation of complex multi-component samples. Comprehensive multidimensional gas chromatography (GC×GC) employs largely independent first- and second-dimension separation mechanisms and typically generates peak capacity of the order of several thousand, making it a highly appropriate technology for the separation and analysis of complex multicomponent samples such as essential oils.

A substantial majority of GC×GC publications for essential oil analysis in the periodical literature have used a "non-polar" column in the first dimension and employed a "polar" column in the second dimension.[1] In practice this almost always translates to use of a 100% polydimethylsiloxane or 5% diphenyl 95% dimethyl polysiloxane stationary phase in the first-dimension combined with a 50% diphenyl 50% dimethyl polysiloxane or a polyethylene glycol (wax) second-dimension column, although there are notable departures from this convention, including applications reversing the order of "polarity",[2] providing class-type separation of citrus oil components and those using cyclodextrin derivative stationary phases for enantioselective analysis.[3–6] Even [illegible] ensemble is used, the mechanism o[illegible] volatility and polarity, but using an appropriate temperature programme cancels out the influence of volatility on retention in the second dimension column.[7] Thus, GC×GC separations are temperature-programmed to maximize differences in separation mechanisms in the two dimensions.

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However, because both columns are commonly installed in the same oven, the temperature stability of one of the separation columns typically imparts an upper temperature limit on the separation system. Applications that use 50% diphenyl 50% dimethyl polysiloxane second dimension columns are benefited in terms of high-temperature stability compared with those applications employing wax columns, but more suitable selectivity of wax columns for polar essential oil components was shown many years ago and wax stationary phases are almost universally preferred.[8]

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Recently, we received a 5 m × 100 µm i.d. MEGA-WAX HT high-temperature wax column with a stationary phase film thickness of 0.10 µm (Mega, Legnano, Italy) and have been using this column for our GC×GC work involving essential oils analysis. The wax second dimension column used in the current investigation has more than 9000 N/m tested in isothermal mode and an upper column oven limit of 300 °C. Results from the GC×GC analysis of kunzea essential oil obtained by steam distillation of aerial parts of *Kunzea ambigua* are reported here.

Results

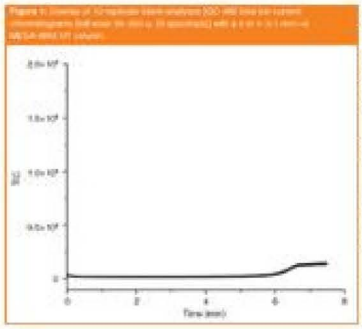
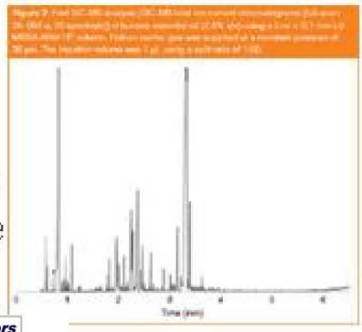


Figure 1

Kunzea ambigua is a shrub native to the Eastern parts of Australia. As an effective killer of bacteria, kunzea essential oil has numerous traditional folk medicine uses and researchers have recently developed a kunzea oil formulation for veterinary use.[9] Kunzea oil is rich in sesquiterpene alcohols and as a consequence one-dimensional GC lacks the resolving power to provide adequate separation of the complex oil. In the present investigation a GC×GC column set comprising a 30 m × 250 µm i.d. Rxi-5Sil MS column with a stationary phase film thickness of 0.25 µm (Restek, Bellefonte, Pennsylvania, USA) was installed as the first dimension separation column and the second dimension column was a 1 m × 100 µm i.d. MEGA-WAX HT column with a stationary phase film thickness of 0.10 µm. The primary goal of this investigation was to determine the suitability of the MEGA-WAX HT column as a second-dimension column for essential oil analysis, in particular for providing adequate separation of the sesquiterpene alcohols in kunzea oil. To date, we have not attempted comprehensive peak identification of the essential oil components using GC×GC–MS but we anticipate that these results will be reported in time.



Prior to removing a 1.0 m length from the MEGA-WAX HT column, a series of fast GC–MS analyses were performed using the 5 m column as received. All analyses were performed using a Shimadzu GC–MS-QP2010-Plus (Shimadzu Oceania, Melbourne, Australia). A fast temperature programmed gradient from 40 °C to 300 °C in 6.5 min (40 °C/min) was employed for these analyses and the oven was held at the maximum temperature for 1 min at the end of the temperature programme. The carrier gas (He) was delivered at a constant pressure of 36 psi. Figure 2 analyses [GC–MS total ion current chromatograms (full-scan 35–350 u, 20 spectra/s)] that were performed to assess the level of stationary phase bleed. Even using a reasonably aggressive rapid temperature programme rate up to 300 °C these results are highly satisfactory. The average baseline response (n = 10) at the maximum oven temperature (6.5–7.5 min) was less than 7.5× the average baseline response recorded between 2 and 5 min.

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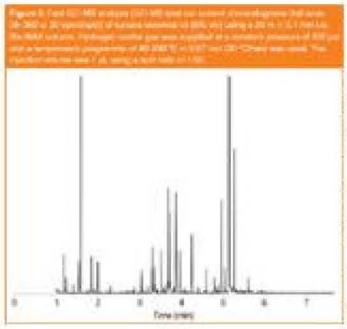

Figure 3

Fast GC–MS analysis of the kunzea essential oil was also performed using this configuration and a typical chromatogram is shown in Figure 2. Note the maximum intensity of the small peak marked # in Figure 2, which has a low relative peak intensity of 1.09%, is more than 19× the average baseline response between 2 and 5 min. To compare the general selectivity of the MEGA-WAX HT column, a fast GC–MS chromatogram of kunzea essential oil using a 20 m × 100 µm i.d. Rtx-WAX column is shown in Figure 3. Temperature effects as well as differences in the stationary phase chemistry each influence the absolute retention order so an attempt to overlay these chromatograms would be pointless. The MEGA-WAX HT column is also 75% shorter than the Rtx-WAX column, so the resolution using the latter column is understandably better. Nonetheless, elution of the monoterpene and sesquiterpene hydrocarbons, followed by the monoterpene and sesquiterpene alcohols is in general congruence between the two columns.

Acknowledgements

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Samuel Poynter is a PhD student in ACROSS at University of Tasmania (UTAS).

Robert Shellie is senior lecturer at UTAS. He leads a research group in ACROSS (UTAS) that focuses on development and application of hyphenated techniques in chromatography to solve complex separation problems.

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9. J. Thomas et al., *Vet. Rec.*, **164**, 619–623 (2009)

10. J. Beens et al., *J. Chromatogr. A*, **919**(1), 1

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What is FAST-GC

What is FAST-GC.

FAST-GC is a technique that allows you to reduce the analysis time while keeping an adequate resolution power, thus increasing your throughput.

FAST-GC can be applied to medium-to-high complexity mixtures analysis and provides 3-10x faster analysis compared to conventional GC.

What you need to make FAST-GC.

To accomplish the FAST-GC you will simply need:

- a shorter column with a smaller internal diameter (so-called "narrow-bore" columns). Typically a 100µm ID x 5 or 10m length columns are used.
- an high temperature rate (usually more than 15°C/min) and a fast acquisition frequency on your detector (see Figure 1 to see how the acquisition frequency does affect the peak shape in FAST-GC).

Just contact us at info@mega.mi.it to have more information.

Some fundamental theoretical notion to better understand FAST-GC.

The parameter that best describes the theoretical separation power of a gas-chromatographic capillary column is the **number of the theoretical plates (N)**.

N is calculated as:

$$N = \frac{L}{H}; \qquad (H \sim ID)$$

where L is the column length and H is the height of the theoretical plates that can be approximated very well with the column's internal diameter (ID).

Is then easy to calculate that a conventional column 0.25mm ID x 25m has 100000 theoretical plates (N). But reducing the internal diameter of the column, we can keep constant the value of N reducing the length of the column. In fact a 100µm ID x 10m has as well 100000 theoretical plates that is the same separation power provided by a conventional GC column.

Narrow bore short columns consent to use high temperature rates and high linear velocities maintaining optimal conditions during the practical usage. That is why, to reduce columns sizes allows to speed up your analysis while retaining a proper separation level.

The importance of the selectivity of the stationary phase in FAST-GC.

The selectivity of the stationary phase is a **key parameter** in gas-chromatography. It takes an even more important role in FAST-GC, where it helps to compensate a natural compression of the peaks, in particular of critical pairs of peaks, in the very short "fast" analysis time.
Have the right selectivity gives the way to solve even very difficult analytical problems but keeping all the advantages of the FAST-GC technique.
In the following pages you will find some application notes where the selectivity of the stationary phase has been investigated and where is role is emphasized.

Principal Parameters Comparison

Conventional GC	**FAST-GC**
Column: *usually columns 0.25mm/0.32mm I.D. x 25m, 30m or 50m length.*	Column: usually columns 0.05mm/0.10mm I.D. x 2.5m, 5m or 10m length.
Temperature Rates: *1 - 15°C/min.*	Temperature Rates: 15 - 60°C/min.
Injection: *using standard injection techniques, is possible to inject quite large quantities (typically 1 - 2µL of a diluted solution with a split ratio of 1:20).*	Injection: the injected quantity has to be at least 10x less than conventional GC. Usually split ratio of 1:100 or higher are used with diluted solutions (< 100ppm).
Carrier Gas: *typical flows are not less than 0.8mL/min with head pressures of 40 - 130kPa depending on column dimensions and carrier gas type (visit the "support-download" page on www.mega.mi.it to see and download the table with the recommended pressures and flows).*	Carrier Gas: typical flows do not exceed 0.9 - 1mL/min with higher head pressures (until 200-250kPa for 0.10mm I.D. columns, and until 300kPa or more for 0.05mm I.D. columns) anyway depending on column dimensions and carrier gas type (visit the "support-download" page on www.mega.mi.it to see and download the table with the recommended pressures and flows).
Peak Width: *2 - 5 seconds.*	Peak Width: 0.5 - 2 seconds.
Detector: *any type of detector for GC can be used.*	Detector: any type of detector for GC can be used. It is only necessary that the acquisition frequency is at least 50Hz (see page 4, Figure 1).
Analysis Time: *20 - 60 min.*	Analysis Time: 1 - 10 min.

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Acquisition Frequency in FAST-GC

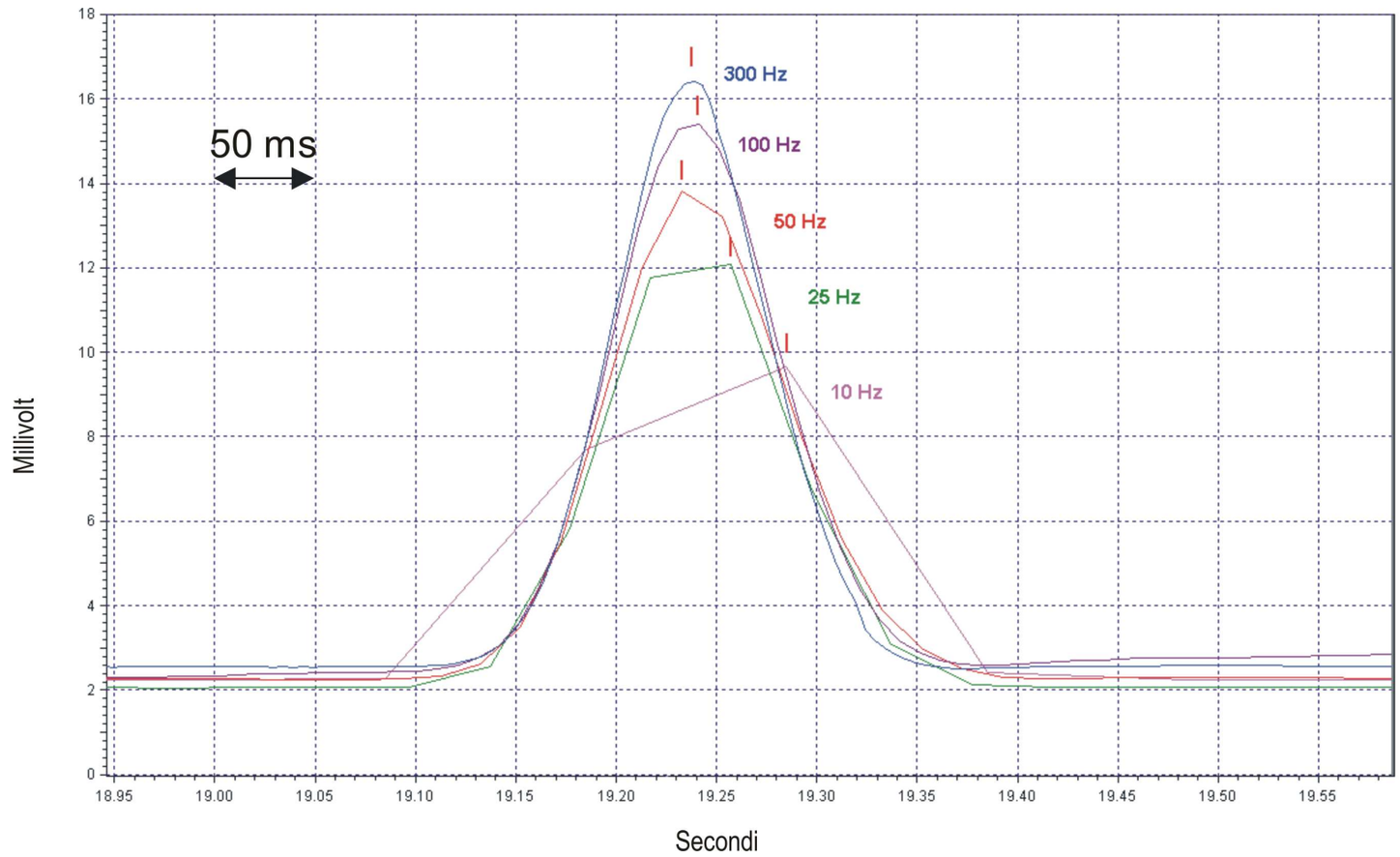

Figure 1 - Effect of the acquisition frequency on the peak shape. In FAST-GC, peaks could have very narrow width (even less than 500ms). For this reason is important to have an "high-speed" detector able to collect at least 10 points for every peak, thus to correctly describe the peak itself. In this way the peak can be properly integrated and quantified. **In FAST-GC an acquisition rate of at least 50Hz is recommended.**

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Typical FAST-GC columns dimensions

FAST-GC solutions

Internal Diameter	Length	Film Thickness	Theoretical Plates (N)
50µm	2.5m	0.05µm, 0.10µm	50000
	5m		100000
100µm	5m	0.10µm, 0.20µm	50000
	10m		100000

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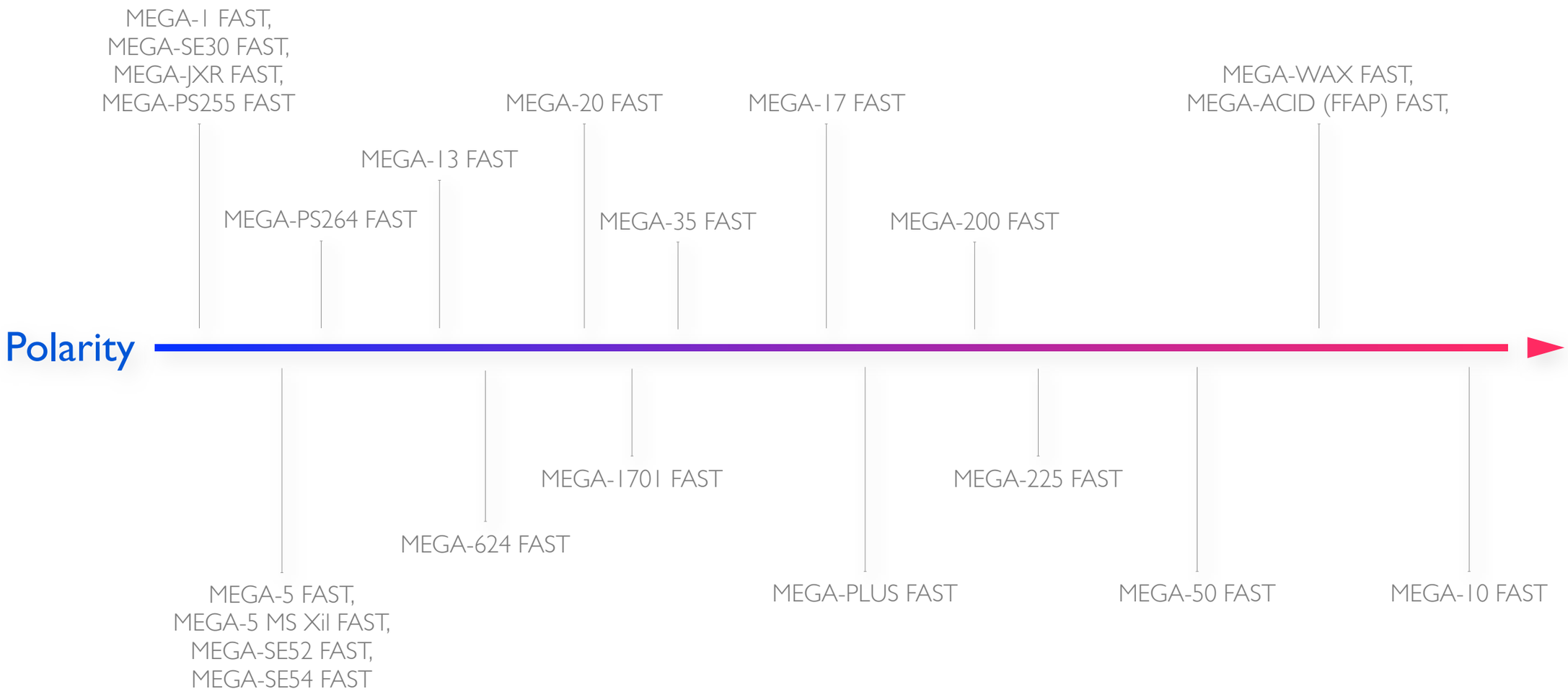
FAST-GC available stationary phases from MEGA



And even more...our MEGA-VOC 1 & 2 FAST , MEGA-POF 1 & 2 FAST unique stationary phases, MEGA-TNT 8095 FAST and our exclusive MEGA-DEX chiral columns FAST line.
Visit our website to find all our stationary phases and you can also ask us for custom solutions.

Considering the importance of the selectivity in FAST-GC, MEGA can offer more than 30 different stationary phases for your FAST-GC analysis. We are also able to tune the selectivity for your specific analytical needs with our MEGA-2D technology and using our experience in the mixed phases works [1], [2].

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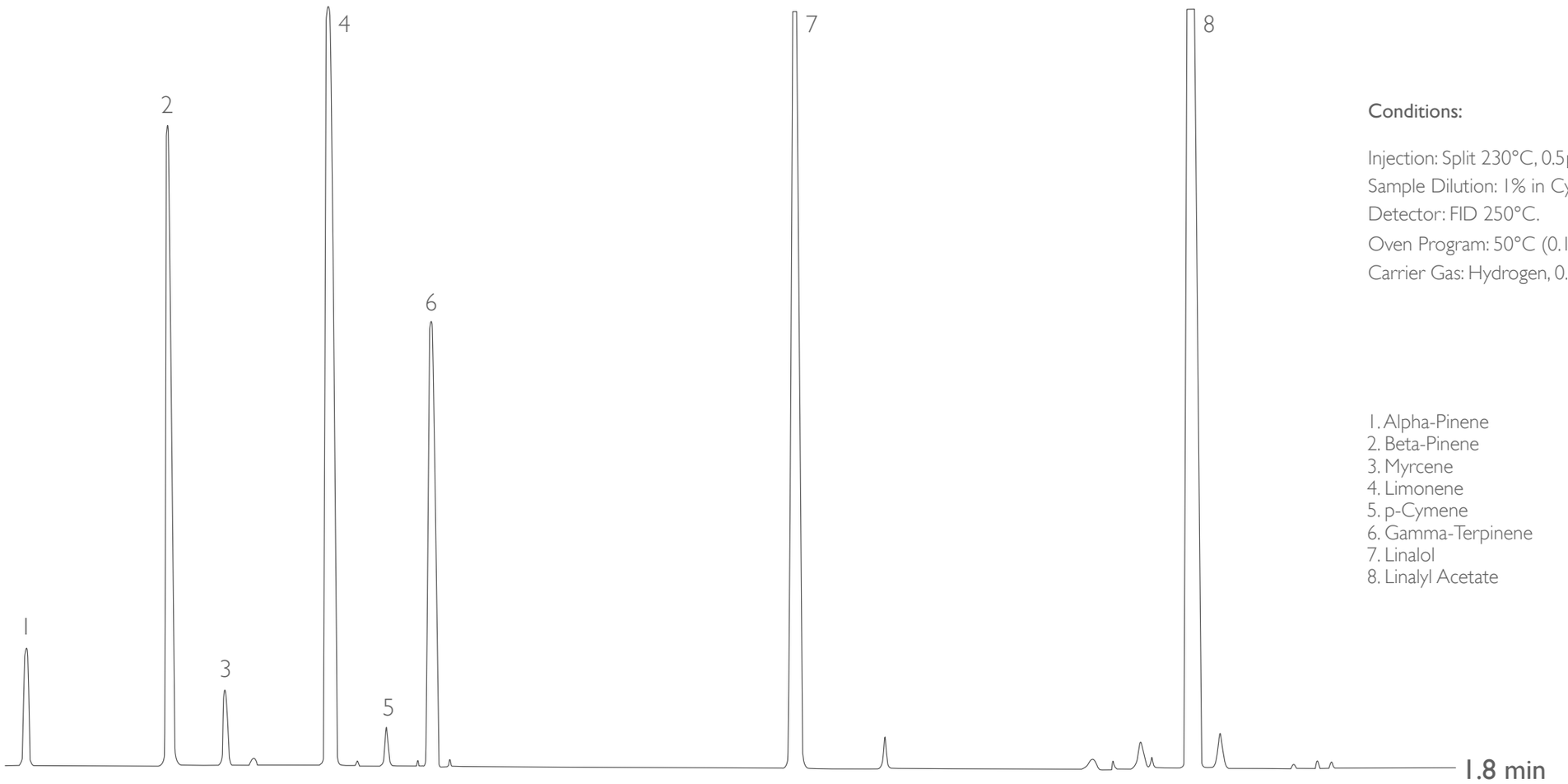
Bergamot Essential Oil

Column: **MEGA-1701 FAST - 0.10mm, 0.10µm, 5m**
Catalog Code: F-1701-010-010-5



Conditions:

Injection: Split 230°C, 0.5µL, 1:250 Split Ratio.
Sample Dilution: 1% in Cyclohexane.
Detector: FID 250°C.
Oven Program: 50°C (0.1min), 50°C/min, 250°C.
Carrier Gas: Hydrogen, 0.5mL/min.

1. Alpha-Pinene
2. Beta-Pinene
3. Myrcene
4. Limonene
5. p-Cymene
6. Gamma-Terpinene
7. Linalol
8. Linalyl Acetate

Acknowledgement: **Prof. C. Bicchi, C.Brunelli et al.**, Università di Torino, Dipartimento di Scienza e Tecnologia del Farmaco, Via Pietro Giuria, 9 - Torino - Italy.

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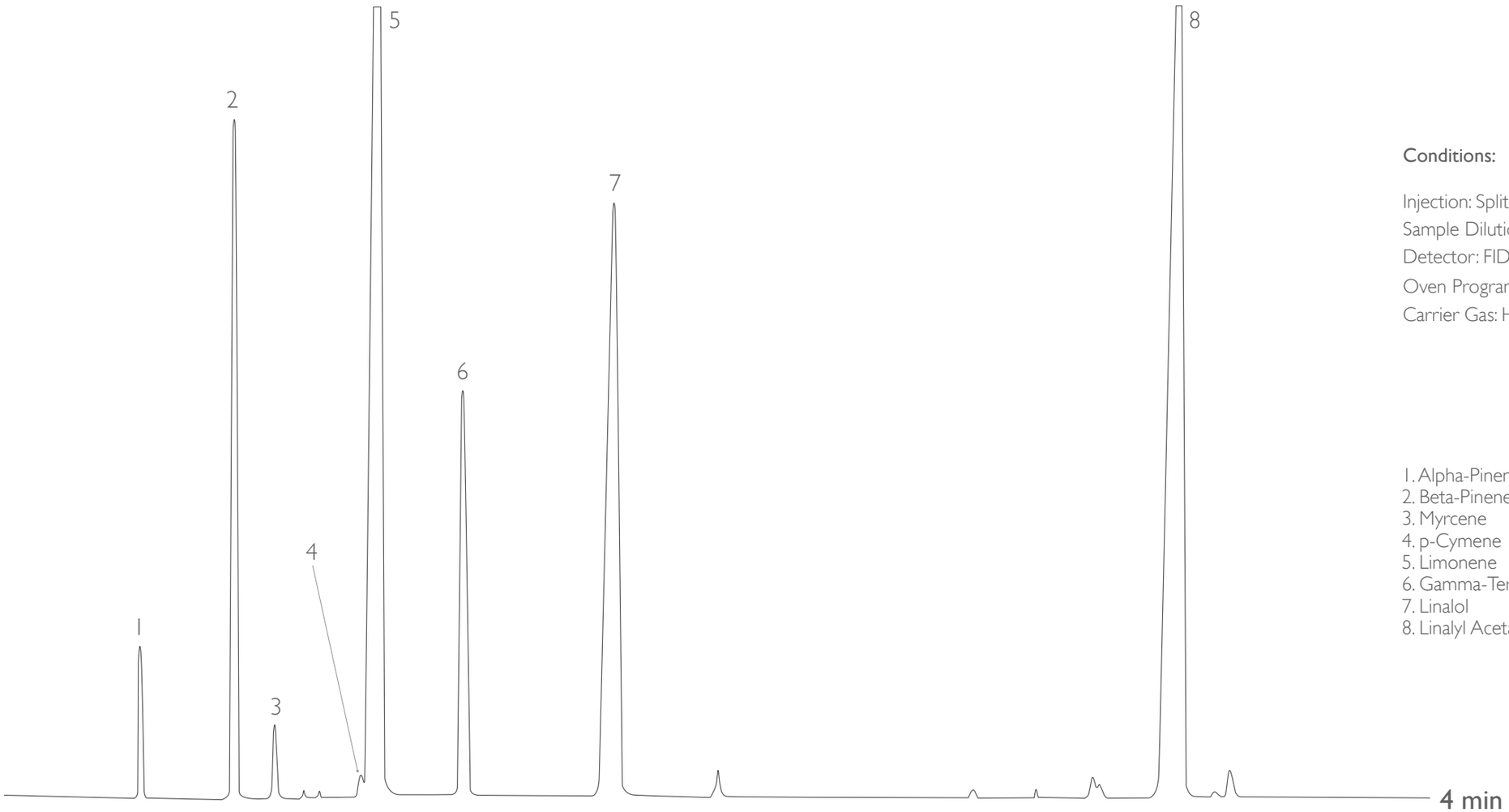
Bergamot Essential Oil

Column: **MEGA-SE54 FAST - 0.10mm, 0.10µm, 5m**
Catalog Code: F-SE54-010-010-5



Conditions:

Injection: Split 230°C, 0.5µL, 1:250 Split Ratio.
Sample Dilution: 1% in Cyclohexane.
Detector: FID 250°C.
Oven Program: 50°C (0.1min), 30°C/min, 250°C.
Carrier Gas: Hydrogen, 0.5mL/min.

1. Alpha-Pinene
2. Beta-Pinene
3. Myrcene
4. p-Cymene
5. Limonene
6. Gamma-Terpinene
7. Linalol
8. Linalyl Acetate

Acknowledgement: **Prof. C. Bicchi, C.Brunelli et al.**, Università di Torino, Dipartimento di Scienza e Tecnologia del Farmaco, Via Pietro Giuria, 9 - Torino - Italy.

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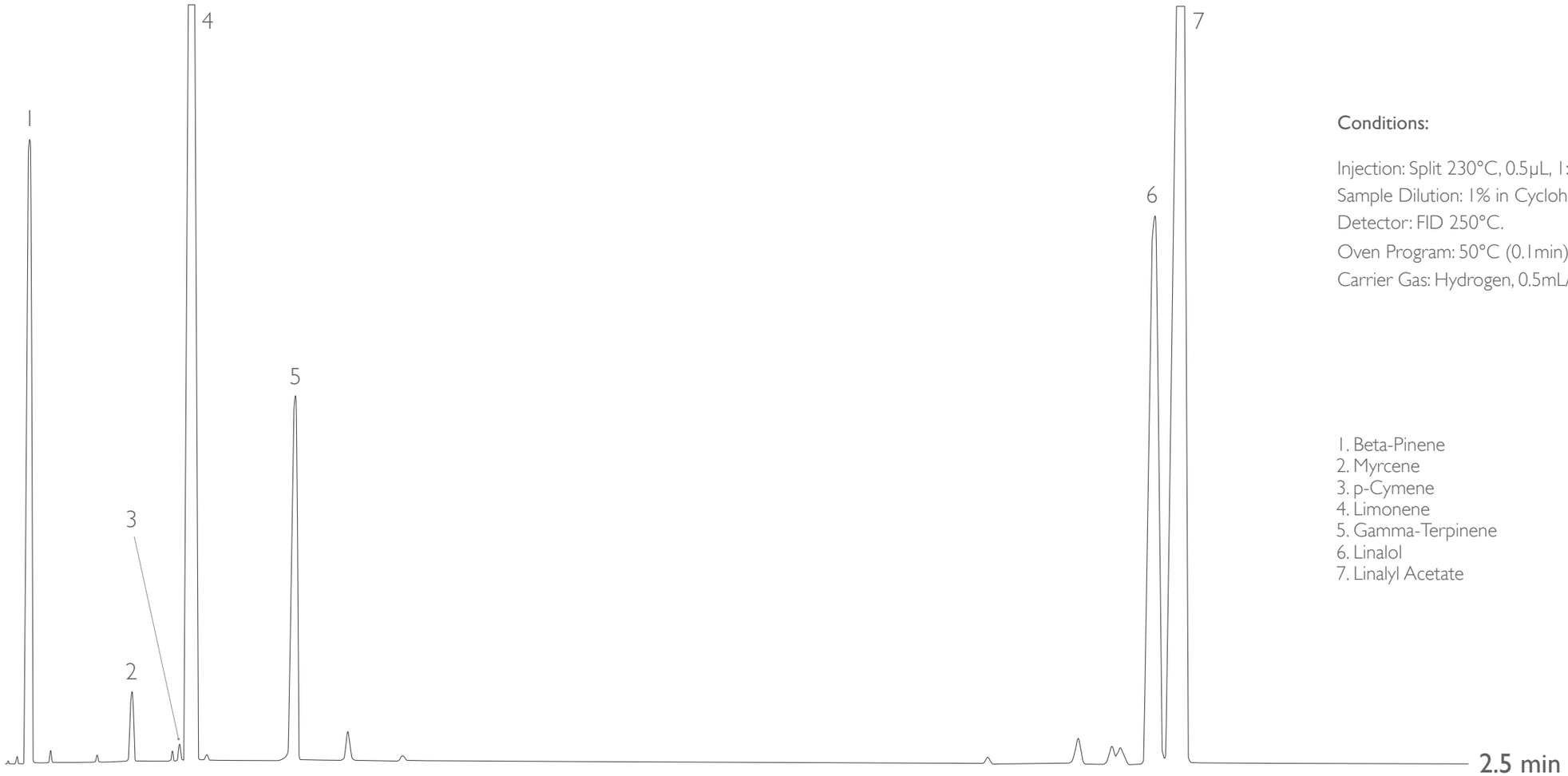
Bergamot Essential Oil

Column: **MEGA-WAX FAST - 0.10mm, 0.10µm, 5m**
Catalog Code: F-WAX-010-010-5



Conditions:

Injection: Split 230°C, 0.5µL, 1:250 Split Ratio.
Sample Dilution: 1% in Cyclohexane.
Detector: FID 250°C.
Oven Program: 50°C (0.1min), 30°C/min, 250°C.
Carrier Gas: Hydrogen, 0.5mL/min.

1. Beta-Pinene
2. Myrcene
3. p-Cymene
4. Limonene
5. Gamma-Terpinene
6. Linalol
7. Linalyl Acetate

Acknowledgement: **Prof. C. Bicchi, C.Brunelli et al.**, Università di Torino, Dipartimento di Scienza e Tecnologia del Farmaco, Via Pietro Giuria, 9 - Torino - Italy.

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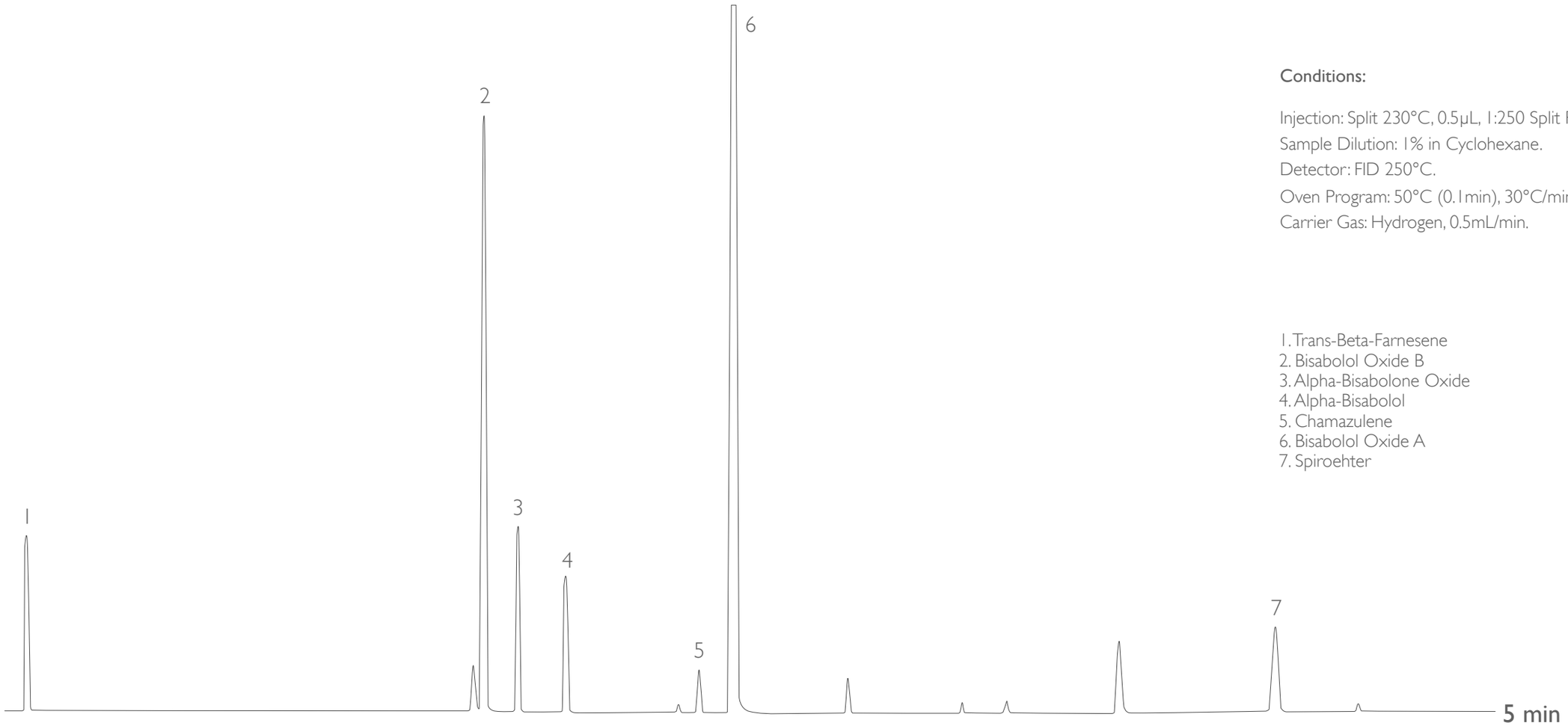
Chamomile Essential Oil

Column: **MEGA-WAX FAST - 0.10mm, 0.10µm, 5m**
Catalog Code: F-WAX-010-010-5



Conditions:

Injection: Split 230°C, 0.5µL, 1:250 Split Ratio.
Sample Dilution: 1% in Cyclohexane.
Detector: FID 250°C.
Oven Program: 50°C (0.1min), 30°C/min, 250°C.
Carrier Gas: Hydrogen, 0.5mL/min.

1. Trans-Beta-Farnesene
2. Bisabolol Oxide B
3. Alpha-Bisabolone Oxide
4. Alpha-Bisabolol
5. Chamazulene
6. Bisabolol Oxide A
7. Spiroehter

Acknowledgement: **Prof. C. Bicchi, C.Brunelli et al.**, Università di Torino, Dipartimento di Scienza e Tecnologia del Farmaco, Via Pietro Giuria, 9 - Torino - Italy.

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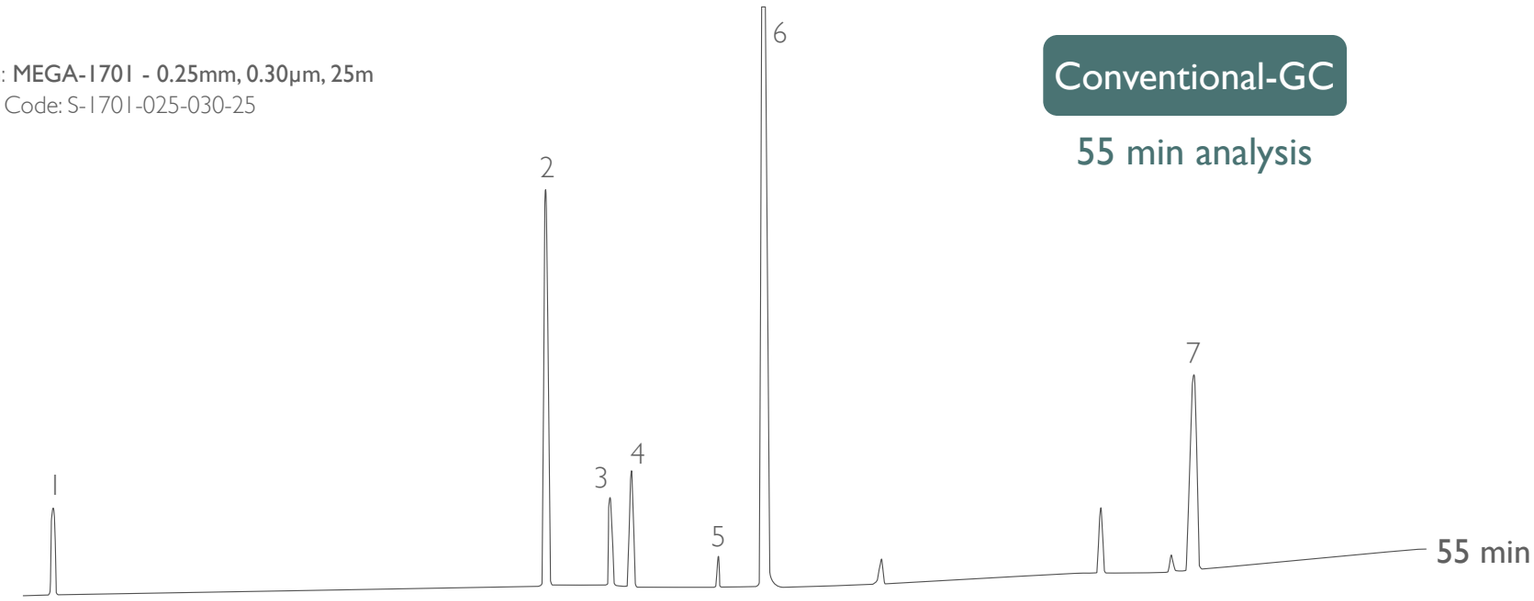
Chamomile Essential Oil

Column: **MEGA-1701 - 0.25mm, 0.30µm, 25m**
Catalog Code: S-1701-025-030-25

Conventional-GC

55 min analysis



Conventional-GC Conditions:

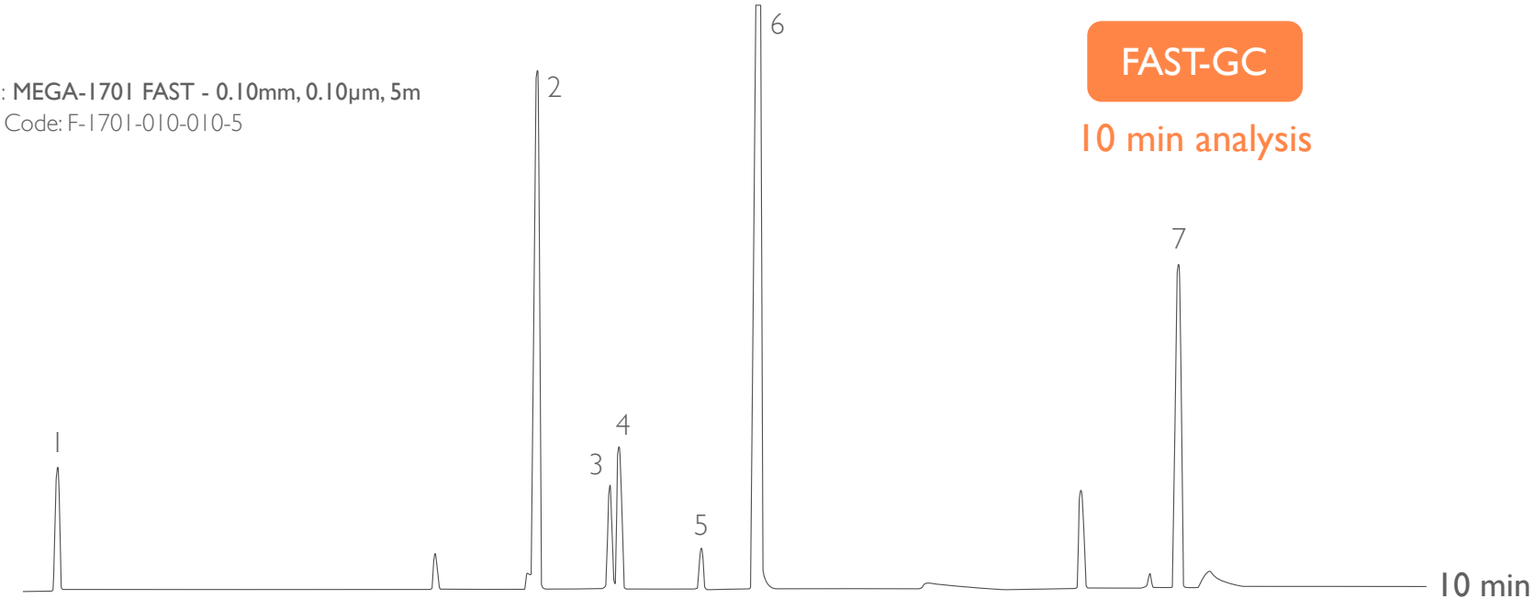
Injection: Split 230°C, 1µL, 1:50 Split Ratio.
Sample Dilution: 1% in Cyclohexane.
Detector: FID 250°C.
Oven Program: 50°C (0.1min), 3°C/min, 250°C (5min).
Carrier Gas: Hydrogen, 1.5mL/min.

1. Trans-Beta-Farnesene
2. Bisabolol Oxide B
3. Alpha-Bisabolol
4. Alpha-Bisabolone Oxide
5. Chamazulene
6. Bisabolol Oxide A
7. Spiroether

Column: **MEGA-1701 FAST - 0.10mm, 0.10µm, 5m**
Catalog Code: F-1701-010-010-5

FAST-GC

10 min analysis



FAST-GC Conditions:

Injection: Split 230°C, 0.5µL, 1:250 Split Ratio.
Sample Dilution: 1% in Cyclohexane.
Detector: FID 250°C.
Oven Program: 50°C (0.1min), 50°C/min, 250°C (5min).
Carrier Gas: Hydrogen, 0.5mL/min.

Acknowledgement: **Prof. C. Bicchi, C.Brunelli et al.**, Università di Torino, Dipartimento di Scienza e Tecnologia del Farmaco, Via Pietro Giuria, 9 - Torino - Italy.

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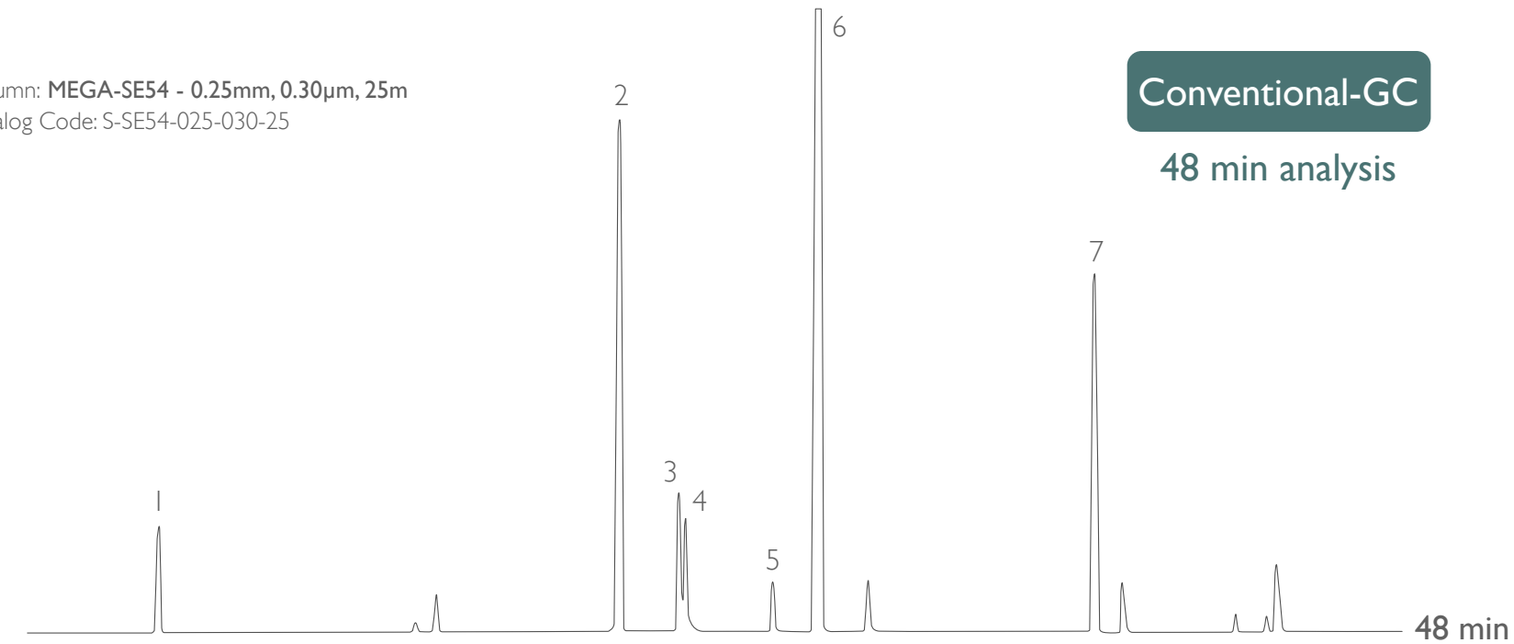
Chamomile Essential Oil

Column: **MEGA-SE54 - 0.25mm, 0.30µm, 25m**
Catalog Code: S-SE54-025-030-25

Conventional-GC

48 min analysis



Conventional-GC Conditions:

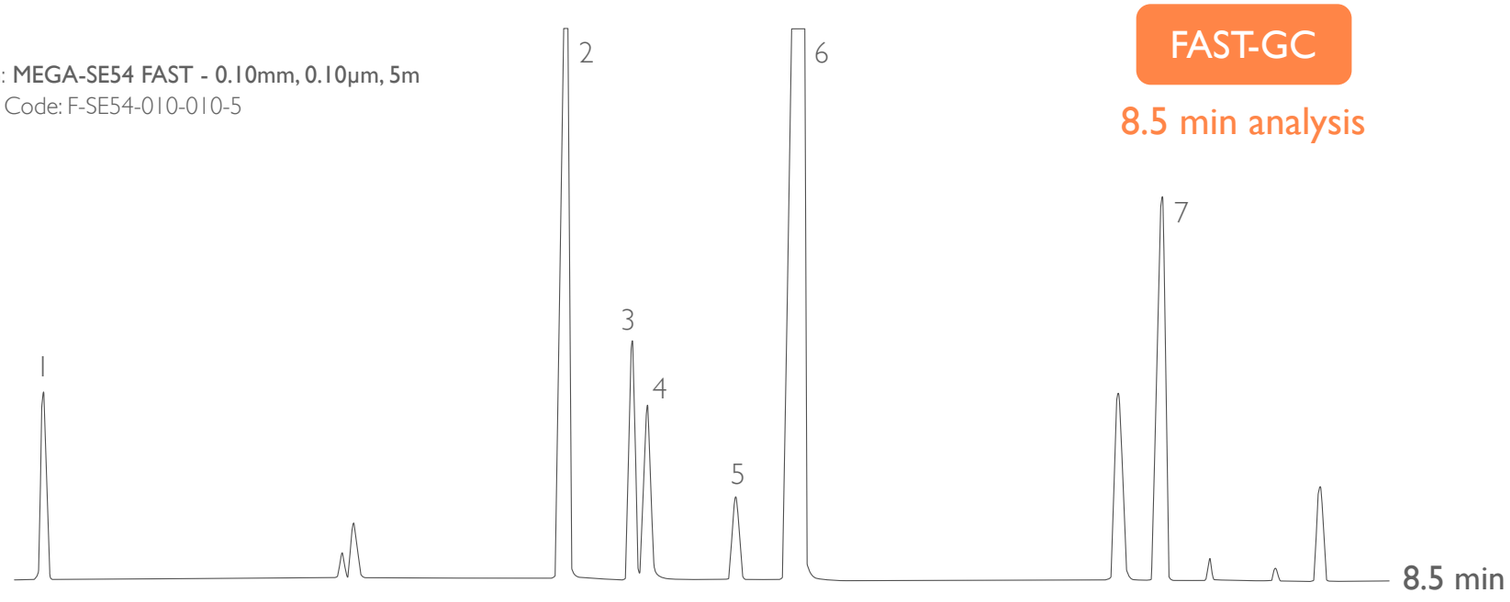
Injection: Split 230°C, 1µL, 1:50 Split Ratio.
Sample Dilution: 1% in Cyclohexane.
Detector: FID 250°C.
Oven Program: 50°C (0.1min), 3°C/min, 250°C (5min).
Carrier Gas: Hydrogen, 1.5mL/min.

1. Trans-Beta-Farnesene
2. Bisabolol Oxide B
3. Alpha-Bisabolone Oxide
4. Alpha-Bisabolol
5. Chamazulene
6. Bisabolol Oxide A
7. Spiroether

Column: **MEGA-SE54 FAST - 0.10mm, 0.10µm, 5m**
Catalog Code: F-SE54-010-010-5

FAST-GC

8.5 min analysis



FAST-GC Conditions:

Injection: Split 230°C, 0.5µL, 1:250 Split Ratio.
Sample Dilution: 1% in Cyclohexane.
Detector: FID 250°C.
Oven Program: 50°C (0.1min), 50°C/min, 250°C (5min).
Carrier Gas: Hydrogen, 0.5mL/min.

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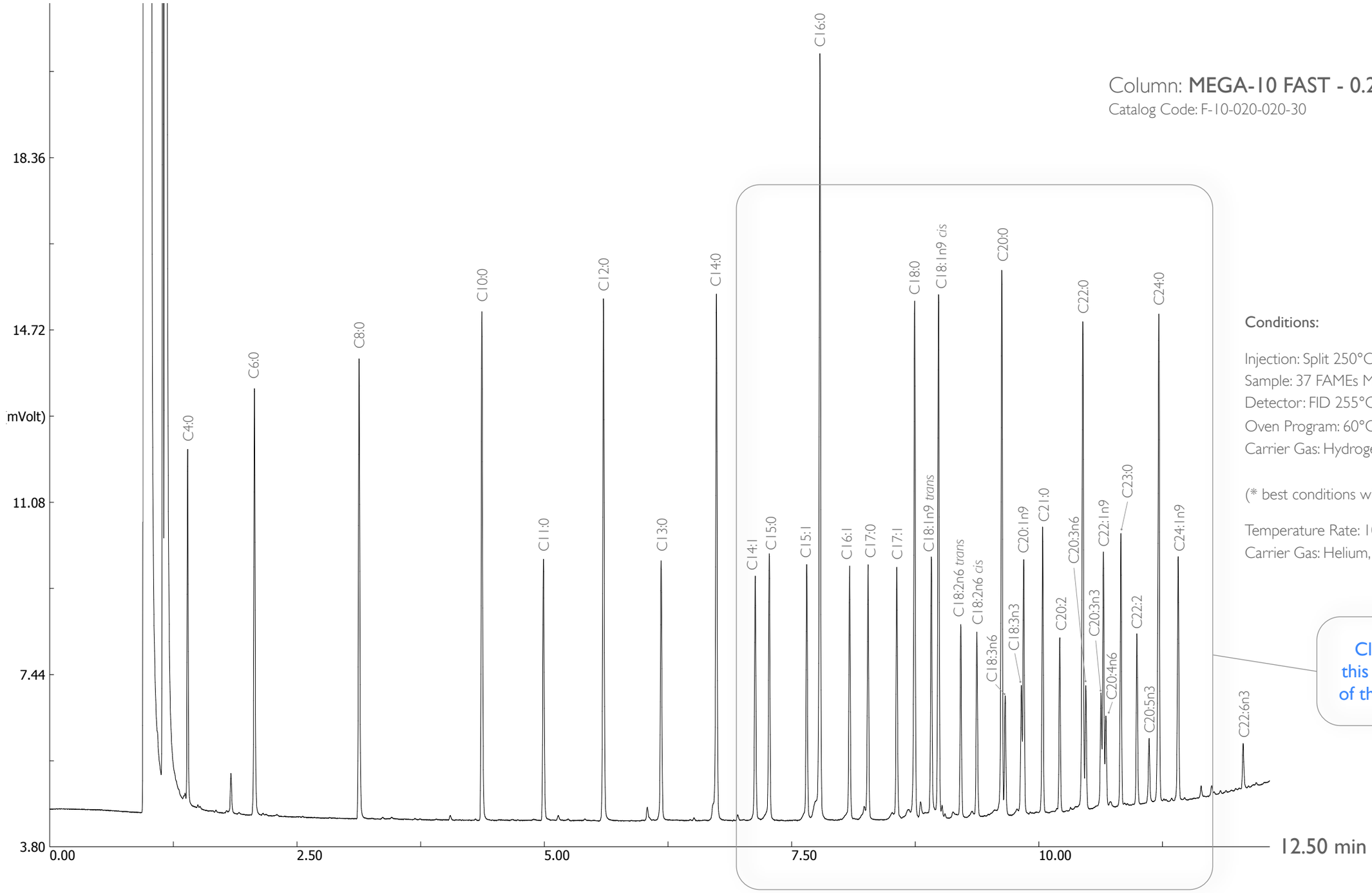
FAMEs *cis-trans* isomers



Column: **MEGA-10 FAST - 0.20mm, 0.20µm, 30m**

Catalog Code: F-10-020-020-30

Conditions:

Injection: Split 250°C, 0.5µL, 1:250 Split Ratio.
Sample: 37 FAMEs Mix (Supelco cat. #: 47885-U).
Detector: FID 255°C.
Oven Program: 60°C, 15°C/min, 250°C.*
Carrier Gas: Hydrogen, 150 kPa.*

(* best conditions with Helium Carrier Gas:

Temperature Rate: 10 - 12°C/min.
Carrier Gas: Helium, 180 - 200 kPa.)

Click here to see this zoomed portion of the chromatogram

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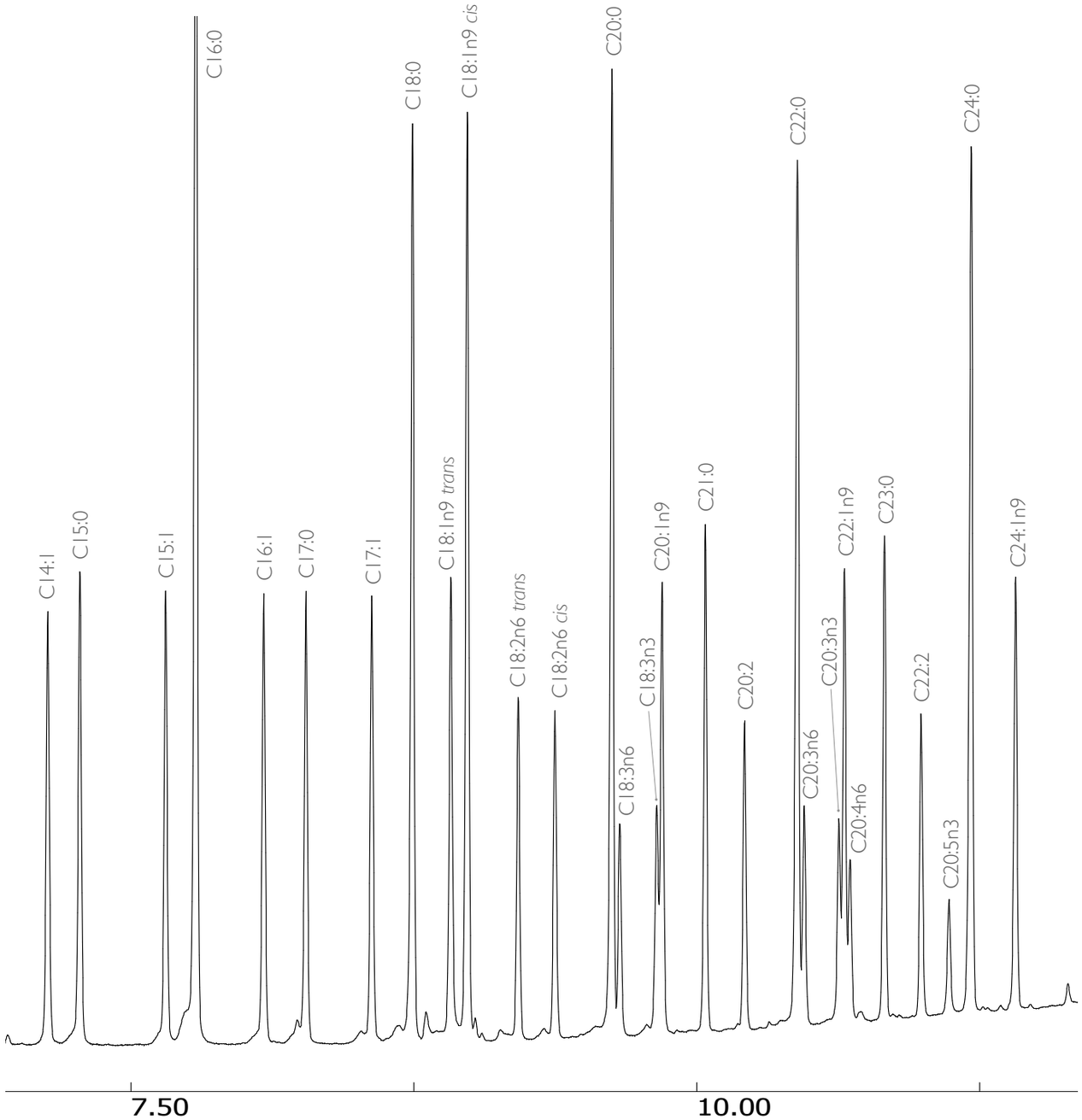
FAMEs *cis-trans* isomers detail



Column: **MEGA-10 FAST - 0.20mm, 0.20µm, 30m**
Catalog Code: F-10-020-020-30

Conditions:

Injection: Split 250°C, 0.5µL, 1:250 Split Ratio.
Sample: 37 FAMEs Mix (Supelco cat. #: 47885-U).
Detector: FID 255°C.
Oven Program: 60°C, 15°C/min, 250°C.*
Carrier Gas: Hydrogen, 150 kPa.*

(* best conditions with Helium Carrier Gas:

Temperature Rate: 10 - 12°C/min.
Carrier Gas: Helium, 180 - 200 kPa.)

Click here to go to the previous page and see the complete chromatogram

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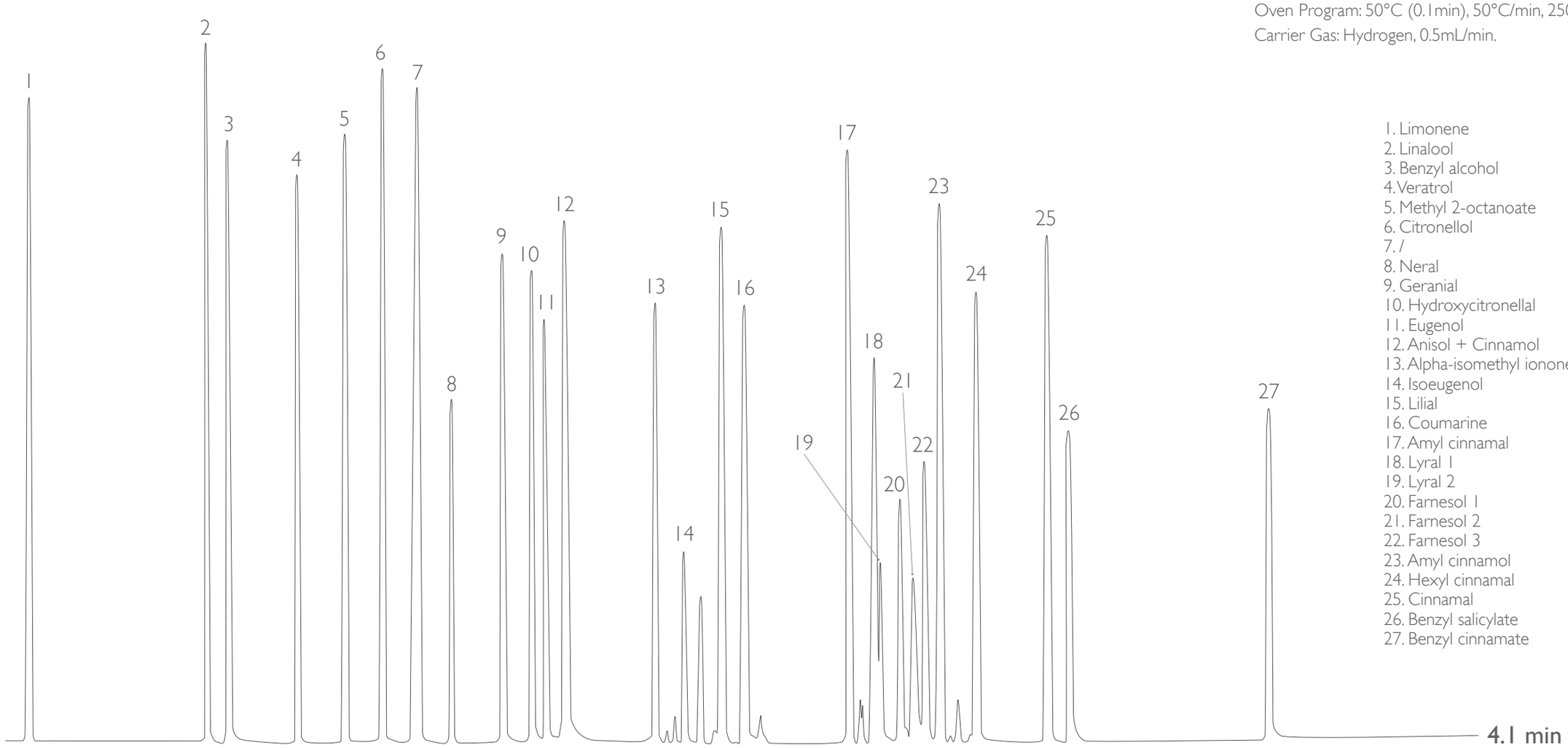
Fragrance Allergens

Column: **MEGA-1701 FAST - 0.10mm, 0.10µm, 5m**
Catalog Code: F-1701-010-010-5

Conditions:

Injection: Split 230°C, 0.5µL, 1:300 Split Ratio.
Sample Dilution: 1% in Cyclohexane.
Detector: FID 250°C.
Oven Program: 50°C (0.1min), 50°C/min, 250°C (5min).
Carrier Gas: Hydrogen, 0.5mL/min.



1. Limonene
2. Linalool
3. Benzyl alcohol
4. Veratrol
5. Methyl 2-octanoate
6. Citronellol
7. /
8. Neral
9. Geranial
10. Hydroxycitronellal
11. Eugenol
12. Anisol + Cinnamol
13. Alpha-isomethyl ionone
14. Isoeugenol
15. Lilial
16. Coumarine
17. Amyl cinnamal
18. Lyral 1
19. Lyral 2
20. Farnesol 1
21. Farnesol 2
22. Farnesol 3
23. Amyl cinnamol
24. Hexyl cinnamal
25. Cinnamal
26. Benzyl salicylate
27. Benzyl cinnamate

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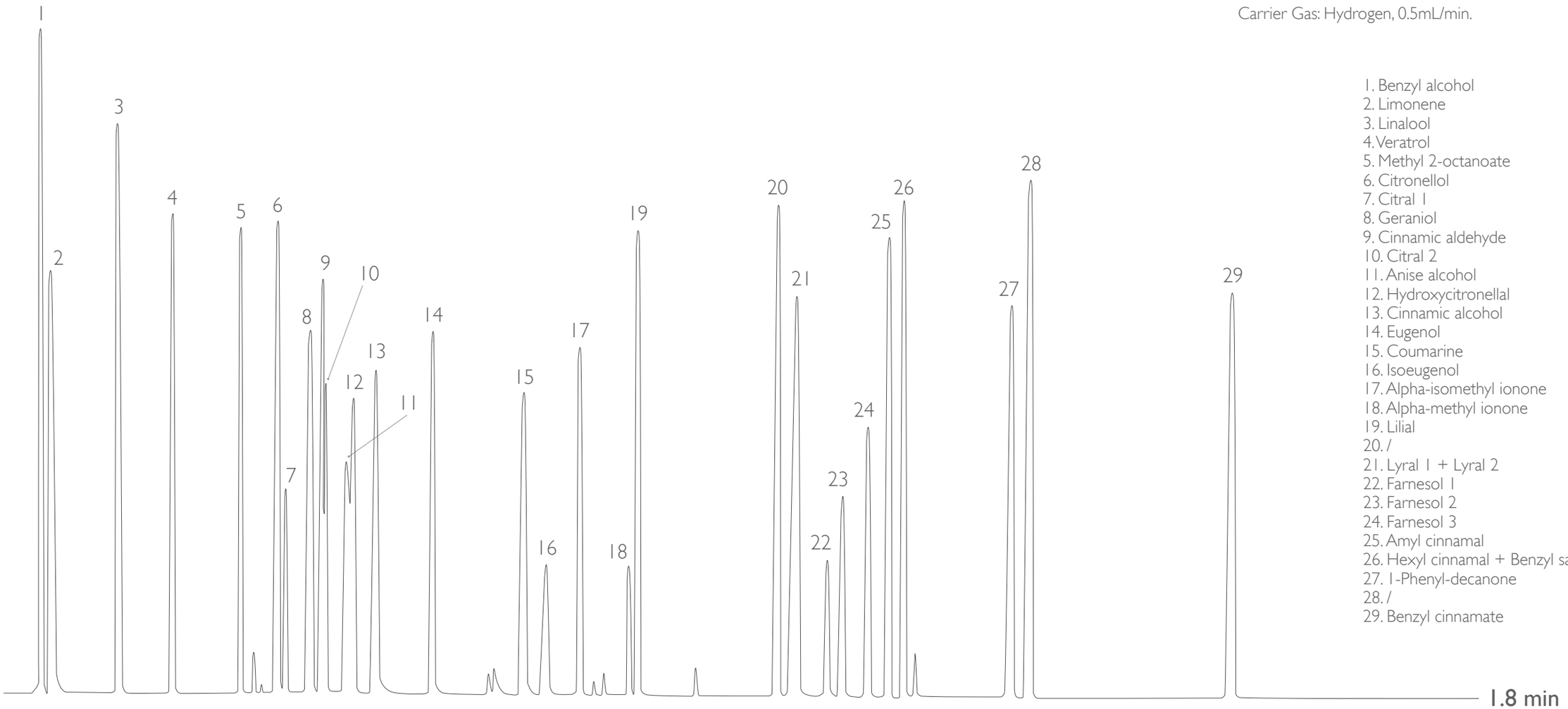
Fragrance Allergens

Column: **MEGA-SE54 FAST - 0.10mm, 0.10µm, 5m**
Catalog Code: F-SE54-010-010-5

Conditions:

Injection: Split 230°C, 0.5µL, 1:300 Split Ratio.
Sample Dilution: 1% in Cyclohexane.
Detector: FID 250°C.
Oven Program: 50°C (0.1min), 50°C/min, 250°C (5min).
Carrier Gas: Hydrogen, 0.5mL/min.



1. Benzyl alcohol
2. Limonene
3. Linalool
4. Veratrol
5. Methyl 2-octanoate
6. Citronellol
7. Citral 1
8. Geraniol
9. Cinnamic aldehyde
10. Citral 2
11. Anise alcohol
12. Hydroxycitronellal
13. Cinnamic alcohol
14. Eugenol
15. Coumarine
16. Isoeugenol
17. Alpha-isomethyl ionone
18. Alpha-methyl ionone
19. Lilial
20. /
21. Lyral 1 + Lyral 2
22. Farnesol 1
23. Farnesol 2
24. Farnesol 3
25. Amyl cinnamal
26. Hexyl cinnamal + Benzyl salicylate
27. 1-Phenyl-decanone
28. /
29. Benzyl cinnamate

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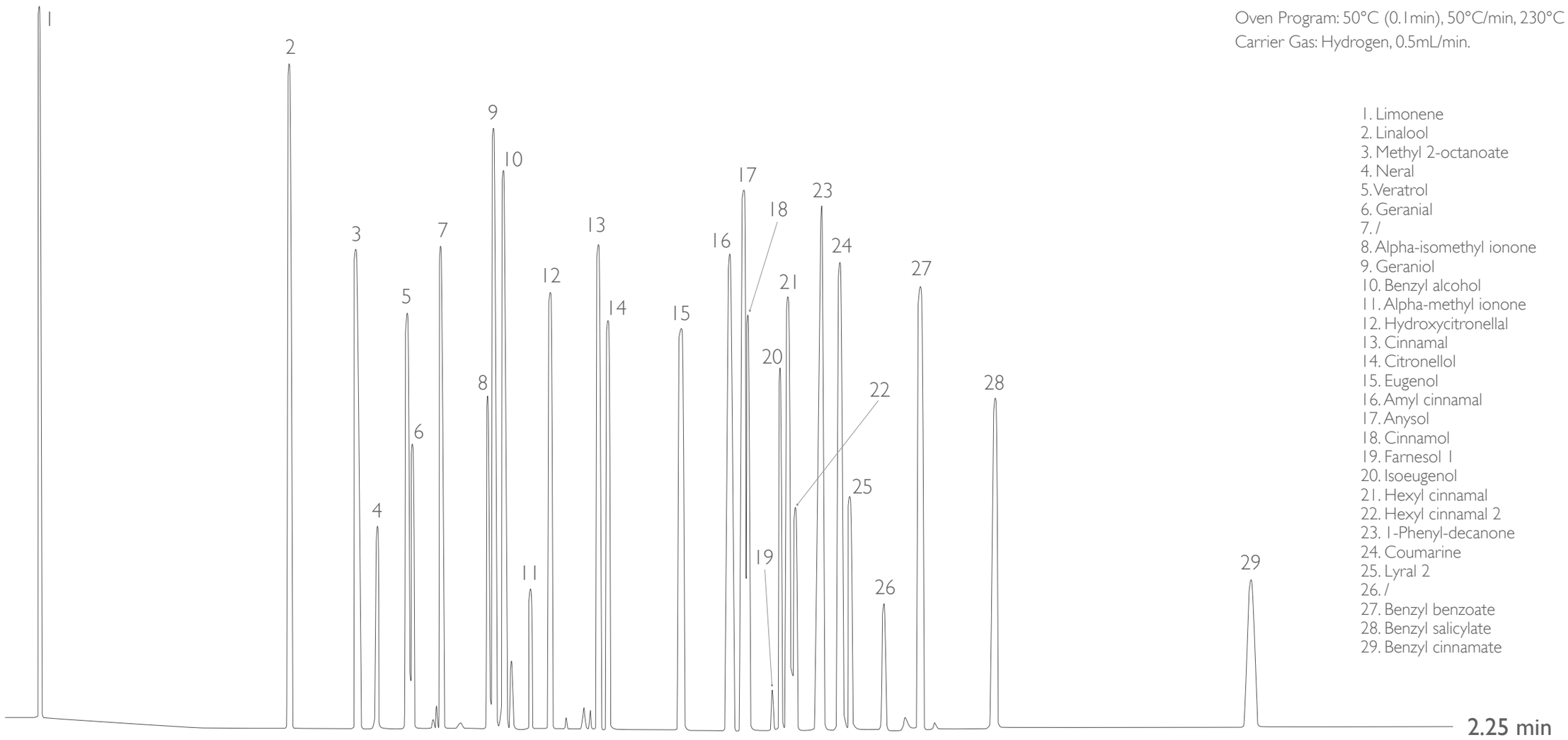
Fragrance Allergens

Column: **MEGA-WAX FAST - 0.10mm, 0.10µm, 5m**
Catalog Code: F-WAX-010-010-5



Conditions:

Injection: Split 230°C, 0.5µL, 1:300 Split Ratio.
Sample Dilution: 1% in Cyclohexane.
Detector: FID 250°C.
Oven Program: 50°C (0.1min), 50°C/min, 230°C (2min).
Carrier Gas: Hydrogen, 0.5mL/min.

1. Limonene
2. Linalool
3. Methyl 2-octanoate
4. Neral
5. Veratrol
6. Geranial
7. /
8. Alpha-isomethyl ionone
9. Geraniol
10. Benzyl alcohol
11. Alpha-methyl ionone
12. Hydroxycitronellal
13. Cinnamal
14. Citronellol
15. Eugenol
16. Amyl cinnamal
17. Anysol
18. Cinnamol
19. Farnesol 1
20. Isoeugenol
21. Hexyl cinnamal
22. Hexyl cinnamal 2
23. 1-Phenyl-decanone
24. Coumarine
25. Lyral 2
26. /
27. Benzyl benzoate
28. Benzyl salicylate
29. Benzyl cinnamate

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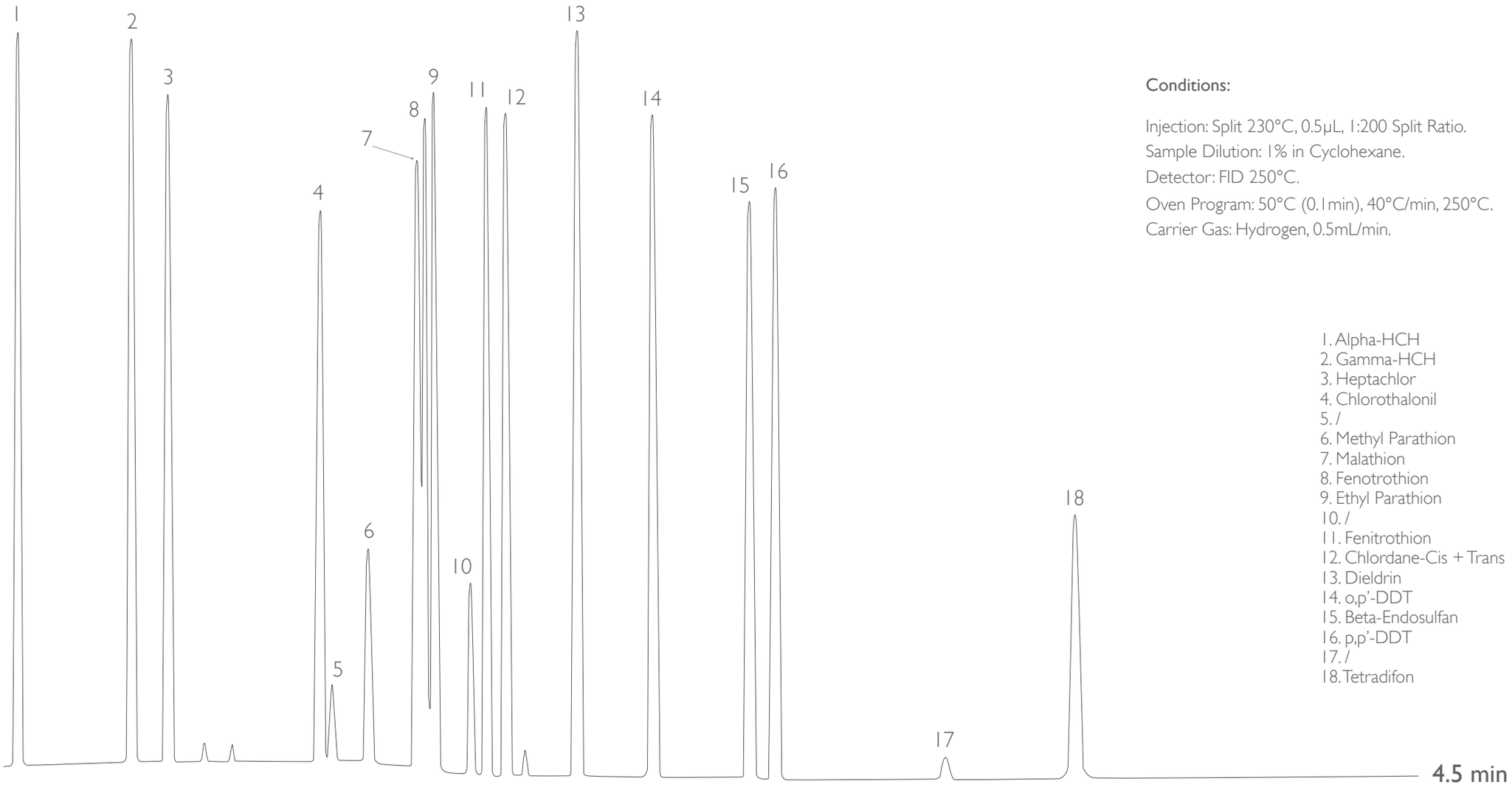
Pesticides

Column: **MEGA-1701 FAST - 0.10mm, 0.10µm, 5m**
Catalog Code: F-1701-010-010-5



Conditions:

Injection: Split 230°C, 0.5µL, 1:200 Split Ratio.
Sample Dilution: 1% in Cyclohexane.
Detector: FID 250°C.
Oven Program: 50°C (0.1min), 40°C/min, 250°C.
Carrier Gas: Hydrogen, 0.5mL/min.

1. Alpha-HCH
2. Gamma-HCH
3. Heptachlor
4. Chlorothalonil
5. /
6. Methyl Parathion
7. Malathion
8. Fenotrothion
9. Ethyl Parathion
10. /
11. Fenitrothion
12. Chlordane-Cis + Trans
13. Dieldrin
14. o,p'-DDT
15. Beta-Endosulfan
16. p,p'-DDT
17. /
18. Tetradifon

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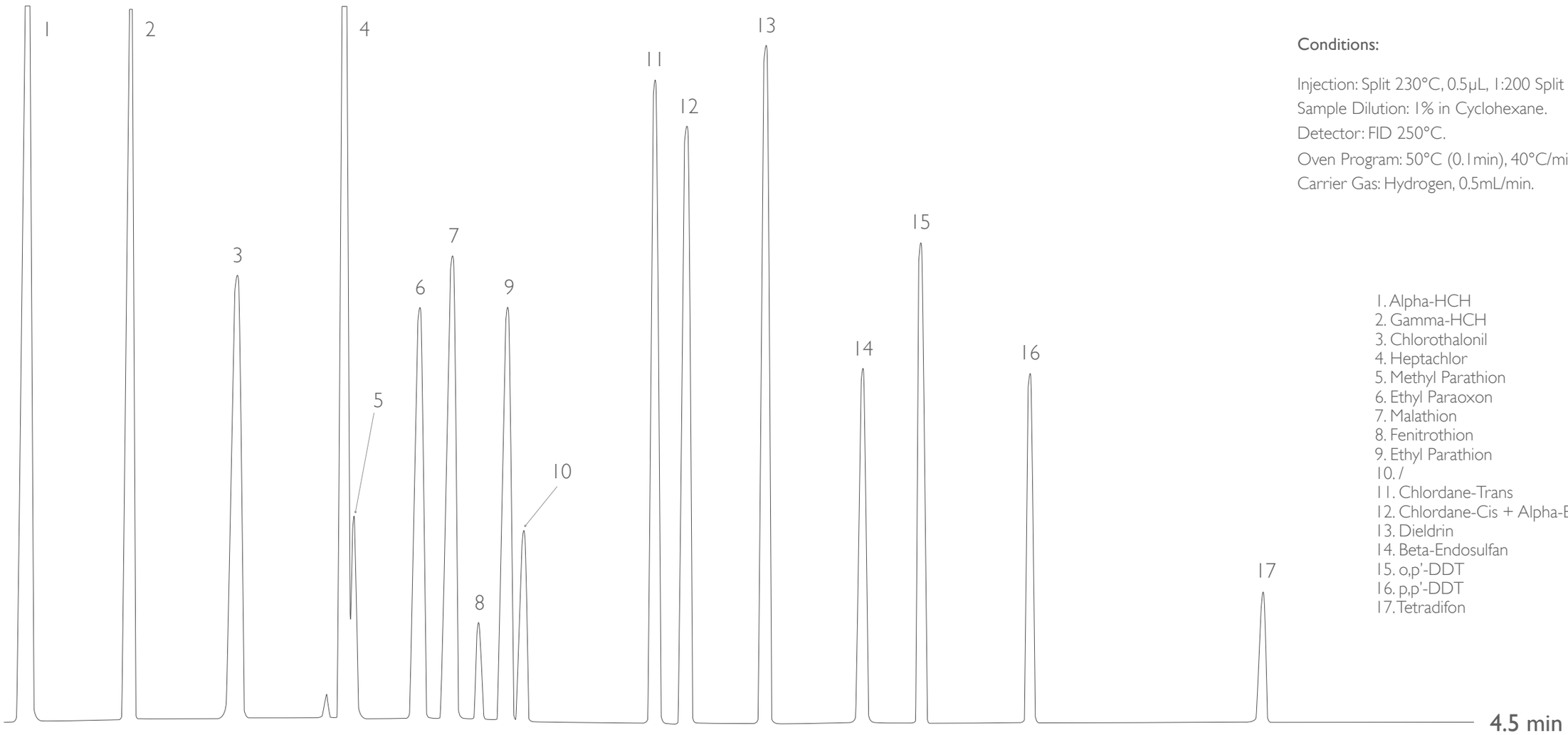
Pesticides

Column: **MEGA-SE54 FAST - 0.10mm, 0.10µm, 5m**
Catalog Code: F-SE54-010-010-5



Conditions:

Injection: Split 230°C, 0.5µL, 1:200 Split Ratio.
Sample Dilution: 1% in Cyclohexane.
Detector: FID 250°C.
Oven Program: 50°C (0.1min), 40°C/min, 250°C.
Carrier Gas: Hydrogen, 0.5mL/min.

1. Alpha-HCH
2. Gamma-HCH
3. Chlorothalonil
4. Heptachlor
5. Methyl Parathion
6. Ethyl Paraoxon
7. Malathion
8. Fenitrothion
9. Ethyl Parathion
10. /
11. Chlordane-Trans
12. Chlordane-Cis + Alpha-Endrin
13. Dieldrin
14. Beta-Endosulfan
15. o,p'-DDT
16. p,p'-DDT
17. Tetradifon

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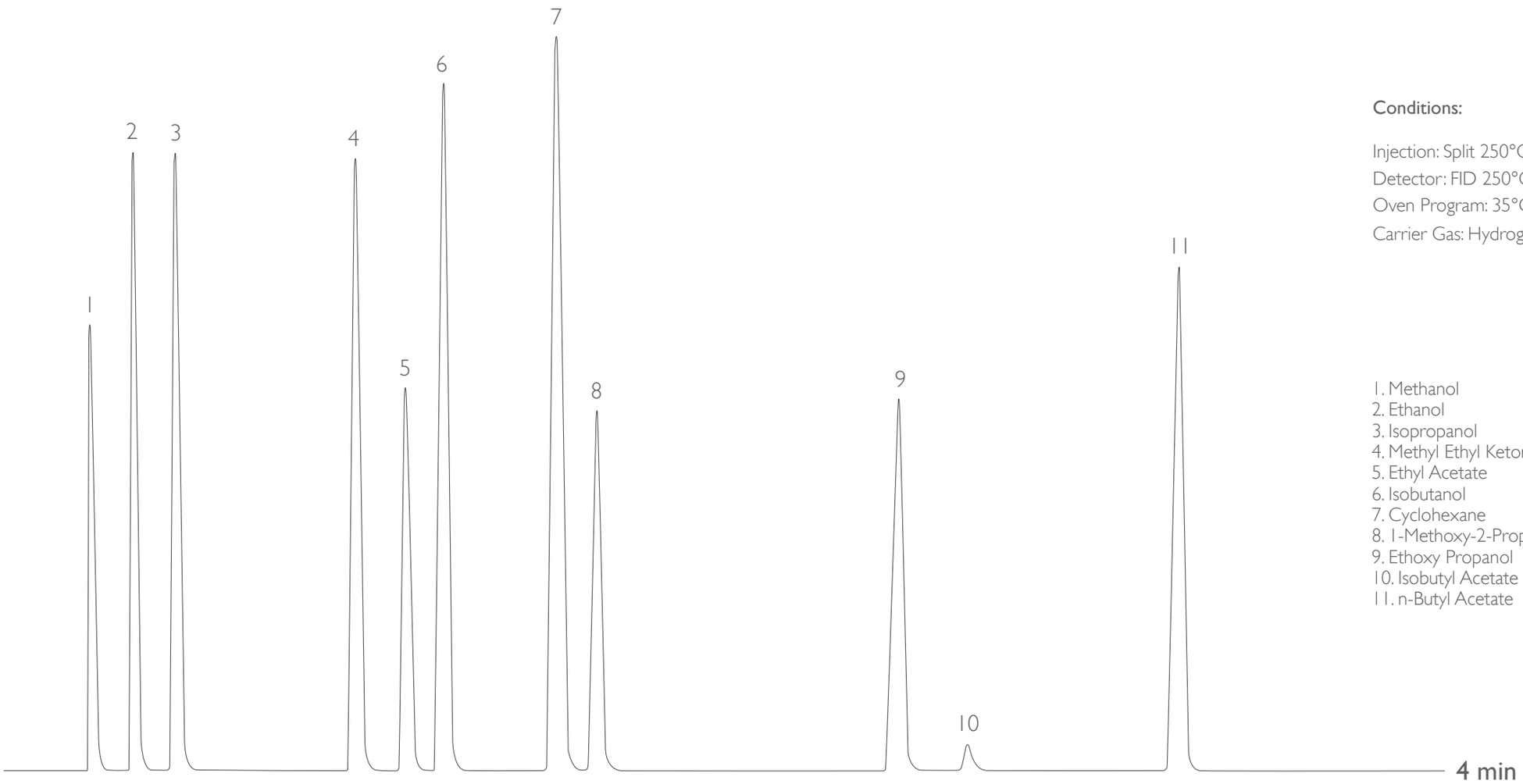
Food Packaging Residual Solvents

Column: **MEGA-VOC 2 FAST - 0.20mm, 1.00µm, 10m**
Catalog Code: F-VOC2-020-100-10



Conditions:

Injection: Split 250°C.
Detector: FID 250°C.
Oven Program: 35°C (0.5min), 15°C/min, 100°C.
Carrier Gas: Hydrogen, 50kPa.

1. Methanol
2. Ethanol
3. Isopropanol
4. Methyl Ethyl Ketone (MEK)
5. Ethyl Acetate
6. Isobutanol
7. Cyclohexane
8. 1-Methoxy-2-Propanol
9. Ethoxy Propanol
10. Isobutyl Acetate
11. n-Butyl Acetate

Analysis carried out with DANI Master GC.

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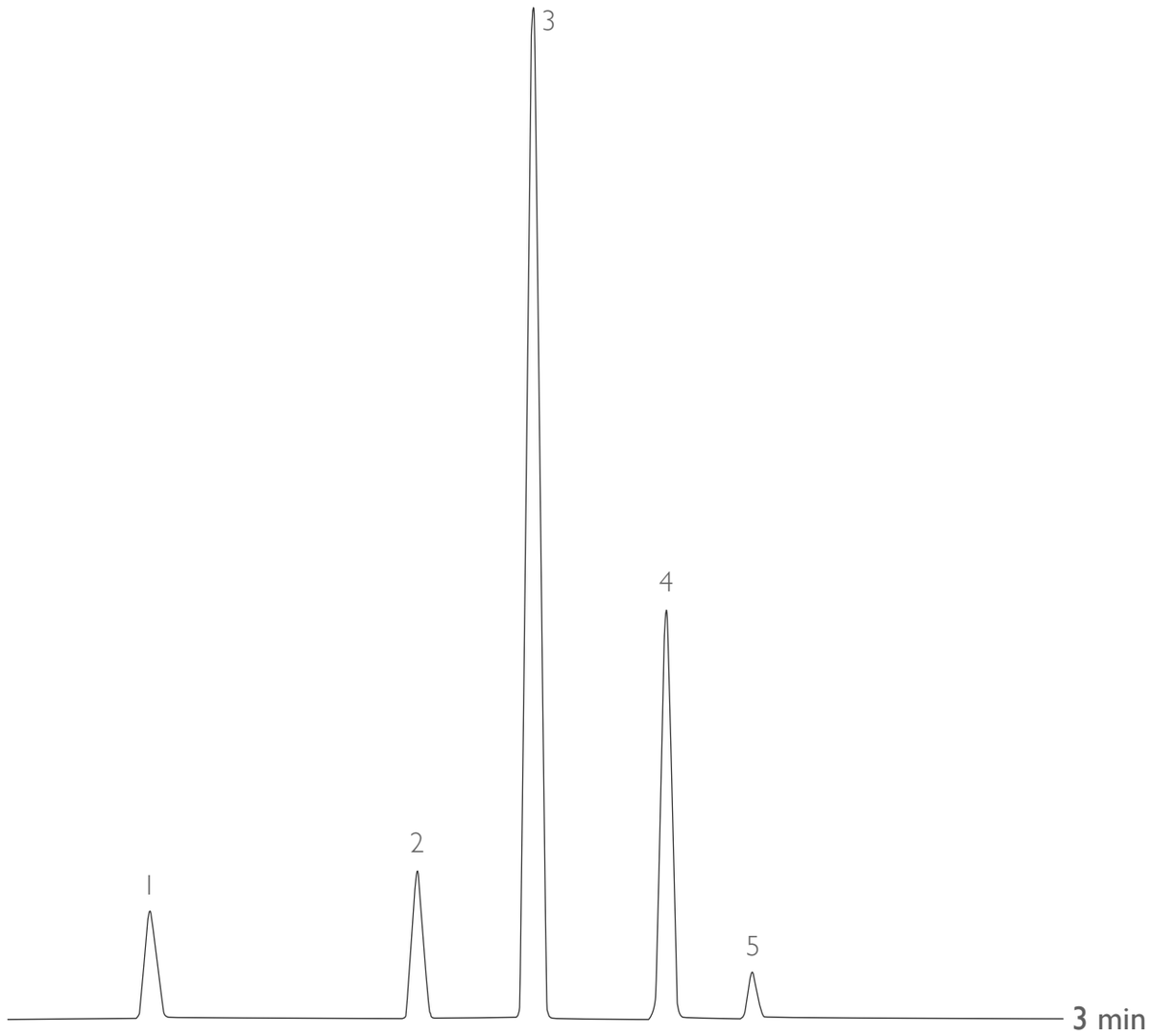
USP 467 Residual Solvents (OVIs) Headspace



Analysis carried out with DANI Master GC.

Column: **MEGA-624 FAST - 0.10mm, 0.45µm, 10m**
Catalog Code: F-624-010-045-10

(USP G43 phase)

Conditions:

Injection: Split 250°C, 0.5mL with Gas Syringe, 1:100 Split Ratio.
Sample: Headspace of Residual Solvents Mix, hold 45min @ 80°C.
Detector: FID 250°C.
Oven Program: 35°C, 15°C/min, 100°C.
Carrier Gas: Hydrogen, 0.4mL/min.

1. Methylene Chloride
2. Chloroform
3. Benzene
4. 1,1,1 - trichloroethylene
5. 1,4 - dioxane

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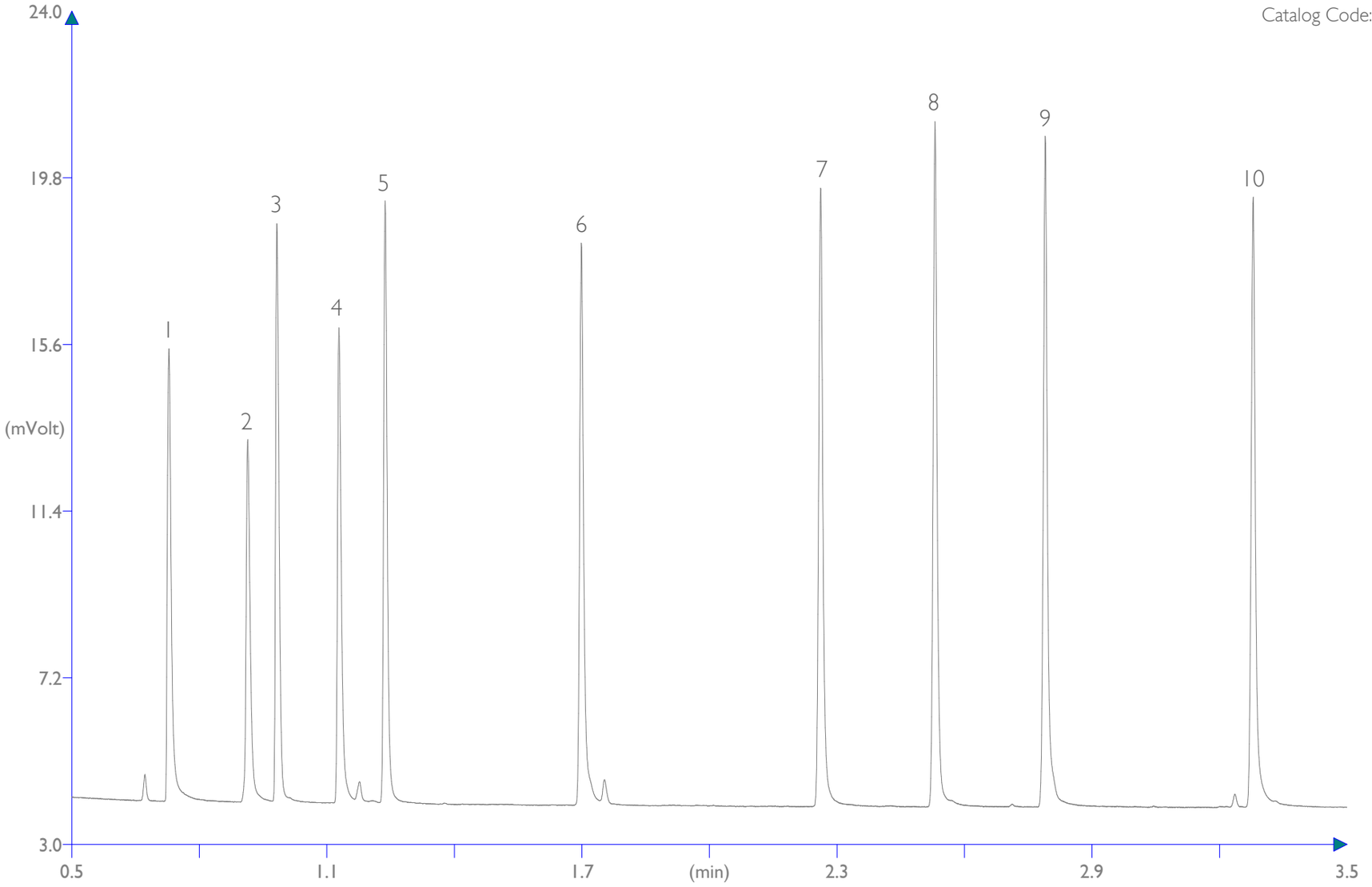
Free Fatty Acids

Column: **MEGA-ACID (FFAP) FAST - 0.10mm, 0.10µm, 5m**
Catalog Code: F-ACID-010-010-5



Conditions:

Injection: Split 250°C, 0.2µL, 80mL/min Split Flow.
Sample Dilution: from 28 to 46mg/100mL each component, sol. 50% Ethanol.
Detector: FID 250°C.
Oven Program: 80°C (0.1min), 40°C/min, 250°C.
Carrier Gas: Hydrogen, 130kPa.

1. Acetic Acid
2. Propionic Acid
3. Iso-Butyric Acid
4. Butyric Acid
5. Iso-Valeric Acid
6. Caproic Acid
7. Caprylic Acid
8. Nonanoic Acid
9. Decanoic Acid
10. Dodecanoic Acid

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Bibliography and acknowledgments

[1]. Chiara Cordero, Patrizia Rubiolo, Barbara Sgorbini, Mario Galli, Carlo Bicchi

Comprehensive two-dimensional gas chromatography in the analysis of volatile samples of natural origin: A multidisciplinary approach to evaluate the influence of second dimension column coated with mixed stationary phases on system orthogonality.

Journal of Chromatography A, Volume 1132, Issues 1-2, 3 November 2006, Pages 268-279.

[2]. A.Antonelli, Mario Galli

Determination of volatiles in spirits using combined stationary phases in capillary GC.

Chromatographia, Volume 41, Numbers 11-12 / December, 1995.

We would like to thank all the partners and friends, mentioned in the previous pages, that have helped us to prepare a lot of application notes reported in this work, in particular Prof. C. Bicchi and all his group at the University of Turin for their continuous support.

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