

SF-GC Columns

For Super Fast Analysis

What is SF-GC (Super Fast)

What is SF-GC.

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

SF-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 SF-GC.

To accomplish the SF-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 SF-GC).

Some fundamental theoretical notion to better understand SF-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:

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

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).

It 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 SF-GC.

The selectivity of the stationary phase is a key parameter in gas-chromatography. It takes an even more important role in SF-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 SF-GC technique. In the following pages you will find some application notes where the selectivity of the stationary phase has been investigated and where the role is emphasized.

Principal Parameters Comparison

Conventional GC

Column:

Usually columns 0.25mm/0.32mm I.D. x 25m, 30m or 50m length.

Temperature Rates:

1 - 15 °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).

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

Peak Width:

2 - 5 seconds.

Detector:

Any type of detector for GC can be used.

Analysis Time:

20 - 60 min.

SF - GC

Column:

Usually columns 0.05mm/0.10mm I.D. x 2.5m, 5m or 10m length.

Temperature Rates:

15 - 60 °C/min.

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 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.

Peak Width:

0.5 - 2 seconds.

Detector:

Any type of detector for GC can be used. It is only necessary that the acquisition frequency is at least 50Hz (see page 3, Figure 1).

Analysis Time:

1 - 10 min.

Acquisition Frequency in SF-GC

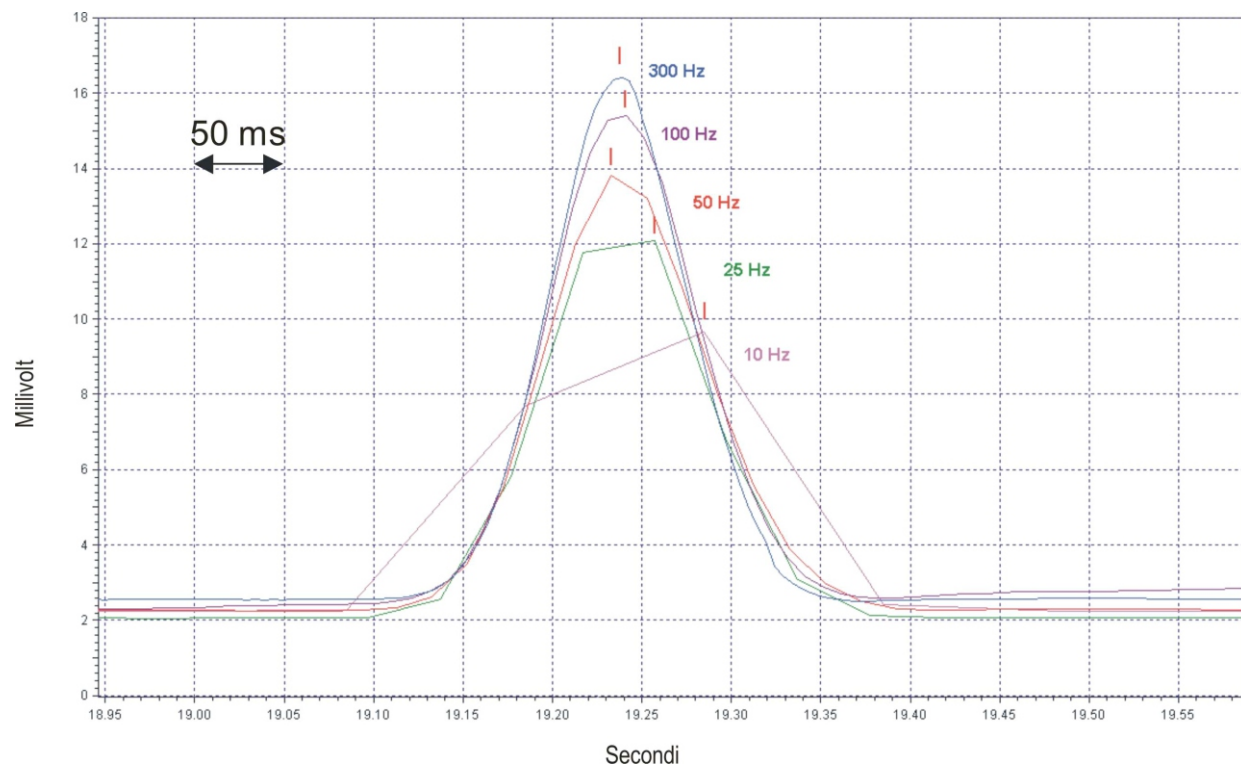


Figure 1- Effect of the acquisition frequency on the peak shape. In SF-GC, peaks could have very narrow width (even less than 500ms). For this reason it is important to have an “high-speed” detector able to collect at least 10 points for every peak, thus to correctly describe the peak itself. In this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

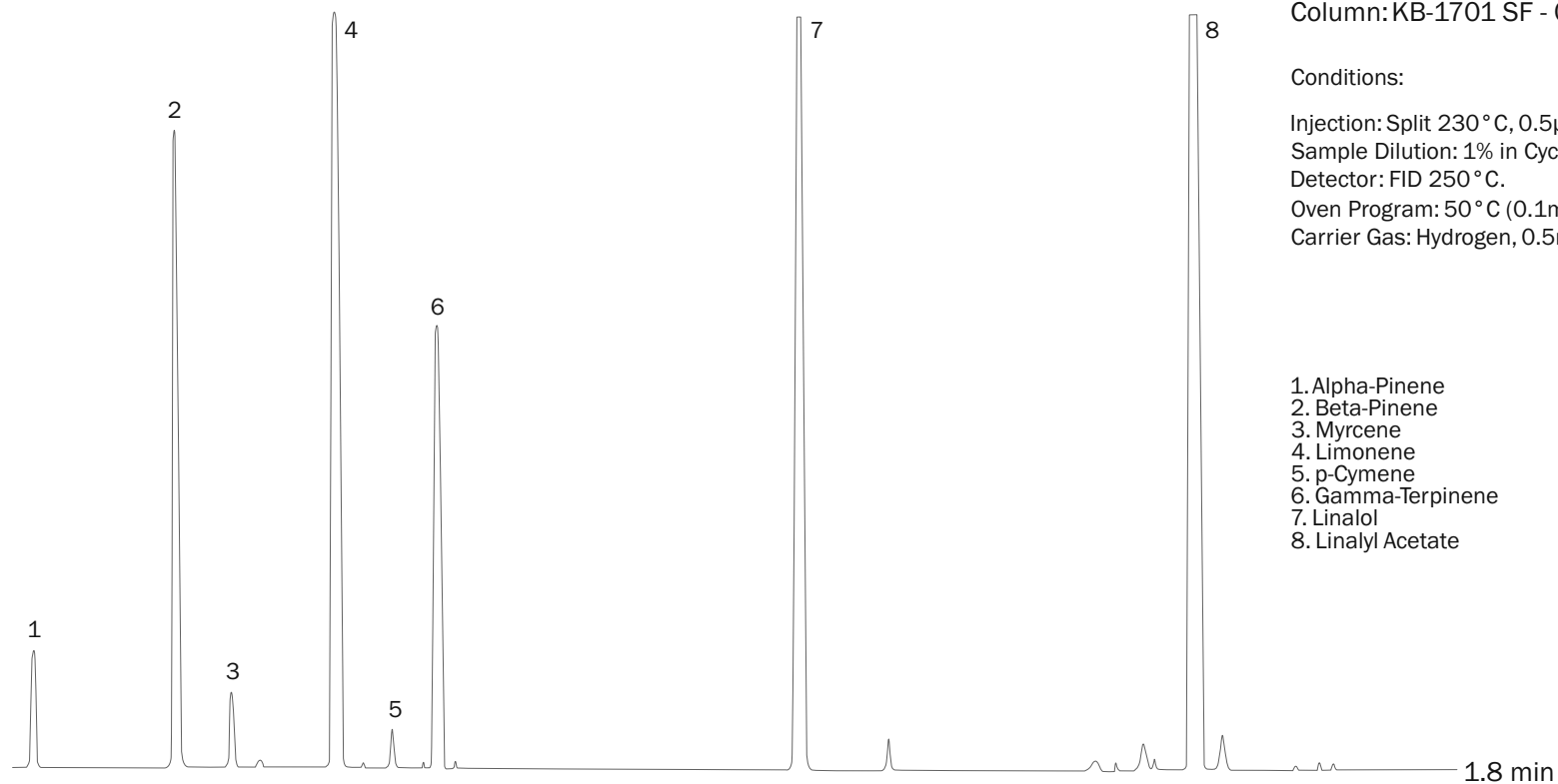
Typical SF-GC columns dimensions

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

SF-GC available stationary phases from Bischoff



Bergamot Essential Oil



Column: KB-1701 SF - 0.10mm, 0.10 μ m, 5m

Conditions:

Injection: Split 230 °C, 0.5 μ L, 1:250 Split Ratio.

Sample Dilution: 1% in Cyclohexane.

Detector: FID 250 °C.

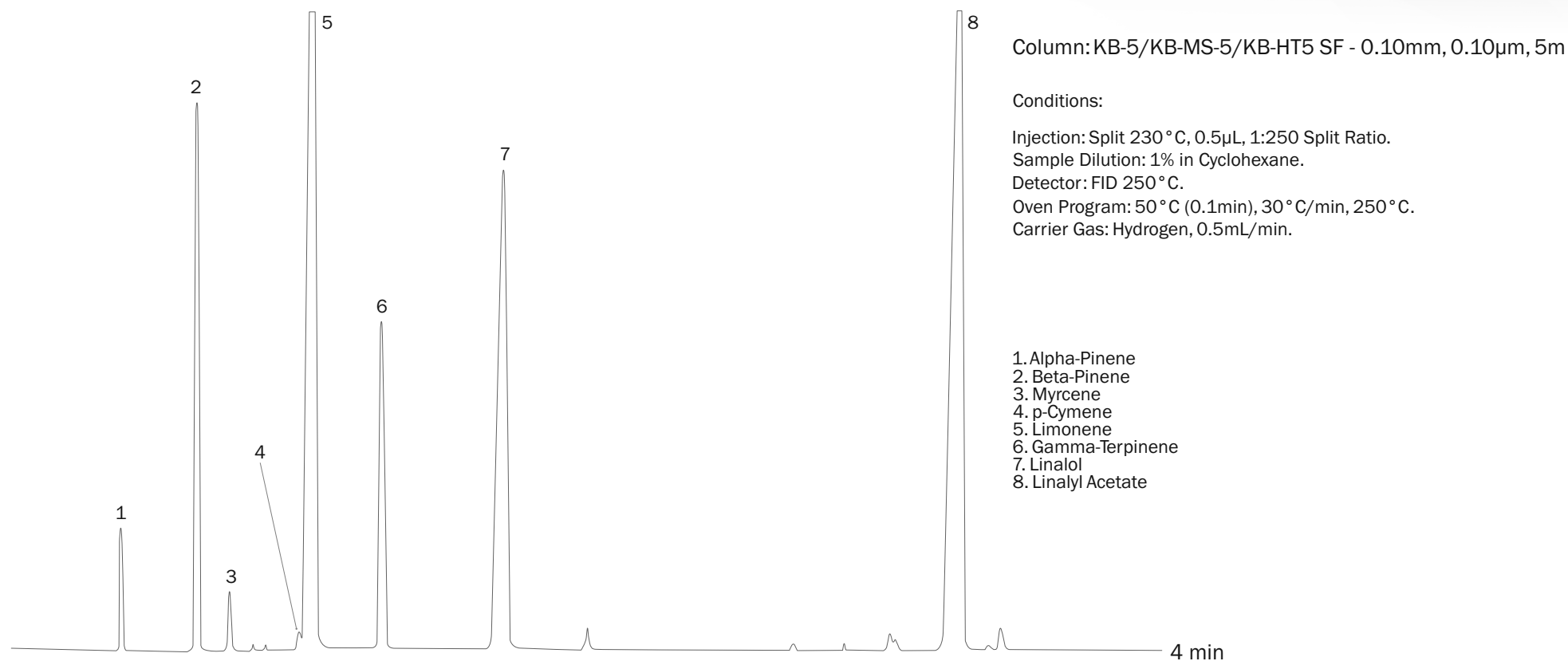
Oven Program: 50 °C (0.1min), 50 °C/min, 250 °C.

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.

Bergamot Essential Oil



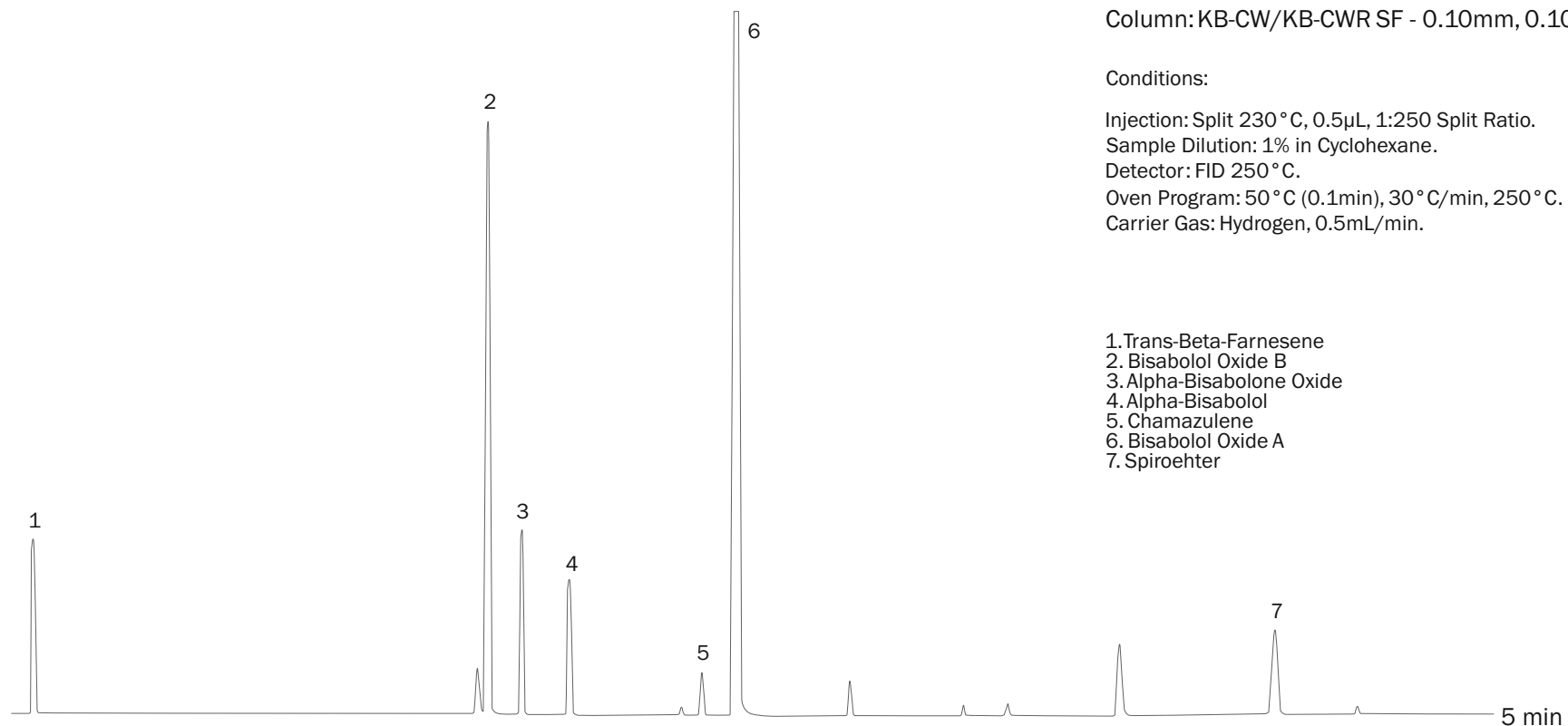
Acknowledgement: Prof. C. Bicchi, C. Brunelli et al., Università di Torino, Dipartimento di Scienza e Tecnologia del Farmaco, Via Pietro Giuria, 9 - Torino - Italy.

Bergamot Essential Oil



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Chamomile Essential Oil



Column: KB-CW/KB-CWR SF - 0.10mm, 0.10 μ m, 5m

Conditions:

Injection: Split 230 °C, 0.5 μ L, 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.

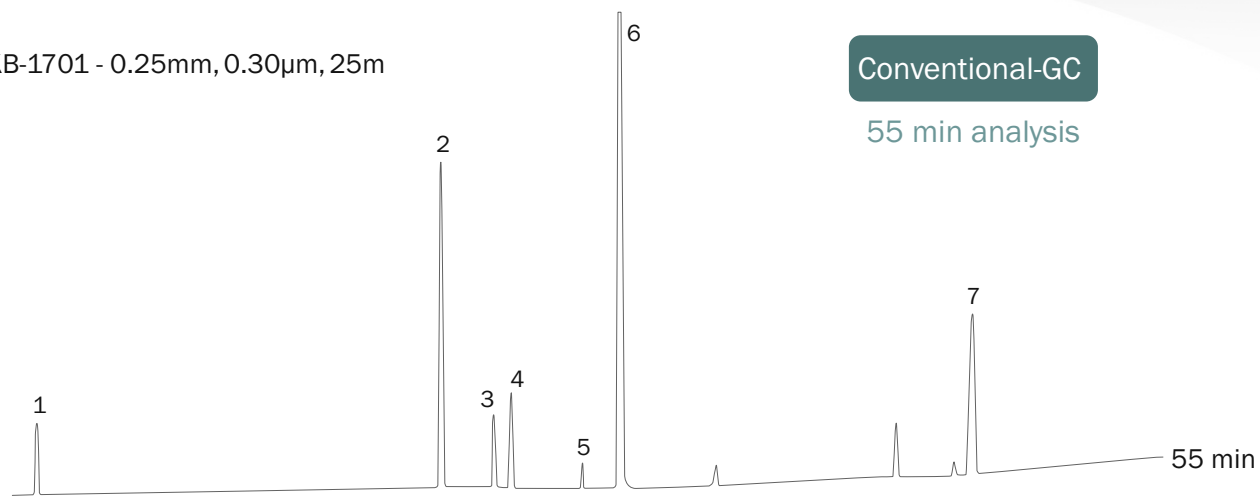
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Chamomile Essential Oil

Column:KB-1701 - 0.25mm, 0.30µm, 25m

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).

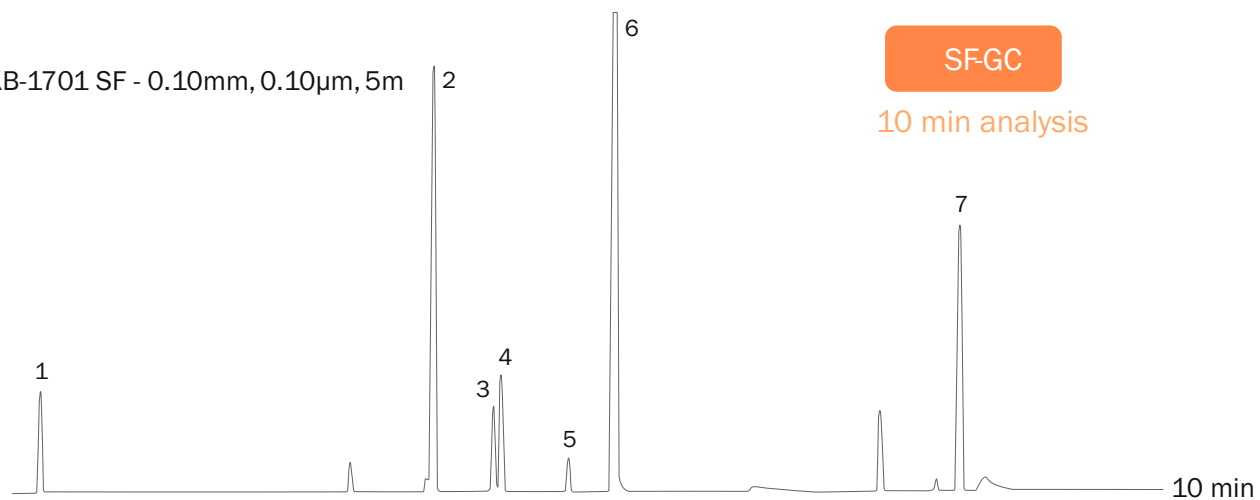
Carrier Gas: Hydrogen, 1.5mL/min.

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

Column:KB-1701 SF - 0.10mm, 0.10µm, 5m

SF-GC

10 min analysis



SF-GC Conditions:

Injection: Split 230 °C, 0.5µL, 1:250 Split Ratio.

Sample Dilution: 1% in Cyclohexane.

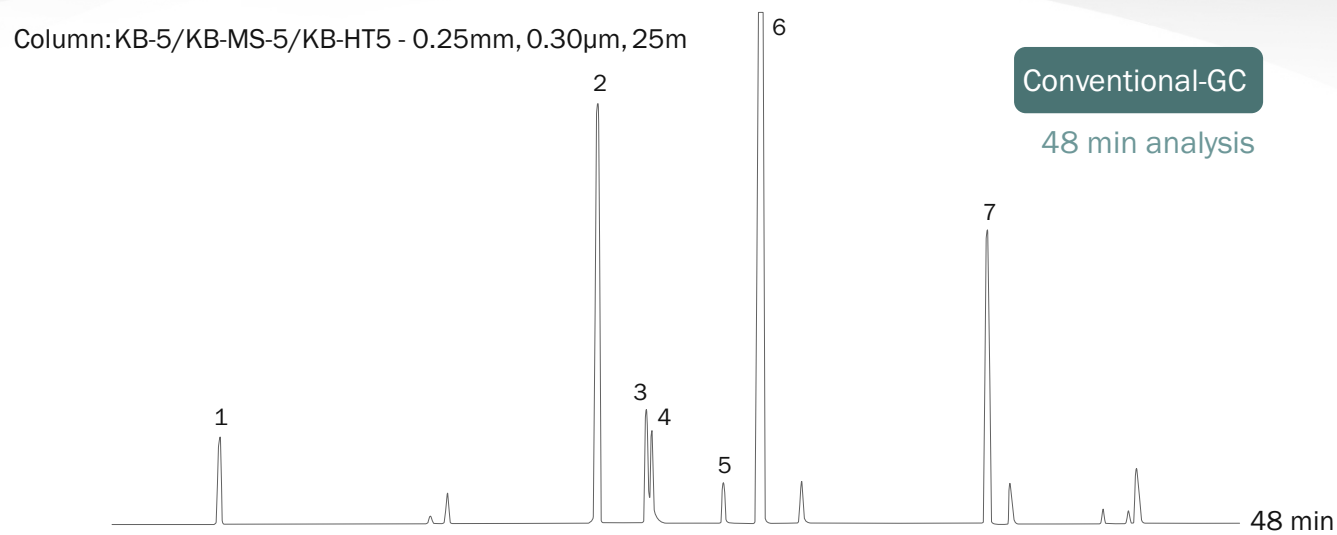
Detector: FID 250 °C.

Oven Program: 50 °C (0.1min), 50 °C/min, 250 °C (5min).

Carrier Gas: Hydrogen, 0.5mL/min.

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Chamomile Essential Oil



Conventional-GC Conditions:

Injection: Split 230 °C, 1µL, 1:50 Split Ratio.

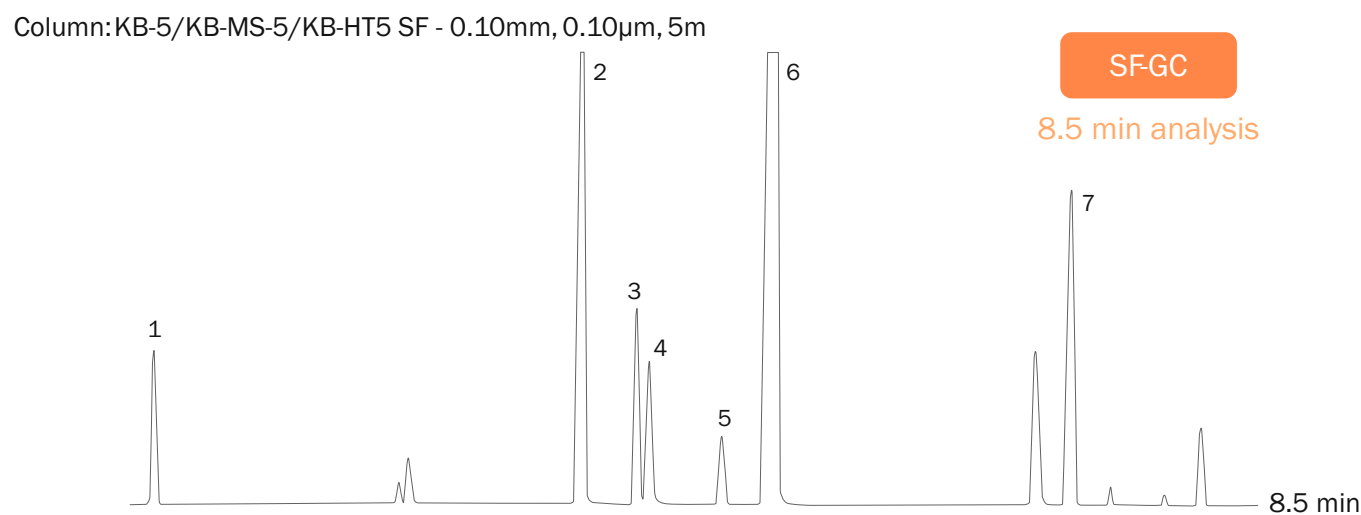
Sample Dilution: 1% in Cyclohexane.

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



SFGC Conditions:

Injection: Split 230 °C, 0.5µL, 1:250 Split Ratio.

Sample Dilution: 1% in Cyclohexane.

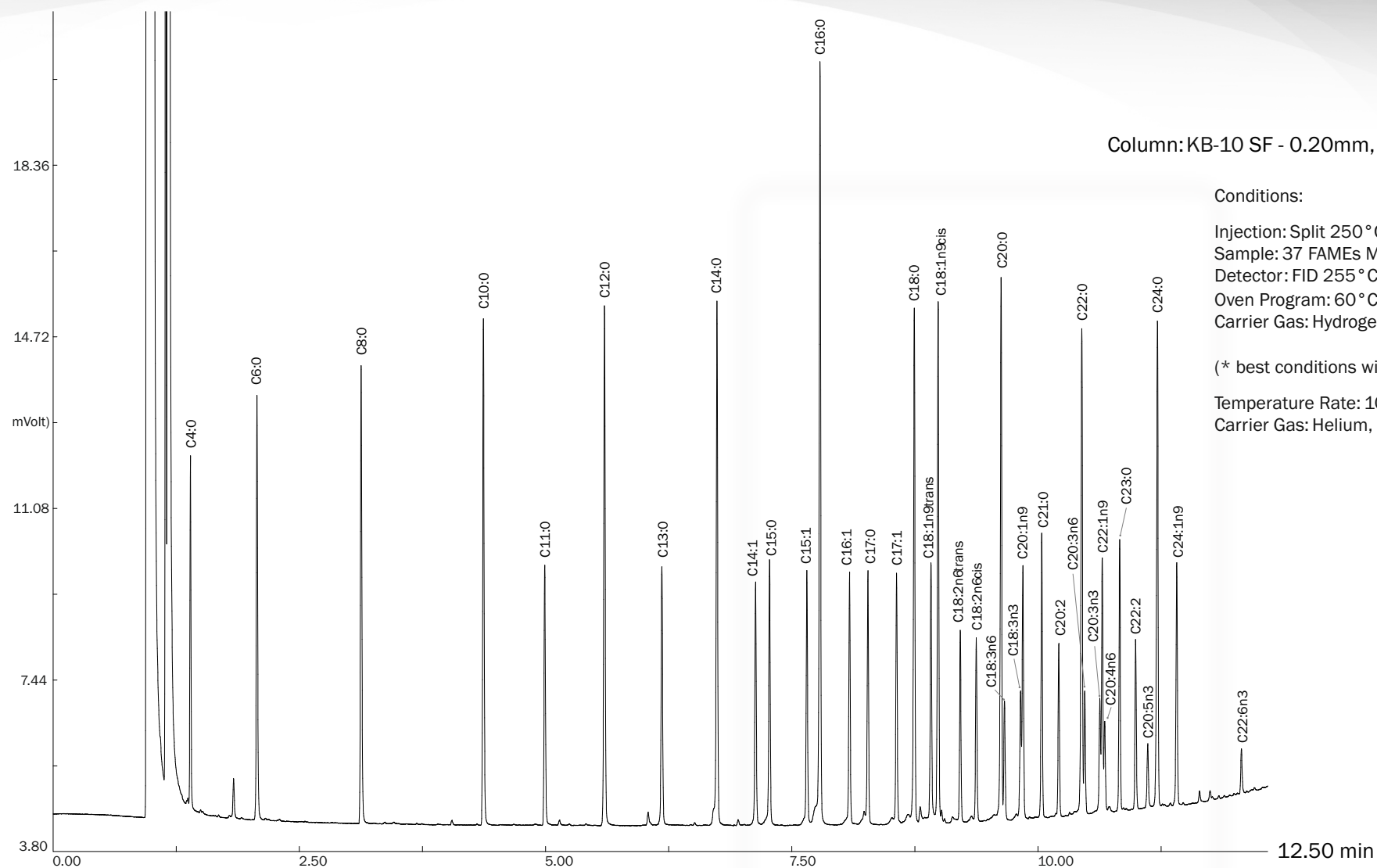
Detector: FID 250 °C.

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: KB-10 SF - 0.20mm, 0.20 μ m, 30m

Conditions:

Injection: Split 250 °C, 0.5 μ L, 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.*

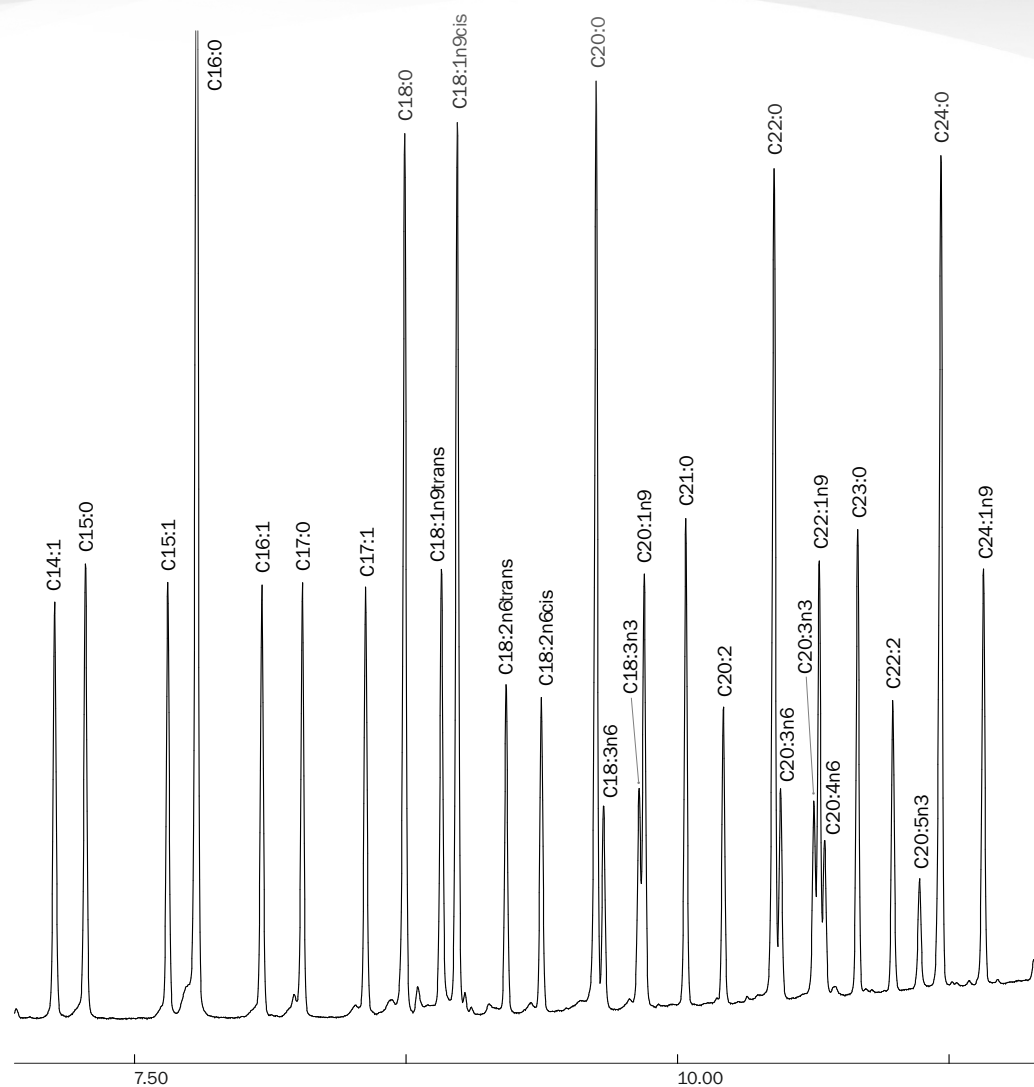
Carrier Gas: Hydrogen, 150 kPa.*

(* best conditions with Helium Carrier Gas:

Temperature Rate: 10 - 12 °C/min.

Carrier Gas: Helium, 180 - 200 kPa.)

FAMES cis-trans isomers detail



Column: KB-10 SF - 0.20mm, 0.20 μ m, 30m

Conditions:

Injection: Split 250°C, 0.5 μ L, 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.*

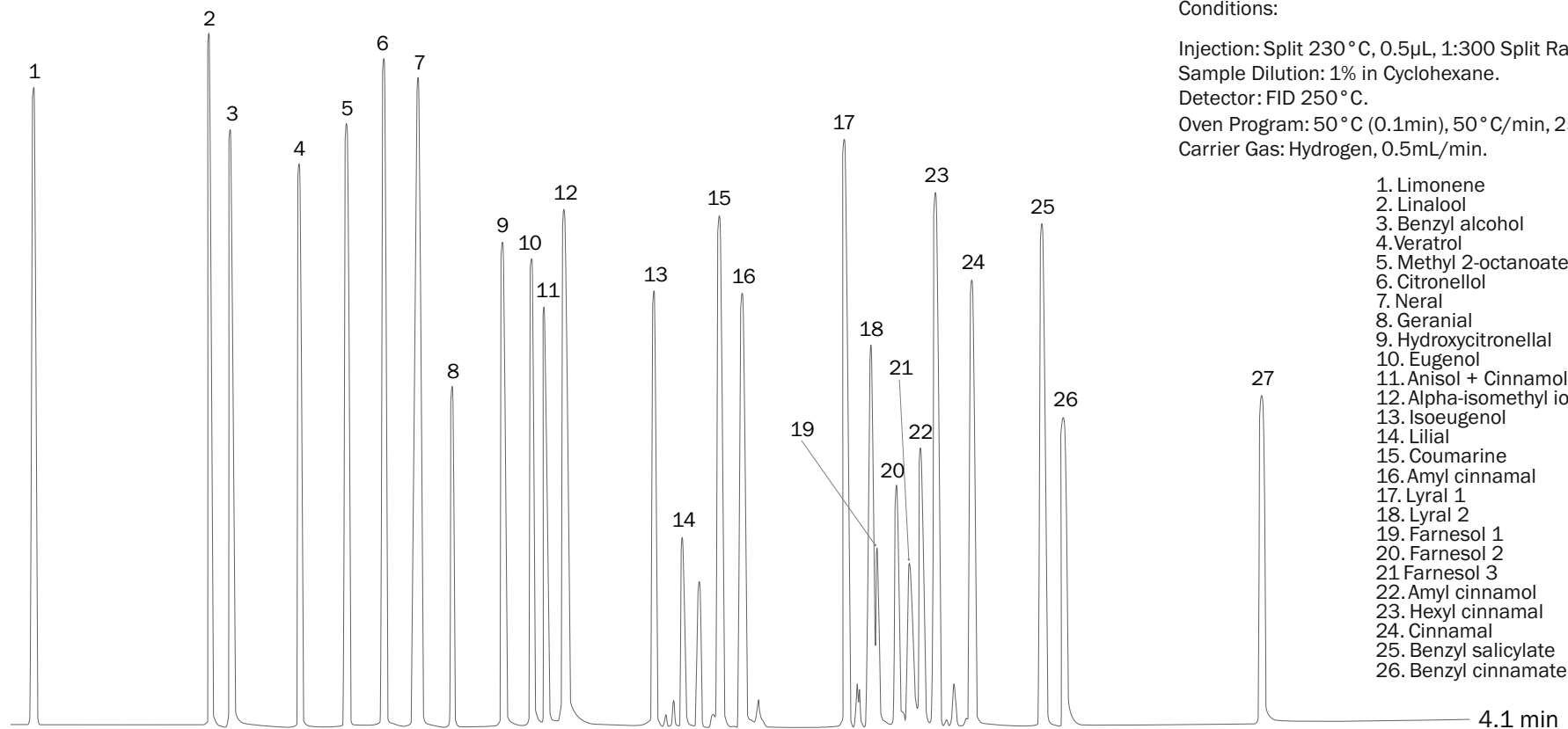
(* best conditions with Helium Carrier Gas:

Temperature Rate: 10 - 12°C/min.

Carrier Gas: Helium, 180 - 200 kPa.)

Fragrance Allergens

Column: KB-1701 SF - 0.10mm, 0.10µm, 5m



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.

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Fragrance Allergens

Column: KB-5/KB-MS-5/KB-HT5 SF - 0.10mm, 0.10µm, 5m

Conditions:

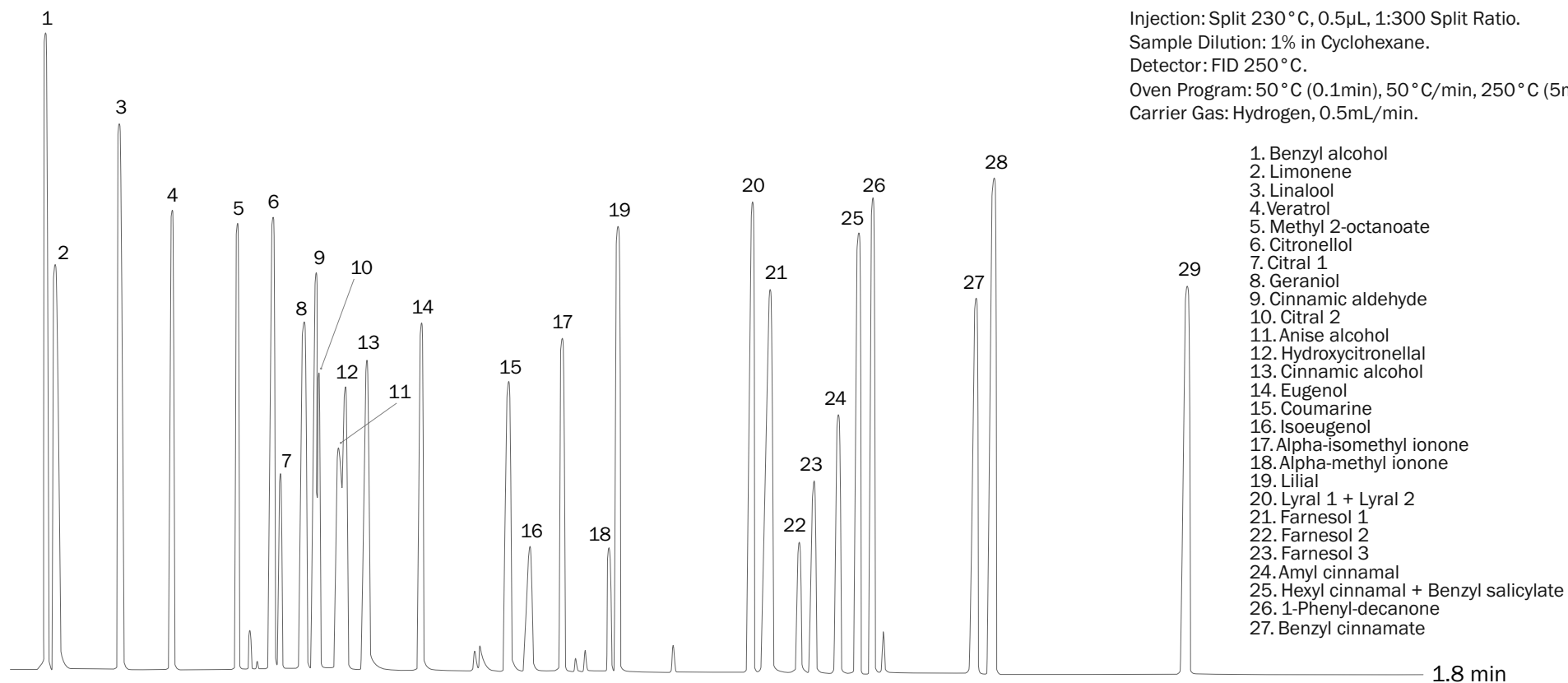
Injection: Split 230 °C, 0.5µL, 1:300 Split Ratio.

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.



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Fragrance Allergens

Column: KB-CW/KB-CWR SF - 0.10mm, 0.10µm, 5m

Conditions:

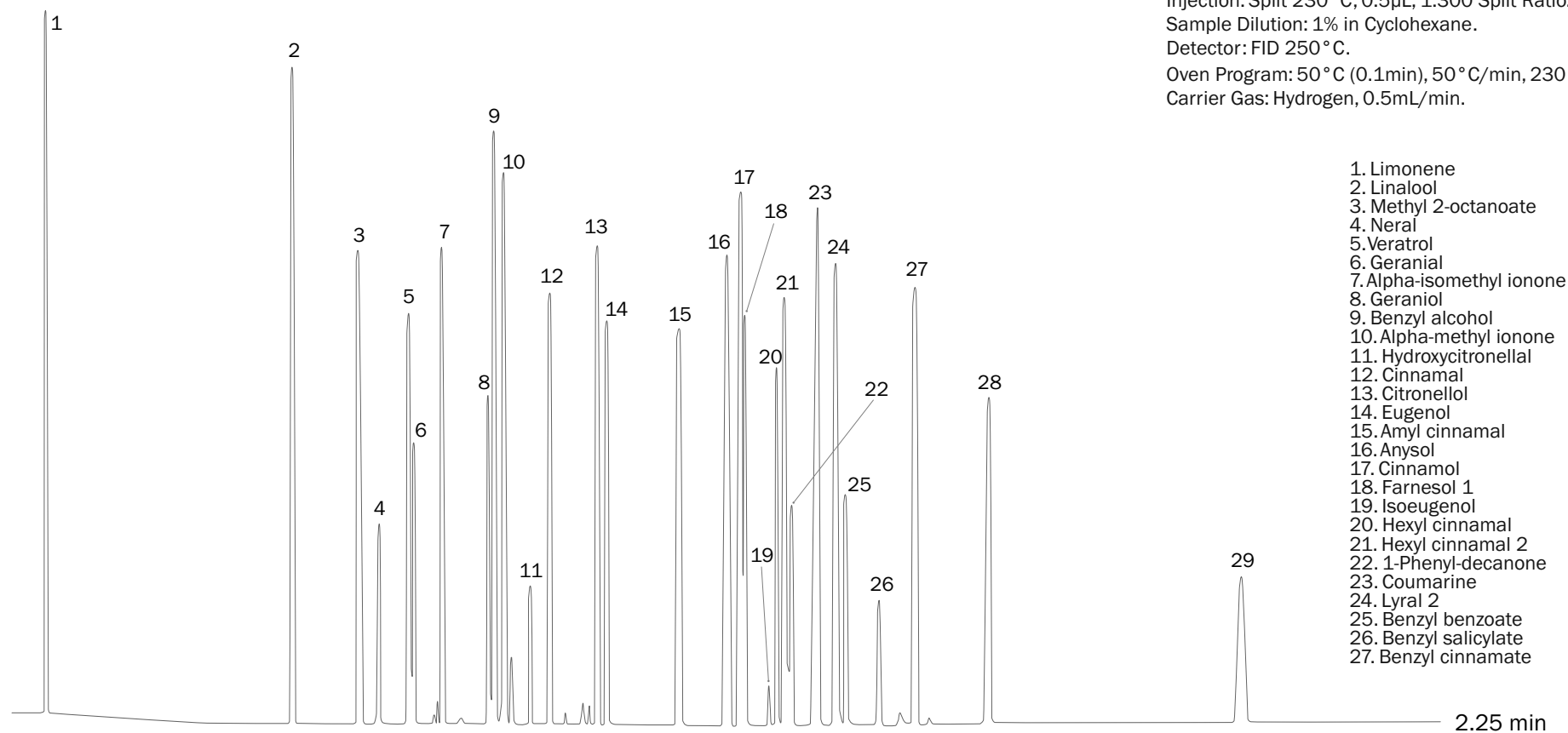
Injection: Split 230 °C, 0.5µL, 1:300 Split Ratio.

Sample Dilution: 1% in Cyclohexane.

Detector: FID 250 °C.

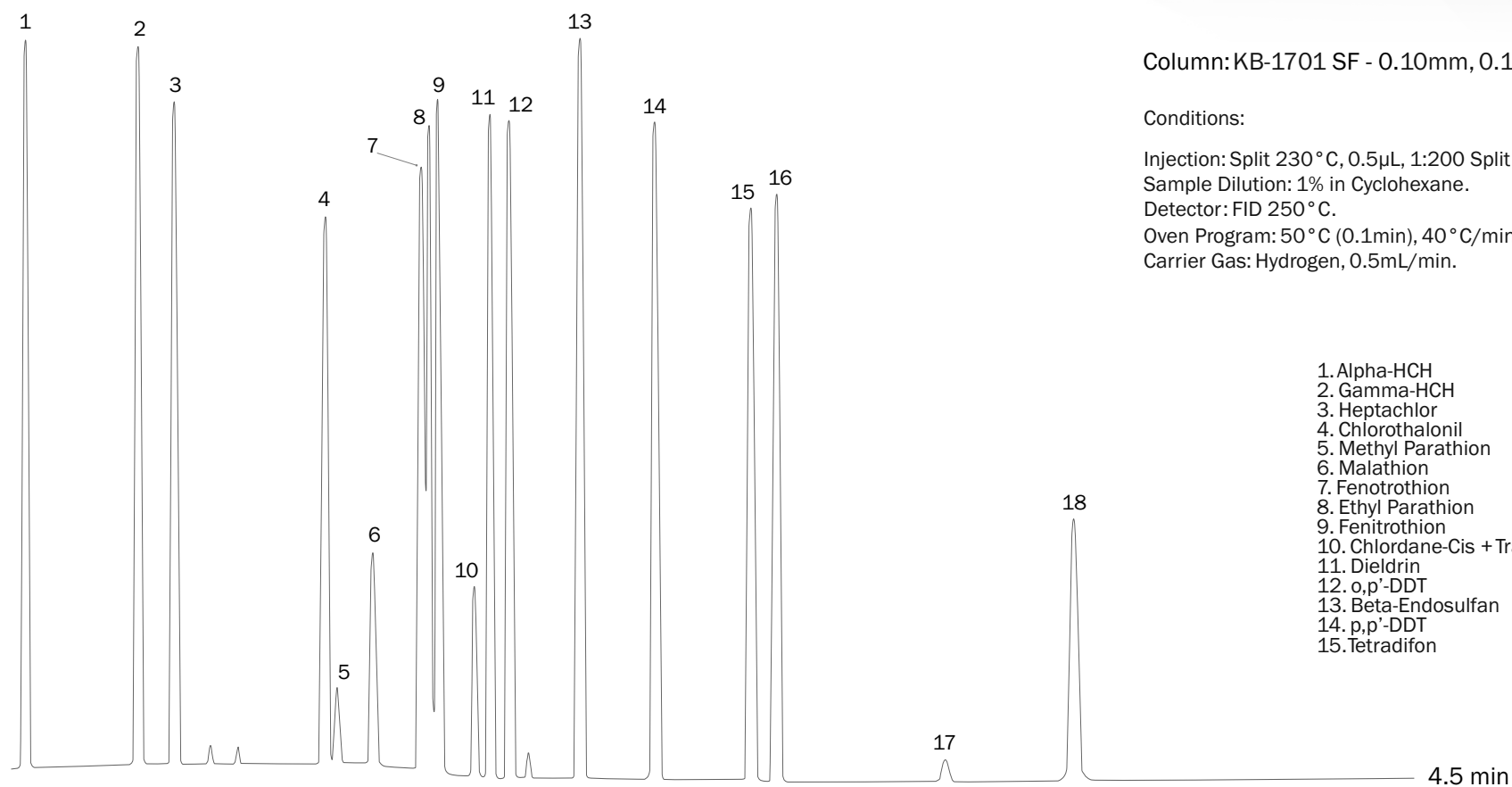
Oven Program: 50 °C (0.1min), 50 °C/min, 230 °C (2min).

Carrier Gas: Hydrogen, 0.5mL/min.



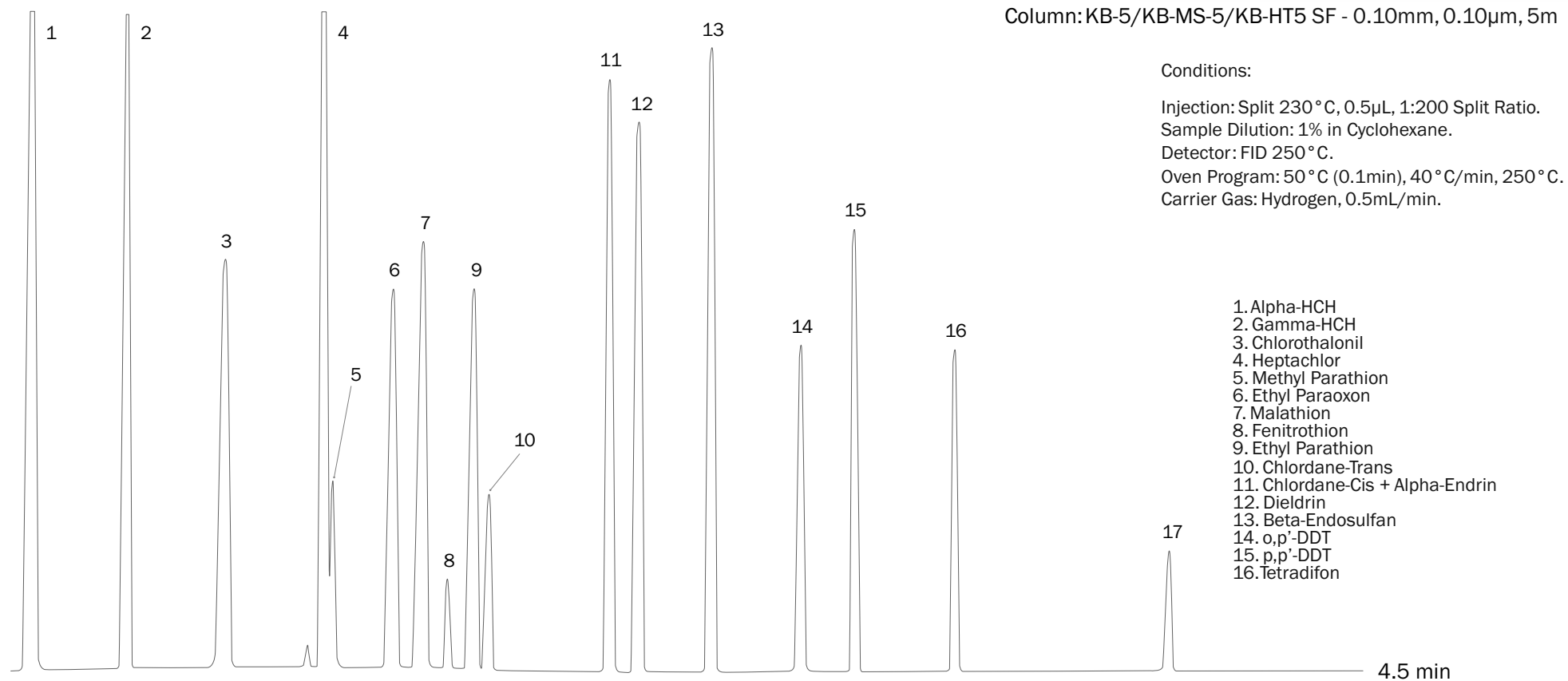
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Pesticides



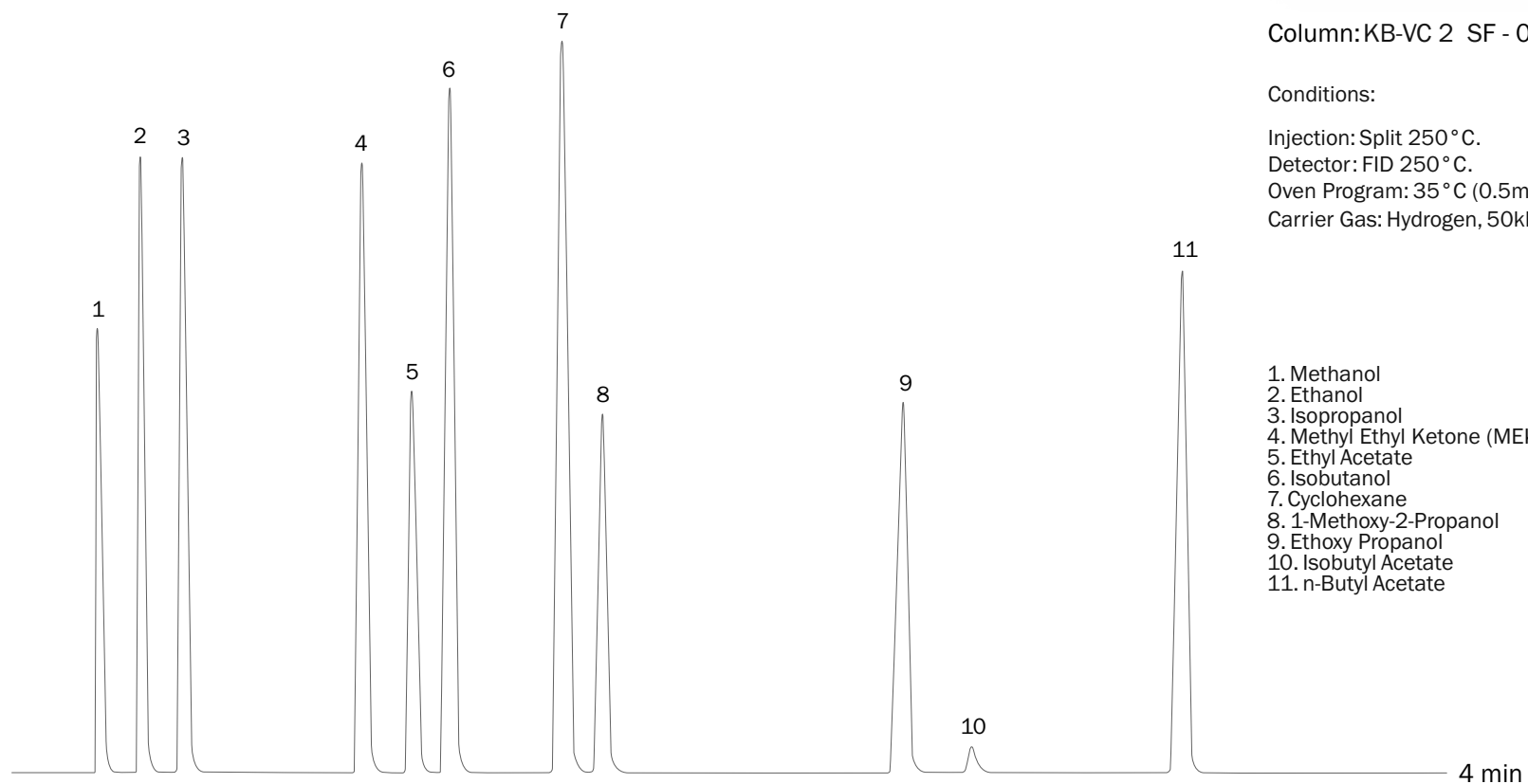
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Pesticides



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Residual Solvents Food Packaging



Column: KB-VC 2 SF - 0.20mm, 1.00 μ m, 10m

Conditions:

Injection: Split 250°C.

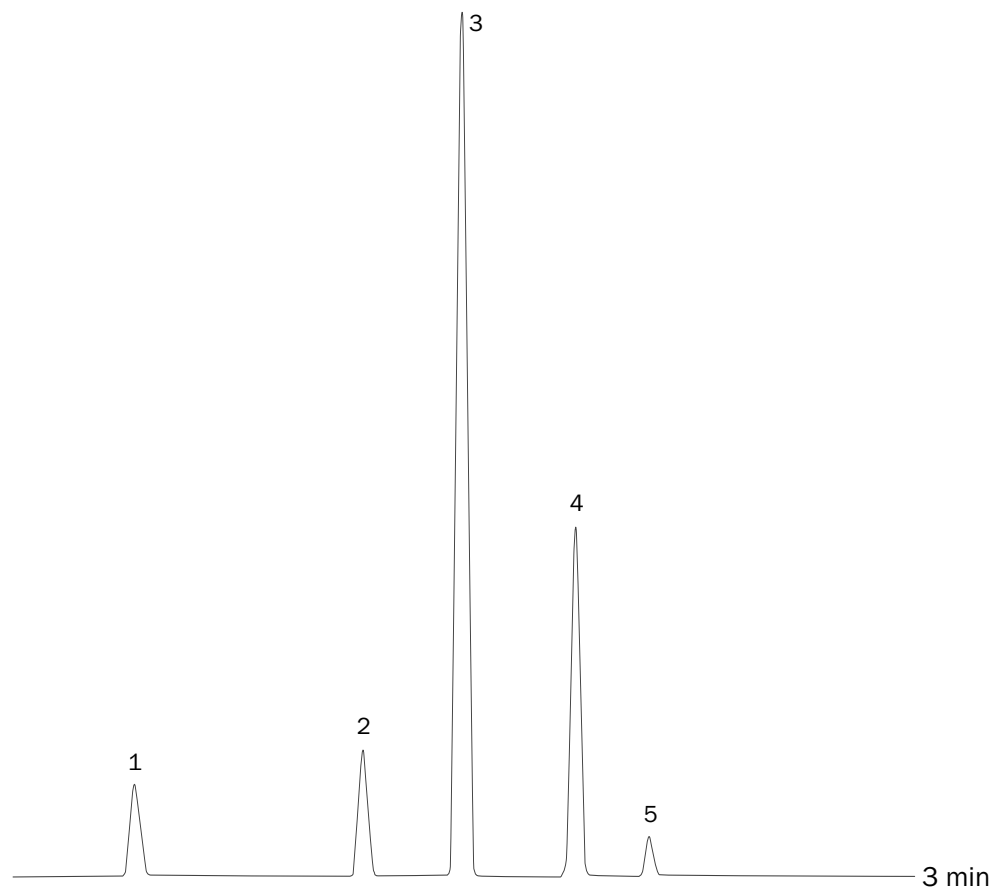
Detector: FID 250°C.

Oven Program: 35°C (0.5min), 15°C/min, 100°C.

Carrier Gas: Hydrogen, 50kPa.

Analysis carried out with DANI Master GC.

USP 467 Residual Solvents (OVIs) Headspace



Analysis carried out with DANI Master GC.

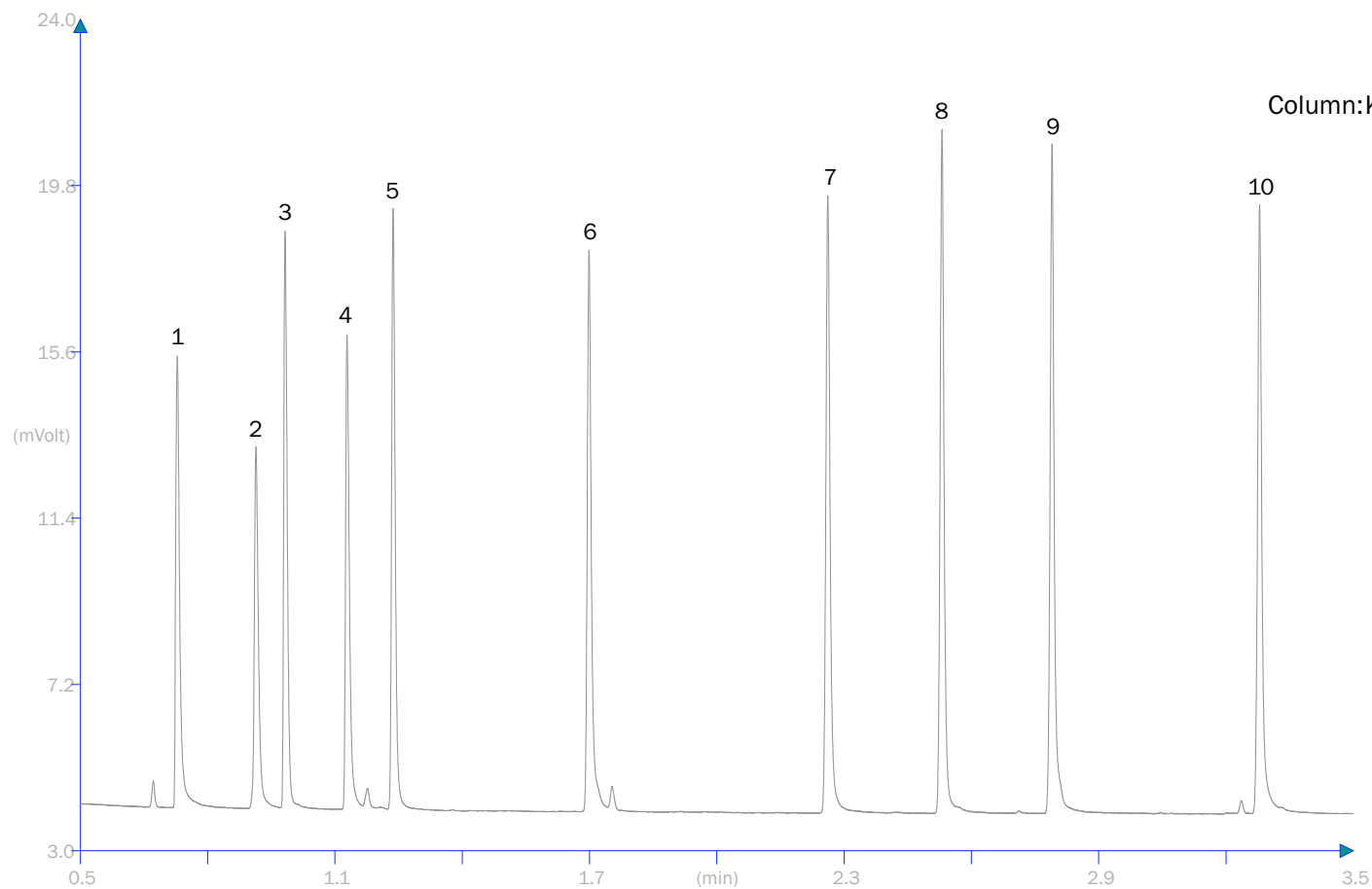
Column: KB-624 SF - 0.10mm, 0.45 μ m, 10m
(USP G43 phase)

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

Free Fatty Acids



Column: KB FFAP-AC SF - 0.10mm, 0.10 μ m, 5m

Conditions:

Injection: Split 250 °C, 0.2 μ L, 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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