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Gas Chromatography

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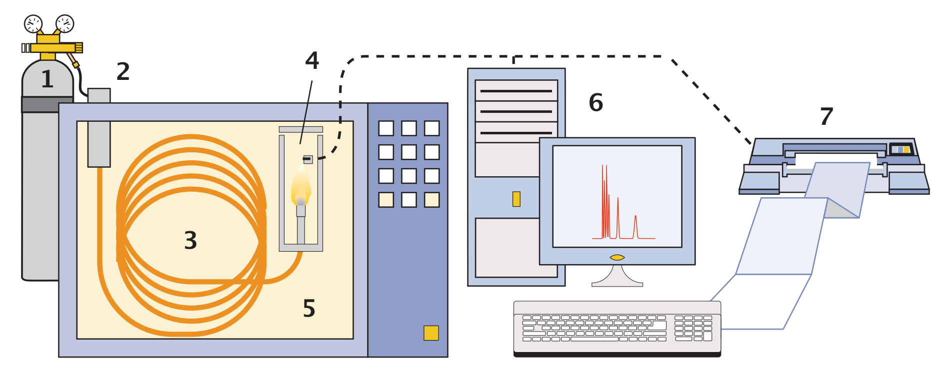
The GC system



1 – 5 compose the chromatograph:

1. **gas supplies:** carrier gas and e.g. burner gases for a flame ionisation detector (FID)
2. **sample injector:**
   with ***direct injection*** the sample is introduced into the column with-out contact with other parts from glass or metal (on-column injec-tion);
   with ***indirect injection*** the sample is introduced into an evaporator, and the vapour is then transferred into the column either completely or partially (split technique);
   both techniques allow low tem-peratures, high temperatures or temperature programming
3. **capillary column:** the heart of the GC system
4. **detector:** indicates a substance by generation of an electrical signal (response). Some detectors are specific for certain classes of sub-stances or for certain elements (P, N, etc.).
5. **oven** with temperature control

6 and/or 7 serve for evaluation of the separation

6. **data station** for digital evaluation of chromatograms
7. **recorder** for plotting or printing chromatograms

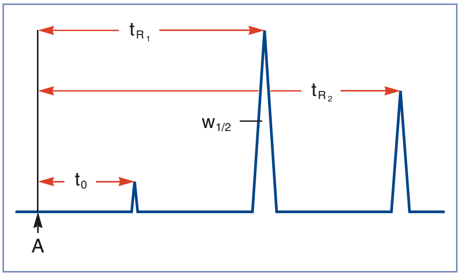
The separation process

Separation is achieved by repeated distribution of each sample compo-nent between two phases: in GC, the **mobile phase** is always a gas (mostly N_2, H_2, He). The **stationary phase** is a mostly viscous gum-like liquid coated to the inner wall of a capillary column (WCOT = Wall Coated Open Tubular).

Transport of the analytes is achieved exclusively in the gas phase, separa-tion is accomplished in the stationary phase. The quality of a separation (resolution) depends on how long the components to be separated stay in the stationary phase and on how often they interact with this phase. The type of interaction between component and phase (selectivity) is determined by the functional groups. The polarity of the phase is a function of station-ary phase substituents.

The chromatogram

A chromatogram consists of a base line and a number of peaks. Peak areas allow quantitative determinations:



A: starting point of a chromatogram = time of injection of a dissolved solute

A component can be identified by its **retention time** (qualitative determination):

$$t_{R_i} = t_0 + t_{R_i}'$$

t_0: dead time = void time = residence time of a solute in the mobile phase (time required by a component to migrate through the chromatographic system without any interaction with the stationary phase)

t_{R_i}: retention time = interval between peak i and the point of injection

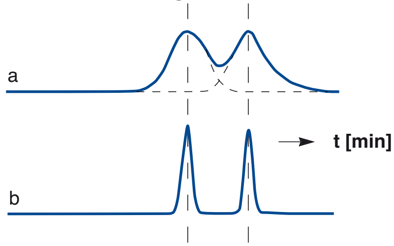
t_{R_i}': net retention time = difference between total retention time and dead time t_0. It indicates how long a substance stays in the stationary phase.

Other terms characterising a separation:

k': capacity factor: a measure for the position of a sample peak in the chromatogram. The capacity factor is specific for a given compound and constant under constant conditions.

$$k'_i = \frac{t_{R_i} - t_0}{t_0}$$

The relative retention does not provide any information on the quality of a separation, since for equal values of α two very broad peaks may overlap, (as shown in trace a), or may be completely resolved (as in trace b), if they are correspondingly narrow.



R: resolution: a measure for the quality of a separation, taking the peak width at half height ($w_{1/2}$) into account according to

$$R = \frac{t_{R_2} - t_{R_1}}{(w_{1/2})_2 + (w_{1/2})_1}$$

N_{th}: number of theoretical plates: characterises the quality of a column (should be determined for $k' > 5$).

The height equivalent to a theoretical plate (h, HETP) is calculated by dividing the length L of the column by the number of theoretical plates N_{th}. The smaller this value the better works the column.

$$N_{th} = 5.54 \cdot \left(\frac{t_{R_i}}{w_{1/2}}\right)^2$$

$$h = HETP = \frac{L}{N_{th}}$$

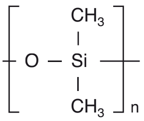
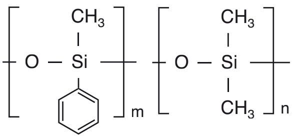
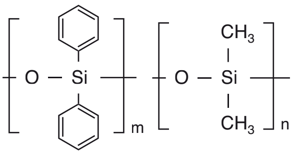
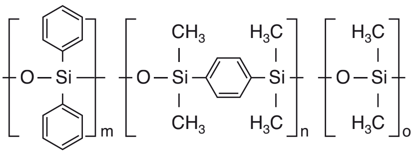
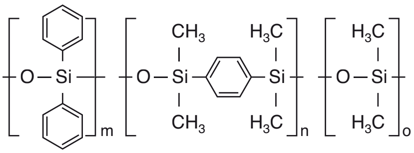
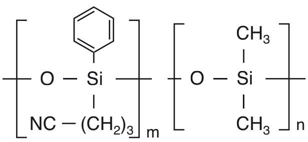
MN phases for GC

Phase	Composition	**Relative polarity** [1]	max. Temperature [2]
OPTIMA® 1	100 % dimethylpolysiloxane		340/360 °C
OPTIMA® 1 MS			
OPTIMA® 1 MS Accent			
OPTIMA® 5	5 % phenyl – 95 % dimethylpolysiloxane		340/360 °C
OPTIMA® 5 MS	5 % diphenyl - 95 % dimethylpolysiloxane		340/360 °C
OPTIMA® 5 MS Accent	silarylene phase equivalent to 5 % diphenyl – 95 % dimethylpolysiloxane		340/360 °C
OPTIMA® δ-3	phase with autoselectivity		340/360 °C
OPTIMA® XLB	phase with optimised silarylene content		340/360 °C
OPTIMA® δ-6	phase with autoselectivity		340/360 °C
OPTIMA® 1301	6 % cyanopropylphenyl – 94 % dimethylpolysiloxane		300/320 °C
OPTIMA® 624	6 % cyanopropylphenyl – 94 % dimethylpolysiloxane		280/300 °C
OPTIMA® 624 *LB*	as above, low bleed phase		280/300 °C

1 = nonpolar, = polar properties

2 first temperature for isothermal operation, second value for short isotherms in a temperature programme (please note, that for columns with 0.53 mm ID and for columns with thicker films temperature limits are generally lower)

Summary

Structure	USP	Phases which provide a similar selectivity based on chemical and physical properties
	G1 G2 G38	PERMABOND® SE-30, OV-1, DB-1, SE-30, HP-1, SPB-1, CP-Sil 5 CB, Rtx®-1, 007-1, BP1, MDN-1, AT™-1, ZB-1, OV-101 Ultra-1, DB-1MS, HP-1MS, Rtx®-1MS, Equity™-1, AT™-1MS, VF-1MS, CP-Sil 5 CB MS
	G27 G36	PERMABOND® SE-52, SE-54, SE-52, DB-5, HP-5, SPB-5, CP-Sil 8, Rtx®-5, 007-5, BP5, MDN-5, AT™-5, ZB-5
	G27 G36	DB-5MS, HP-5MS, Ultra-2, Equity™-5, CP-Sil 8CB low bleed/MS, Rtx®-5SIL-MS, Rtx®-5MS, 007-5MS, BPX5, MDN-5S, AT™-5MS, VF-5MS
	G27 G36	
see description on page 10	G49	no similar phases
	–	DB-XLB, Rtx®-XLB, MDN-12, VF-XMS
see description on page 10	–	no similar phases
	G43	HP-1301, DB-1301, SPB-1301, Rtx®-1301, CP-1301, 007-1301 HP-624, HP-VOC, DB-624, DB-VRX, SPB-624, CP-624, Rtx®-624, Rtx®-Volatiles, 007-624, BP624, VOCOL
For special phases and phases tested for specific applications see table on page 21		

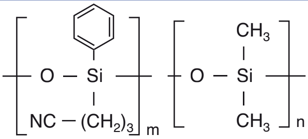
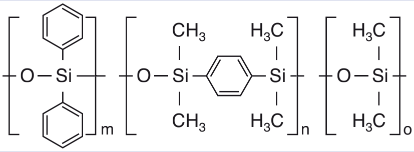
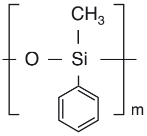
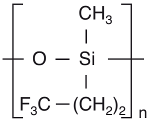
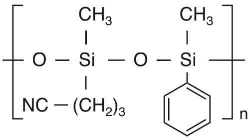
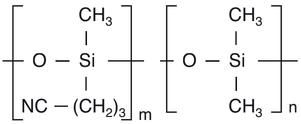
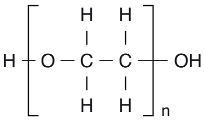
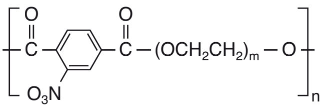
MN phases for GC

Phase	Composition	Relative polarity [1]	max. Temperature [2]
OPTIMA® 1701	14 % cyanopropylphenyl – 86 % dimethylpolysiloxane		300/320 °C
OPTIMA® 35 MS	silarylene phase with selectivity similar to a 35 % diphenyl – 65 % dimethylpolysiloxane phase		360/370 °C
OPTIMA® 17	phenylmethylpolysiloxane, 50 % phenyl		320/340 °C
OPTIMA® 210	trifluoropropylmethylpolysiloxane (50 % trifluoropropyl)		260/280 °C
OPTIMA® 225	50 % cyanopropylmethyl – 50 % phenylmethylpolysiloxane		260/280 °C
OPTIMA® 240	33 % cyanopropylmethyl – 67 % dimethylpolysiloxane		260/280 °C
OPTIMA® WAX	polyethylene glycol 20 000 daltons		250/260 °C
OPTIMA® FFAP	polyethylene glycol 2-nitroterephthalate		250/260 °C

1 (yellow) = nonpolar, (red) = polar properties

2 first temperature for isothermal operation, second value for short isotherms in a temperature programme (please note, that for columns with 0.53 mm ID and for columns with thicker films temperature limits are generally lower)

Summary

Structure	USP	Phases which provide a similar selectivity based on chemical and physical properties
	G46	OV-1701, DB-1701, CP-Sil 19 CB, HP-1701, Rtx®-1701, SPB-1701, 007-1701, BP10, ZB-1701
	G42	DB-35 MS, HP-35, SPB-35, Rtx-35, 007-35, BPX-35, MDN-35, AT-35 MS, ZB-35, OV-11, VF-35 MS
	G3	OV-17, DB-17, HP-50+, HP-17, SPB-50, SP-2250, Rtx®-50, CP-Sil 24 CB, 007-17, ZB-50
	G6	OV-210, DB-210, Rtx®-200, 007-210
	G7 G19	DB-225, HP-225, OV-225, Rtx®-225, CP-Sil 43, 007-225, BP225
	–	no similar phases
	G16	PERMABOND® CW 20 M, DB-Wax, Supelcowax™, HP-Wax, HP-INNOWax, Rtx®-Wax, CP-Wax 52 CB, Stabilwax, 007-CW, BP20, AT™-Wax, ZB-Wax
	G25 G35	PERMABOND® FFAP, DB-FFAP, HP-FFAP, CP-SIL 58 CB, 007-FFAP, CP-FFAP CB, Nukol
For special phases and phases tested for specific applications see table on page 21		

Phase selection in GC

Selecting the proper stationary phase is the most important decision when selecting a capillary column for a given separation task. In this chapter you will find some guidelines and concepts that simplify the process. There are four major column parameters (primary selection features) and four hardware-and-problem adapted secondary selection features:

Primary selection features: +

- phase polarity
- film thickness
- inner diameter
- column length

Secondary selection features:

- temperature stability
- deactivation
- bleeding
- special selectivities

Phase polarity

Phase selectivity is determined by the physicochemical interactions of the solute molecules with the stationary phase.

- **General rule: only an adequate polarity of the GC phase leads to satisfying separation and peak shape**

Use similar polarities for phase and target compounds (e. g. nonpolar molecules require nonpolar polysiloxane phases in the column).

MN offers more than 40 different phases for gas chromatography, from very nonpolar to polar columns.

- **Nonpolar** stationary phases, starting with 100 % dimethylpolysiloxane, separate by volatility (i. e. boiling point) only.

  Typical nonpolar phases:
  OPTIMA® 1 or OPTIMA® 5

  Typical analytes:
  linear hydrocarbons (*n*-alkanes).

For structures and relative polarities of MN OPTIMA® phases please refer to the table on the preceding pages.

- **Mid-polar** phases offer additional interactions, which may improve a separation. With increasing polarity, e. g. by introducing phenyl and/or cyanopropyl groups, the separation is increasingly influenced by differences in dipole moment and by charge transfer.

  Typical mid-polar phase:
  OPTIMA® 1701

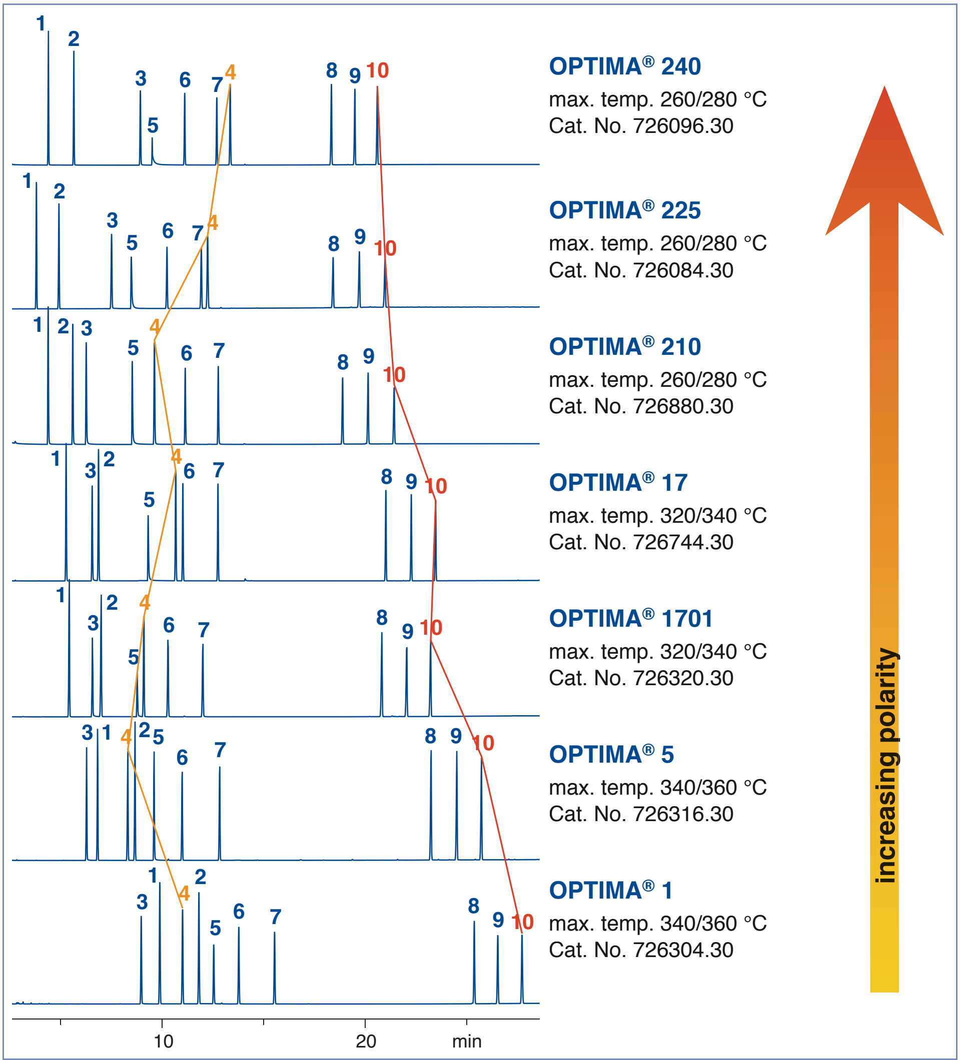
  Typical analytes:
  molecules which can be polarised (e. g. aromatic compounds).

- For **polar** components featuring medium to strong hydrogen bonding capacities, polyethylene glycol phases (WAX) are the best choice for a separation.

  Typical polar phase:
  OPTIMA® WAX

  Typical analytes:
  alcohols and carboxylic acids.

Comparison of separation properties of selected OPTIMA® phases



All columns: 0.5 µm film, 30 m x 0.32 mm ID
Sample: MN-OPTIMA® test mixture (REF 722316)
Injection: 1.0 µl, split 1: 50
Carrier gas: 80 kPa N_2
Temperature: 80 °C → T_{max} (isothermal), 8 °C/min
Detector: FID, 260 – 300 °C

Peaks:
1. Undecane
2. Dodecane
3. Octanol
4. **Dimethylaniline**
5. Decylamine
6. Methyl decanoate
7. Methyl undecanoate
8. Henicosane
9. Docosane
10. **Tricosane**

Phase selection in GC

Autoselectivity · OPTIMA® δ phases

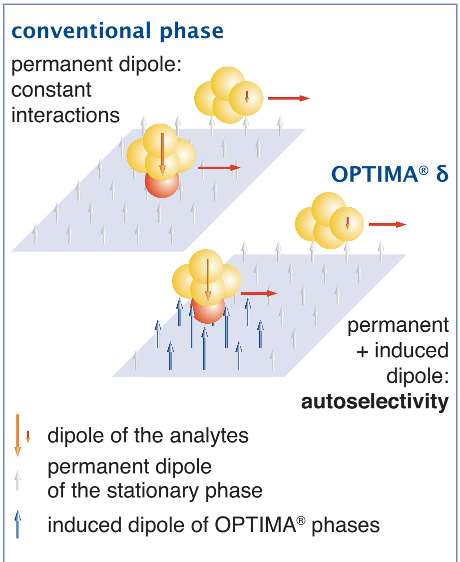
The polarity of all standard phases is defined by their composition.

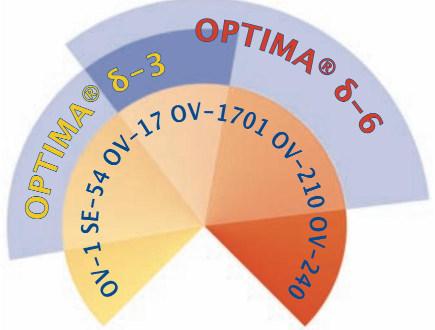
In conventional mid-polar phases an increased polarity is achieved by an increase of the phenyl content in the dimethylpolysiloxane or by adding e. g. cyanopropyl or trifluoromethyl groups to the dimethylpolysiloxane often resulting in an increased tendency for bleeding.

OPTIMA® δ phases were developed to adjust themselves to the polarity of the target compounds: with non-polar compounds the phase reacts nonpolar, for polar compounds the phase increases its polarity.

The OPTIMA® δ phases consist of cross-linked polysiloxane block polymers with defined composition, exclusively produced for MN. Polar molecules are able to induce a dipole moment in the stationary phase, so that the analytes show stronger interactions. We call this phenomenon autoselectivity, because the stationary phase adjusts itself to the polarity of the analytes. Thus OPTIMA® δ phases cover broader ranges of polarity.

Due to their structure, OPTIMA® δ phases show very high temperature limits of 340/360 °C and low bleed levels, making them well suited for MSD or PND.





range of polarities
covered by OPTIMA® δ phases

Isomeric phenols are difficult to analyse on standard phases due to coelutions. The autoselective OPTIMA® δ-3 readily separates all of 22 isomeric phenols as shown in application 250060 on page 61.

Polarity · Most frequently used phases

Selectivity has to be optimized for the critical pair of components or the main component.

You should always select the least polar column which solves your separation task.

About 70 % of all GC separations can be performed on non- to mid-polar columns.

In fact, 5-type phases (5 % phenyl – 95 % methylpolysiloxane) are the most commonly used GC phases in the world, because they generally feature high temperature stability, low column bleeding and good deactivation.

The second most common phases are WAX and/or FFAP. They represent the other end of the polarity range and are well suited for all compounds with strong hydrogen bonding capacity (e. g. compounds with OH, COOH or NH_x functionalities).

Mid-polar phases like 1301, 35, 17, 1701, 210 and 225 feature alternative polarities for special separations or for confirming analytical results.

Film thickness

Film thickness of MN capillary columns reaches from 0.1 to 5.0 µm.

Standard film thickness is 0.25 µm.

Thin films (0.1 – 0.2 µm) are very well suited for high-boiling or temperature labile compounds, fast separations, or very closely eluting substances.

Increasing film thickness will increase the capacity, the retention time for low-boiling compounds, and improve inertness. This is especially useful for samples with widely differing concentrations, or for the separation of volatile polar substances.

Better coverage of the column wall by a thicker film and a reduction of the column surface by reducing column length is favourable for extremely active substrates, which in many cases cause noticeable tailing, if they come in contact with uncoated spots of the column wall.

Thick films also mean more phase in the column, and consequently higher bleeding. This results in lower maximum operating temperatures for thick film columns. In addition, thick film columns may have a lower efficiency.

Variation of the film thickness is often better than increasing the column length as may be seen in applications 200030 and 200041 page 196.

Phase selection in GC

Inner diameter

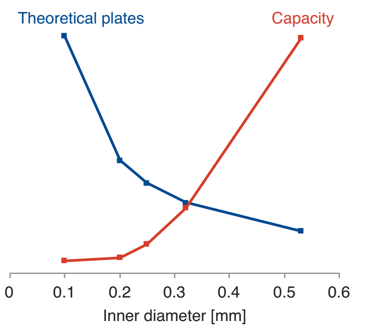
The lower the ID of a GC column, the higher is the theoretically possible number of plates per meter.

- **0.1 – 0.2 mm ID**
  for high resolution and short retention times with low carrier gas flows (Fast GC)
- **0.25 mm ID**
  all-purpose columns for analyses of complex mixtures
- **0.32 mm ID**
  for routine analyses with short retention times, but increased capacity
- **0.53 mm ID**
  for rapid separations with inert surface and highest capacity

Plate number as a function of ID

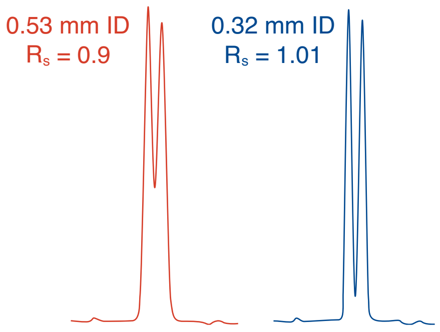
Column ID [mm]	Theoretical plates/m
0.10	12500
0.20	5940
0.25	4750
0.32	3710
0.53	2240

Plate number and capacity as function of inner diameter



Influence of inner diameter on resolution

Column: 30 m, identical film thickness



Decreasing the inner diameter and thus increasing resolution is useful for high speed/Fast GC procedures, but some side effects have to be considered:

- retention time increases as well (at identical head pressure)
- the back pressure of a small ID column increases due to restriction
- the capacity of columns decreases (the loadability decreases, see table on previous page)
- the hardware requirements for injection systems (high pressure, high speed of injection) and detectors (highest speed of detection) increase

Because of this, GC procedures can not always take profit from the increase in plate numbers!

Primary column parameters

Sample capacity (loadability) of a 30 m column in ng

Film thickness [µm]	Inner diameter [mm] 0.2	0.25	0.32	0.53
0.10	20 – 35	25 – 50	35 – 75	50 – 100
0.25	35 – 75	50 – 100	75 – 125	100 – 250
0.50	75 – 150	100 – 200	125 – 250	250 – 500
1.00	150 – 250	200 – 300	250 – 500	500 – 1000
3.00		400 – 600	500 – 800	1000 – 2000
5.00		1000 – 1500	1200 – 2000	2000 – 3000

Phase ratio of capillary columns

Column length (L) and retention times (for identical flow and pressure parameters) show a linear relation; resolution is proportional to the square root of L. If other column parameters (ID, film thickness) have to be adapted – for example in case of a new GC with different dimension requirements – a comparable separation can only be achieved with columns with similar phase ratio!

In general a higher phase ratio implies less retention power and shorter retention times and vice versa.

Calculation of the phase ratio:

$$\beta = \frac{r}{2\,d_f}$$

with r = column radius and d_f = film thickness

Phase ratio as a function of inner diameter and film thickness

↓ ID \ d_f →	0.1	0.2	0.25	0.35	0.5	1	1.5	2	3	5
0.1	250	125.0	100	71.43	50	25.0	16.67	12.50	8.3	5.0
0.2	500	250.0	200	142.86	100	50.0	33.33	25.00	16.7	10.0
0.25	625	312.5	250	178.57	125	62.5	41.67	31.25	20.8	12.5
0.32	800	400.0	320	228.57	160	80.0	53.33	40.00	26.7	16.0
0.53	1325	662.5	530	378.57	265	132.5	88.33	66.25	44.2	26.5

Phase selection in GC

Column length

Column length is directly proportional to the separation efficiency (number of plates N).

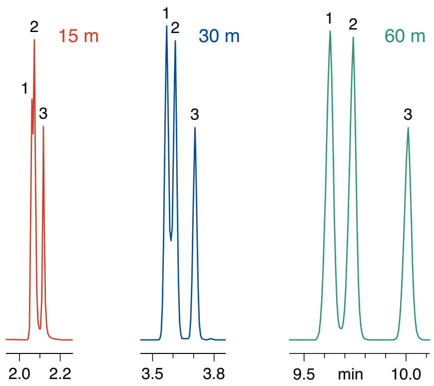
Longer columns show increased resolution, however, R is proportional to the square root of N, i. e. a doubled column length only increases the resolution by a factor of 1.4, while cost and analysis time are proportional to the length.

Routine separations are most frequently performed on 25 or 30 m columns, while complex mixtures may require 50 or 60 m columns. 10 m columns with 0.10 mm ID are used for Fast GC.

As a rule of thumb:
use about 1 m column length per component in your mixture.

Influence of column length on resolution and retention time

Columns: OPTIMA® 1, 0.25 mm ID, 0.25 μm film
Carrier gas: 1 ml/min He, isothermal
Peaks: FAMEs
1. C18:2, 2. C18:1, 3. C18



Fast GC

Characteristics of Fast GC are decreased column diameters, high heating rates and decreased column length for faster GC separations with high resolution efficiency.

- small inner diameters combined with fast temperature programs can reduce the analysis time by up to 80 %
- high heating rates place special demands on stationary phases: OPTIMA® columns meet exactly this requirement, as they show very low bleeding and provide long lifetimes, even when continuously subjected to high heating rates
- small inner diameters result in high column inlet pressures and a lower volume flow of the mobile phase, which as a consequence require very fast injection of very small samples against a high pressure
- the amount of sample, which can be injected, is limited by the inner diameter and the thin film
- high sensitivity detectors with small volume and extremely short response time, as well as a very rapid data acquisition and processing are required

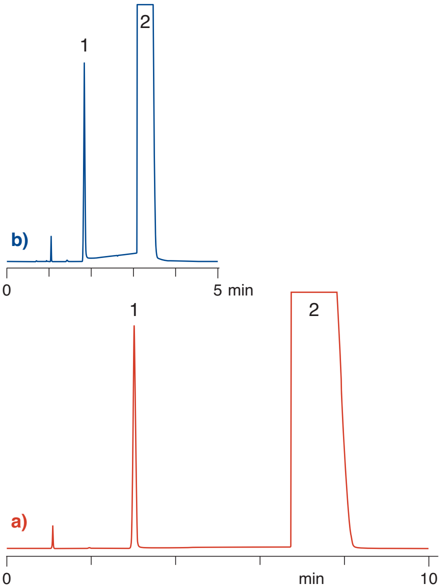
For comparison of a separation on a 50 m standard capillary with a separation on a 10 m fast GC column see application 211260 on page 151.

Temperature stability

High temperature stability of a column is beneficial for high-boiling solutes with very low vapour pressures, which normally have very long retention times and rather broad peak shapes. Since OPTIMA® columns can be operated at increased temperatures, they elute high-boiling compounds faster and with better peak shapes.

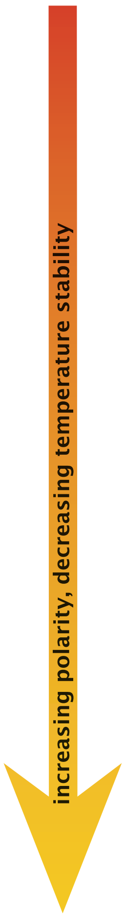
Improved peak shape at higher temperatures

Injection: 0.6 μl, split 1:100
Carrier gas: 0.4 bar He
a) Temperature: 100 °C isothermal
width of peak 2: 1.4 min
b) Temperature: 130 °C isothermal
width of peak 2: 0.5 min



Maximum operating temperatures for OPTIMA® phases

OPTIMA® phase	max. Temp. [°C]
1	340/360
1 MS	340/360
1 MS Accent	340/360
5	340/360
5 MS	340/360
5 MS Accent	340/360
δ-3	340/360
XLB	340/360
δ-6	340/360
1301	300/320
624 / 624 LB	280/300
1701	300/320
35 MS	360/370
17	320/340
210	260/280
225	260/280
240	260/280
WAX	250/260
FFAP	250/260



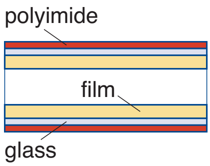
* first temperature for isothermal operation, second value for short isotherms in a temperature programme (please note, that for columns with 0.53 mm ID and for columns with thicker films temperature limits are generally lower)

Phase selection in GC

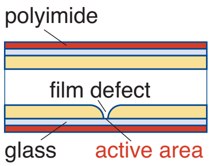
Deactivation

The quality of deactivation in GC columns is influenced by

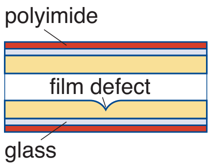
- the deactivation of the glass tube itself
- the binding process of the polysiloxane or polyethylene glycol to the glass wall
- the composition and thickness of the film
- the constancy / quality of the coverage of the column wall



optimal column with even film and perfectly covered walls



column with film defect causing an active area, where analytes can interact with the glass wall, resulting in tailing



thicker films help to avoid active areas, even when the film is not perfectly smooth resulting in less or no tailing

The possibility of film defects increases with increasing column length and decreasing film thickness. Thus especially for polar compounds thin film columns may cause problems like tailing or deformed peaks due to uncontrolled interactions with active spots on the column wall.

Quality control of OPTIMA® columns

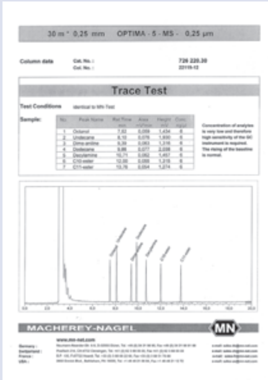
The deactivation process of OPTIMA® columns is optimized for excellent chromatographic performance, improved peak shape, efficiency and sensitivity.

Performance of each GC column from MN is tested by stringent quality control procedures including

- **column efficiency** by measuring the separation number (number of resolved peaks between two members of a series of homologue compounds, in this case FAMEs C11 and C12) in a temperature programme (8 °C/min)
- **polarity** by measuring the retention index of octanol versus decane and undecane
- **bleeding** as difference in baseline values at start and end of the temperature programme
- **inertness** by measuring the peak height ratio for decylamine/undecane (for non- to mid-polar phases)

All MN columns are supplied with test chromatograms of standard test mixtures stating the actual performance of the column (MS columns additionally include the chromatogram of a trace test diluted 1:100). Additionally, we include the corresponding test mixture.

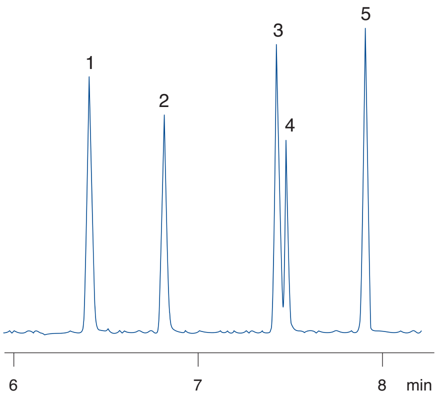
Typical test chromatograms of an OPTIMA® column



Examples of OPTIMA® column performance and deactivation

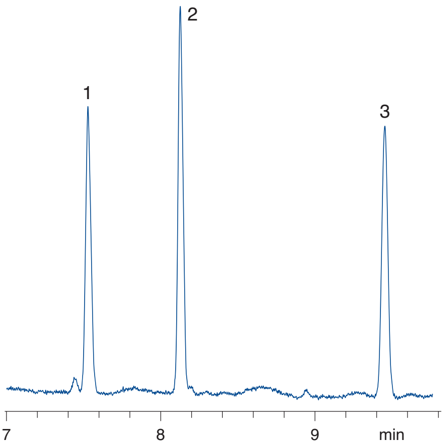
Column: OPTIMA® 35 MS,
30 m x 0.25 mm ID,
0.25 μm film
Injection: 1 μl, split 1:20, **1 ng/peak**
Carrier gas: 1.0 ml/min He
Temperature: 80 °C $\xrightarrow{10\ °C/min}$ 320 °C (10 min)
Detector: MSD

Peaks:
1. *o*-Anisidine
2. 4-Chloroaniline
3. *p*-Cresidine
4. 2,4,5-Trimethylaniline
5. 4-Chloro-*o*-toluidine



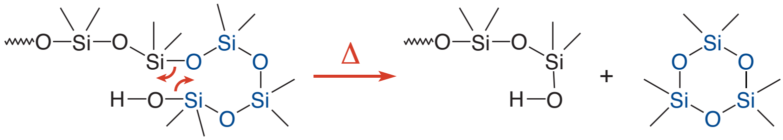
Column: OPTIMA® 5 MS Accent,
30 m x 0.25 mm ID,
0.25 μm film
Injection: 1 μl, split 1:50, **0.2 ng/peak**
Carrier gas: 80 kPa He
Temperature: 80 °C $\xrightarrow{8\ °C/min}$ 360 °C
Detector: MSD

Peaks:
1. Octanol
2. Undecane
3. Dimethylamine



Column bleeding

Degradation of a methylpolysiloxane chain forming hexamethylcyclotrisiloxane



Column bleeding is a thermal degradation of the siloxane polymer caused by splitting of siloxane bonds with lower bond energies (see formula above).

Bleeding is accelerated near the upper temperature limit of the stationary phase (normally above 180 °C). In the presence of oxygen or water bleeding even starts at much lower temperatures. This is why the purity of the carrier gas is very important, especially when working at high temperatures.

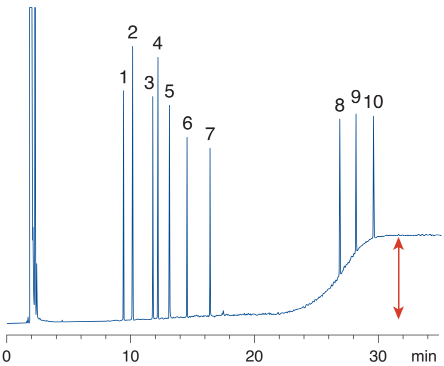
Column bleed increases as column length increases, because longer columns contain more of the stationary phase. However, don't let this fact discourage you to use a longer column if necessary.

Column bleed also increases as film thickness increases. Since thicker films are more retentive, later eluting peaks may shift into a region of much higher column bleed when increasing film thickness as is shown in the chromatogram below.

Column bleeding at elevated temperature

Column: OPTIMA® 5 Amine, 30 x 0.32 mm ID, 1.5 µm film, REF 726356.30, max. temperature 300/320 °C
Injection: 1 µl, split 1:35
Carrier gas: 1.5 bar He
Temperature: 80 °C $\xrightarrow{8\ °C/min}$ 320 °C (10 min)
Detector: FID

Peaks:
1. Octanol
2. Undecane
3. Dimethylaniline
4. Dodecane
5. Decylamine
6. Methyl decanoate
7. Methyl undecanoate
8. Henicosane
9. Docosane
10. Tricosane

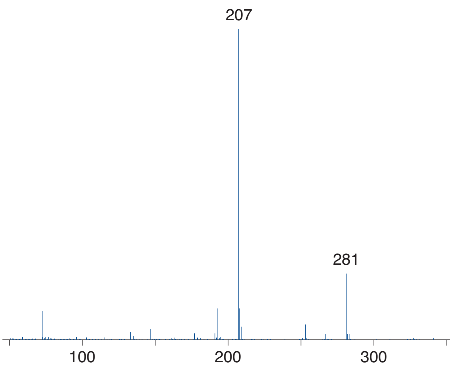


Secondary column parameters

As is shown in the mass spectrum below, the major “bleed” ion from a 5-type phase is m/z = 207 resulting from hexamethylcyclotrisiloxane (D_3), the second important ion m/z = 281 results from the cyclic degradation product with 4 units (D_4).

Mass spectrum of a 5-type phase

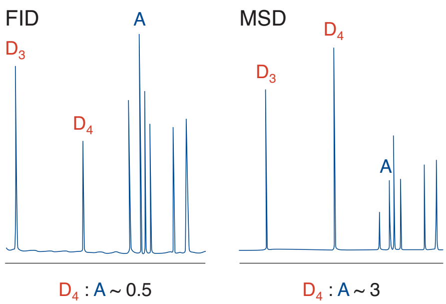
320 °C, TIC, 50 – 500 amu



Influence of the type of detector

The impact of bleeding on the signal to noise ratio of a chromatogram is much more pronounced for ion trap MS detectors than for FID detectors as is shown in the graphs below. With FID detection, the ratio of D_4 to the analyte peak A is about 0.5; with MS detection it is about 3! This is why columns with low bleed characteristics are especially important for use with MS detection.

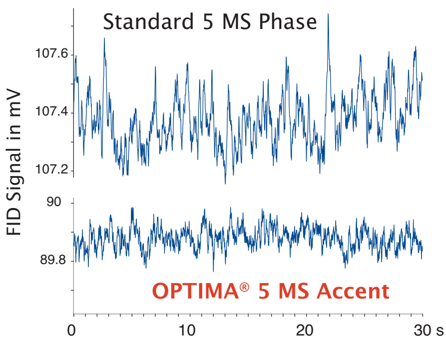
Chromatogram of the same sample analysed with FID and MSD



Benefits of low bleed columns in GC

Low bleed columns allow

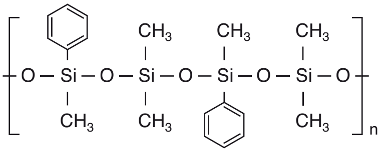
- higher operating temperatures resulting in shorter run times
- less pollution of the detection system
- improved detectability of solutes in GC/MS analyses
- increased detectability due to an improved signal to noise ratio as is shown in the traces at right



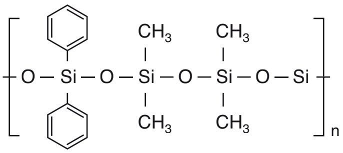
Phase selection in GC

Low-bleed GC/MS columns

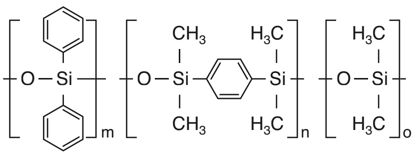
Standard columns with 5-type phases contain phenyl and methyl substituted siloxanes in the ratio 5:95 as shown in the structure below



The first generation of low-bleed GC/MS columns contains diphenyl siloxane groups which improve bleed characteristics due to steric hindrance of the formation of D_3 and D_4.



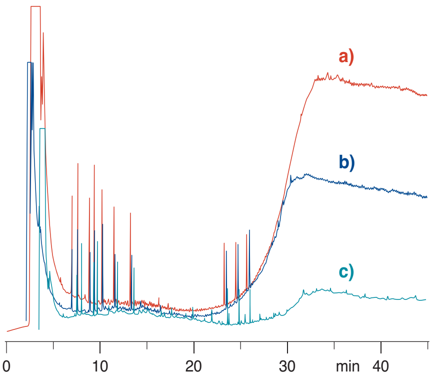
Silarylene-type columns (see figure below) are stabilised by insertion of arylene groups in the siloxane chain, offering lowest bleeding and high inertness even at higher temperatures.



Comparison of bleeding characteristics of 5-type columns

Columns:	30 m x 0.25 mm ID, 0.25 μm film
Injection:	1 μl, split 1:50
Carrier gas:	80 kPa He
Temperature:	80 °C $\xrightarrow{8\ °C/min}$ 360 °C
Detector:	FID

Chromatograms:
a) conventional 5-type phase
b) conventional 5-MS phase
c) OPTIMA® 5 MS Accent



Special selectivities

Achiral columns for special separations

Certain analytical separations can be performed more easily with chromatographic columns, which have been especially developed or tested for the respective task. The following table summarises our programme of GC speciality capillaries. Page numbers refer to the cited applications.

Phase composition	Recommended application	Typical application	Page
OPTIMA® 5 Amine			
5 % phenyl – 95 % methylpolysiloxane especially deactivated	polyfunctional amines such as ethanolamines, amino-functionalised diols	250050 210280	138 140
FS-CW 20 M-AM			
polyethylene glycol, basic, non-immobilised	amines	201520 201530	139 139
PERMABOND® P-100			
dimethylpolysiloxane	petrochemical products	200071	199
PERMABOND® SE-54 HKW			
1 % vinyl – 5 % phenyl – 94 % methylpolysiloxane	volatile halogenated hydrocarbons	212480 200150	40 46
OPTIMA® 1-TG			
dimethylpolysiloxane	triglycerides according to carbon number	200050	197
OPTIMA® 17-TG			
phenyl-methyl-polysiloxane (50 % phenyl)	triglycerides according to degree of unsaturation	201800	176
PERMABOND® Silane			
	monomeric silanes and chlorosilanes	200090	148
PERMABOND® CW 20 M-DEG			
polyethylene glycol, tested for diethylene glycol	diethylene glycol in wine	201500	160

Phase selection in GC

Chiral columns for enantiomer separation

For chiral columns it is not possible to make a general prediction, which phase could solve a given separation task. Even for compounds with small structural differences the enantio-differentiation can be quite different. For numerous chiral separations – arranged by increasing molecular size – refer to pages 201 – 275. Page numbers in the table below refer to the cited typical applications.

Phase	Composition	max. Temp. [° C]	Typical application	Page
LIPODEX® cyclodextrin phases				
LIPODEX® is patented under EP 0407 412 and US Re. 36.092				
LIPODEX® A	hexakis-(2,3,6-tri-O-pentyl)-α-cyclodextrin	200/220	202851	212
LIPODEX® B	hexakis-(2,6-di-O-pentyl-3-O-acetyl)-α-cyclodextrin	200/220	202861	205
LIPODEX® C	heptakis-(2,3,6-tri-O-pentyl)-β-cyclodextrin	200/220	201880	210
LIPODEX® D	heptakis-(2,6-di-O-pentyl-3-O-acetyl)-β-cyclodextrin	200/220	202871	227
LIPODEX® E	octakis-(2,6-di-O-pentyl-3-O-butyryl)-γ-cyclodextrin	200/220	212761	202
LIPODEX® G	octakis-(2,3-di-O-pentyl-6-O-methyl)-γ-cyclodextrin	220/240	250410	259
HYDRODEX cyclodextrin phases, diluted with optimized polysiloxanes				
HYDRODEX β-PM	heptakis-(2,3,6-tri-O-methyl)-β-cyclodextrin	230/250	202030	272
HYDRODEX β-3P	heptakis-(2,6-di-O-methyl-3-O-pentyl)-β-cyclodextrin	230/250	201920	266
HYDRODEX β-6TBDM	heptakis-(2,3-di-O-methyl-6-O-*t*-butyldimethyl-silyl)-β-cyclodextrin	230/250	250170	274
HYDRODEX β-TBDAc	heptakis-(2,3-di-O-acetyl-6-O-*t*-butyldimethyl-silyl)-β-cyclodextrin	220/240	212430	265
HYDRODEX γ-TBDAc	octakis-(2,3-di-O-acetyl-6-O-*t*-butyldimethyl-silyl)-γ-cyclodextrin	220/240	212980	262

The mobile phase in GC

Sometimes it may be difficult to apply the data of a given GC application in reality, because every manufacturer of GC equipment has its own standards and specifications (depending on the country). The physical parameters are fixed, but an adaption has to be made.

Sometimes an older application uses different or out-dated parameters which are no longer in use
The tables and information in this chapter were compiled to separate the "jungle" in order to give practicable professional hints.

Selection of the optimum carrier gas

For optimum column performance, hydrogen carrier gas offers some strong advantages over helium or nitrogen. Hydrogen yields higher plate numbers (= better resolution) at rapid linear velocities and achieves higher velocities at lower pressures. At the same time, the presence of extra hydrogen is advantageous for flame ionization and other detectors that use hydrogen fuel gas.

Nevertheless, in practical work H_2 is not used so often, because it is the gas with the highest price and the highest danger potential!

Helium is not so dangerous, cheaper, with a similar separation efficiency and for this reason the most recommended gas for modern routine analysis. For sure nitrogen has the lowest price, but many separation problems can be avoided or solved directly by switching from N_2 to He or H_2.

The following tables show, that H_2 has the highest gas velocity and the lowest viscosity of all commonly used gases for GC (H_2, He, N_2).

We recommend: if a high resolution (e.g. for chiral separations) or a short analysis time is required, use hydrogen!

Physical parameters of GC gases

Gas	Viscosity *		Linear velocity at 25 °C					
	300 K	500 K	g/mol	m/s	km/h	Factor N_2	Faktor He	Faktor H_2
H_2	9.0	12.7	2.016	1920	6920	3.8	1.4	1
He	20.0	28.4	4.003	1370	4930	2.7	1	0.71
N_2	17.9		28.014	510	1840	1	0.37	0.26
O_2			32	480	1720			

* from Handbook of Chemistry and Physics, 72nd Edition

Working conditions in GC

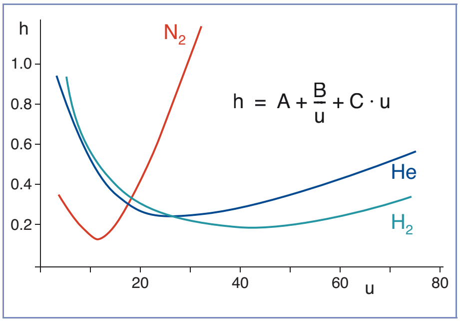
Optimized working conditions for GC

The table below shows the optimum working conditions for standard columns with common lengths and inner diameters. If you adjust your GC parameters to these values, you can be sure to work in the optimum chromatographic region according to the van Deemter curves. If your parameters are outside these values, you will loose separation efficiency and the results may no longer be ideal (poor separation, analysis time too long, dead time too short).

The short dead times mirror the high speed of H_2 compared to the other gases. If the same inlet pressures are applied for hydrogen as for helium, peaks are eluted in less time, because the linear velocity of H_2 is faster than that of helium. In general, when switching from helium to hydrogen retention times will be roughly cut in half if the inlet pressure is unchanged.

Plate height and gas velocity

The Van Deemter equation shows how the plate height h depends on the flow velocity u for 3 different GC gases:



A Eddy diffusion; for WCOT capillary columns A = 0
B molecular axial diffusion; B is a function of the diffusion coefficient of the component in the respective carrier gas
C resistance to mass transfer

In practice often higher velocities than $u_{opt.}$ are chosen, if separation efficiency is sufficient, since higher carrier velocities mean shorter retention times.

Gas	Column length [m]	Column ID [mm]	Average velocity. [cm/s]	Outlet flow [ml/min]	Head pressure [kPa]	Head pressure [psi]	Head pressure [bar]	Dead time [min]
Nitrogen	10	0.10	8 – 16	0.04 – 0.1	55 – 112	8 – 16	0.5 – 1.1	2.1 – 1.0
	25	0.20	8 – 16	0.14 – 0.33	34 – 69	5 – 10	0.3 – 0.69	5.2 – 2.6
	30	0.25	8 – 16	0.21 – 0.48	26 – 53	3.8 – 7.6	0.26 – 0.53	6.3 – 3.1
N_2	30	0.32	8 – 16	0.33 – 0.72	16 – 32	2.3 – 4.6	0.16 – 0.32	6.3 – 3.1
	30	0.53	8 – 16	0.88 – 1.79	5.8 – 11.7	0.8 – 1.7	0.06 – 0.11	6.3 – 3.1
Helium	10	0.10	20 – 40	0.14 – 0.45	156 – 330	22 – 48	1.6 – 3.3	0.83 – 0.42
	25	0.20	20 – 40	0.46 – 1.29	95 – 200	14 – 29	0.95 – 1.99	2.1 – 1.0
	30	0.25	20 – 40	0.65 – 1.74	72 – 150	10 – 22	0.7 – 1.5	2.5 – 1.25
He	30	0.32	20 – 40	0.95 – 2.29	43 – 89	6.3 – 12.9	0.43 – 0.89	2.5 – 1.25
	30	0.53	20 – 40	2.3 – 4.92	16 – 32	2.3 – 4.6	0.16 – 0.32	2.5 – 1.25
Hydrogen	10	0.10	30 – 55	0.18 – 0.47	113 – 215	16 – 31	1.1 – 2.1	0.55 – 0.3
	25	0.20	30 – 55	0.62 – 1.43	69 – 130	10 – 19	0.69 – 1.3	1.4 – 0.7
	30	0.25	30 – 55	0.9 – 2.0	53 – 99	7.6 – 14	0.5 – 0.9	1.7 – 0.9
H_2	30	0.32	30 – 55	1.35 – 2.8	32 – 59	4.6 – 8.5	0.32 – 0.59	1.7 – 0.9
	30	0.53	30 – 55	3.35 – 6.5	11.5 – 21.4	1.7 – 3.1	0.12 – 0.21	1.7 – 0.9

Oven temperature 100 °C, split 10:1, injector temperature 175 °C

Conversion tables

Pressure conversion chart

Multiply value for unit in the left column by the factor given in the table below the desired unit

↓ Unit →	kPa	bar	atm	psi	kg cm^{-2}	Torr
kPa	1	0.0100	0.00987	0.1450	0.0102	7.52
bar	100	1	0.9869	14.5038	1.0197	751.88
atm	101.32	1.0133	1	14.696	1.0332	760
psi	6.8948	0.06895	0.068	1	0.0703	51.713
kg cm^{-2}	98.06	0.9806	0.9678	14.223	1	735.56
Torr	0.1330	0.00133	0.00132	0.0193	0.00136	1

Examples: to convert 250 bar to psi, multiply 250 by 14.5038 = 3626 psi
to convert 3000 psi to kPa, multiply 3000 by 6.8948 = 20684.4 kPa

Conversion of concentrations and amounts of sample per injection

The table shows common concentrations and injection volumes for GC. The upper half is the standard region of detectable concentrations (TCD and FID detectors) and the lower half is the region of ultra trace analysis (MS, Ion Trap, Quadrupol MS, ECD)

Concentration					Injection 1 μl	
[%]	[g/g] [g/ml]	[g/kg] [g/l]	[ppm]	[ppb]	splitless [ng]	split 1: 10 [ng]
100	1	1 000	1 000 000	1 000 000 000	1 000 000	100 000
10	0.1	100	100 000	100 000 000	100 000	10 000
1	0.01	10	10 000	10 000 000	10 000	1 000
0.1	0.001	1	1 000	1 000 000	1 000	100
0.01	0.000 1	0.1	100	100 000	100	10
0.001	0.000 01	0.01	10	10 000	10	1
	[μg/g] [μg/ml]	[mg/kg] [mg/l]				
0.000 1	1	1	1	1 000	1	0.1
0.000 01	0.1	0.1	0.1	100	0.1	0.01
0.000 001	0.01	0.01	0.01	10	0.01	0.001
0.000 000 1	0.001	0.001	0.001	1	0.001	0.000 1
0.000 000 01	0.000 1	0.000 1	0.000 1	0.1	0.000 1	0.000 01
0.000 000 001	0.000 01	0.000 01	0.000 01	0.01	0.000 01	0.000 001
0.000 000 000 1	0.000 001	0.000 001	0.000 001	0.001	0.000 001	0.000 0001

Derivatisation in GC

Derivatisation

The purpose of derivatisation

In gas chromatography it is often advantageous to derivatise polar functional groups (mainly active hydrogen atoms) with suitable reagents. Prerequisite for successful derivatisation is quantitative, rapid and reproducible formation of only one derivative. Aim of this reaction is an improved volatility, better thermal stability or a lower limit of detection due to improved peak symmetry.

The halogen atoms introduced by derivatisation (e. g. trifluoroacetates) allow specific detection (ECD) with the advantage of high sensitivity. Elution orders and fragmentation patterns in mass spectroscopy can be influenced by a specific derivatisation. The derivatisation examples in the table are meant as a first orientation and have to be adjusted or optimized for special problems.

Selection guide for derivatisation of important functional groups in GC

Function	method	derivative	recommended reagents
Alcohols, Phenols	silylation	R'O – TMS	BSA, MSTFA, MSHFBA, TSIM, SILYL-2110, SILYL-21, SILYL-1139
R'OH	acylation	R'O – CO – R	TFAA, HFBA, MBTFA, MBHFBA
	alkylation	R'O – R	TMSH
ster. hindered	silylation	R'O – TMS	TSIM, BSTFA, SILYL-991
Amines	silylation	R' – NR'' – TMS	BSA, MSTFA, MSHFBA, SILYL-991
prim., sec.	acylation	R' – NR'' – CO – R	TFAA, HFBA, MBTFA, MBHFBA
hydrochlorides	silylation	R' – NR'' – TMS	MSTFA
Amides	silylation	not stable	
	acylation	R' – CO – NH – CO – R	TFAA, MBTFA, HFBA, MBHFBA
Amino acids	silylation	CO–O–TMS R'–CH NH–TMS	BSA, BSTFA, MSTFA, MSHFBA
	alkyl. (a) + acyl. (b)	CO–O–R R'–CH NH–CO–R	a) MeOH/TMCS, TMSH b) TFAA, HFBA, MBTFA, MBHFBA
Carboxylic acids	silylation	R' – CO – O – TMS susceptible to hydrolysis	BSA, MSTFA, MSHFBA, TMCS, TSIM, SILYL-2110, SILYL-21, Silyl-1139
(fatty acids)	alkylation	R' – CO – O – R	DMF-DMA, MeOH/TMCS (1 M), TMSH
salts	silylation	R' – CO – O – TMS susceptible to hydrolysis	TMCS
Carbohydrates	silylation acylation		MSTFA, TSIM, HMDS, SILYL-1139 TFAA, MBTFA
Steroids	silylation acylation		BSA, TSIM TFAA, MBTFA, HFBA, MBHFBA

Do's and don'ts in GC

Water on GC columns

Water causes trouble right from the beginning because of its high expansion volume. This overload effect of the injector is called "backflash" and leads to poor separations and bad peak shapes. Reproducibility is not guaranteed for repeated injections.

The table shows the different gas volumes of common GC solvents. Here you find the reason, why nonpolar solvents are always preferred in GC. Even very polar analytes should be injected in nonprotic solvents (if possible).

Volume expansion of solvents

Solvent	Gas volume [μl]
n-Hexane	140
Ethyl acetate	185
Acetone	245
Dichloromethane	285
Acetonitrile	350
Methanol	450
Water	1010

Injection 1 μl, injector temperature 250 °C, pressure 20 psi

Attention: a water sample can contain a (maybe unknown) concentration of salts. This salt load can damage each column immediately.

If water cannot be avoided, some points have to be considered:

- In order to prevent condensation on the column, the start temperature in the oven should be at least 100 °C or higher for a better peak shape.
- Water can extinguish the FID flame or decrease the sensitivity of an ECD.
- Because nonpolar GC phases cannot be wetted well by water, a compound with good solubility in water can show poor peak shapes or double peaks.

GC phases which can be used with water samples – without risk of a direct damage – are phases without oxidizable groups, e. g. OPTIMA® 1, 5, 35, 17, Wax, FFAP types and OPTIMA® δ-3 and δ-6.

More critical are 1301, 1701, 225 and 240 types, because the cyano groups can be oxidised or destroyed catalytically (by acids, bases or metals). The phase has still its correct film thickness, but it is chromatographically "dead"!

All Cyclodextrin columns are directly destroyed by water, so the samples must be dried before injection. We recommend the use of drying cartridges like CHROMAFIX® Dry (REF 731852).

Rule: the higher film thickness is, the more stable the column is towards water.

Water itself is not so critical, but the (possible) ingredients can be (salts, catalysts, acids, bases). When columns have been run with aqueous samples, they should be heated at least at 150 °C in order to remove the water film completely from the column. Lower temperatures have no effect resulting in poor reproducibility.

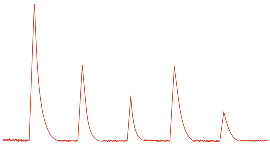
Do's and don'ts in GC

Observation / Possible causes	Suggested remedy

No peaks, no gas flow

detector has no power	check detector power supply and cables
no FID flame	check FID; reignite it
syringe defective / clogged	use a different syringe or clean it
temperature too low for the analytes	check temperature programme, oven temperature (external thermometer)
detector / software / computer hardware failure	check integrator, cables; restart computer
no gas flow	check gas tubes, valves, seals; test gas flow; shorten front of GC column, change injection septum
column connection leaks	use new ferrules
broken GC column	if breakage is at the beginning or at the end, remove the short piece; breakage in the middle can be mended with a glass connector; for multiple break-ages replace column

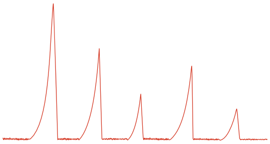
Tailing



sample vaporises too slowly, not evenly or condenses	increase injector temperature (consider max. tem-perature limits of the column)
high-boiling analytes	derivatise polar, basic or high boiling compounds
system leaks	check column installation; search for leaks; replace ferrules
analytes coelute	change temperature programme or use column with different selectivity
sample decomposes	check temperature programme, oven temperature (external thermometer); if analytes are not temper-ature-stable, reduce injector temperature; replace liner by a deactivated one
column absorbs or decomposes analytes	check capillary ends; check intact deactivation using the test mixture; for poor results shorten both column ends by about 10 cm; or replace column; if column test does not show any defects: a) use a column with thicker film b) use phase with better deactivation c) use column with special selectivity
split rate too low	increase split rate
analytes always tending to tail	no chance for symmetric peaks

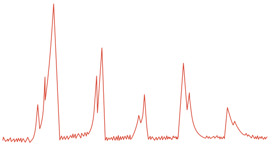
Observation / Possible causes	Suggested remedy

Fronting



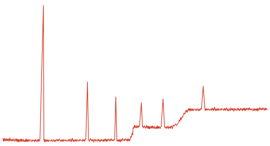
column overload	decrease injection volume; dilute sample
sample vaporises too slowly, not evenly or condenses	increase injector temperature (consider max. temperature limits of the column)
analytes coelute	change temperature programme or use column with different selectivity
sample decomposes	check temperature programme, oven temperature (external thermometer); if analytes are not temperature-stable, reduce injector temperature; replace liner
column absorbs or decomposes analytes	check capillary ends; check intact deactivation using the test mixture; for poor results shorten both column ends by about 10 cm; or replace column; if column test does not show any defects: a) use a column with thicker film b) use phase with better deactivation c) use column with special selectivity

Small peaks on fronting or tailing of bigger peaks



column not properly installed	check capillary ends; check tight and correct fit in injector and detector
temperature of injection too low	check injector temperature; if analytes are stable, increase temperature
solvent not compatible with GC phase	change solvent
splitter defect	measure flow and adjust splitter
poorly deactivated column, film thickness too low	check capillary ends; check intact deactivation using the test mixture; for poor results shorten both column ends by about 10 cm; or replace column

Plateaus at certain temperatures

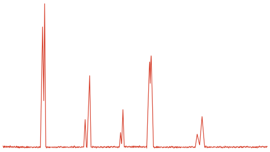


steps in temperature programme too drastic	avoid very short and strong heating periods

Do's and don'ts in GC

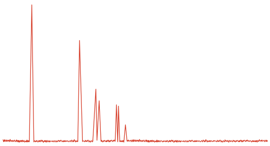
Observation / Possible causes | Suggested remedy

Double peaks, doubled peak tops



Observation / Possible causes	Suggested remedy
solvent and column not compatible	change solvent or use guard column
solvent mixtures with large differences in boiling point and polarity	use just one solvent
sample decomposes	check temperature programme, oven temperature (external thermometer); if analytes are not temperature-stable, reduce injector temperature; replace liner by a deactivated one
analytes coelute	modify temperature programme or use longer column; possibly change column polarity
detector overload	inject less; control make-up flow

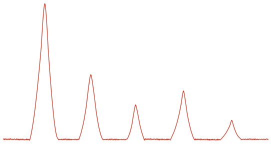
Missing or overlapping peaks, poor separation efficiency



Observation / Possible causes	Suggested remedy
syringe defective / clogged	use a different syringe or clean it
sample too diluted	increase injection volume; concentrate sample
sample concentration too high	decrease injection volume; dilute sample
column connection leaks, column not properly installed	check column installation; search for leaks; replace ferrules
perforated injection septum	replace septum
injector temperature too low	check temperature programme; increase injector temperature
sample decomposes in the injector	check temperature programme; reduce injector temperature; replace liner; check capillary ends
column oven too hot	check temperature programme, oven temperature (external thermometer); decrease temperature
wrong flow rate	measure flow and correct it if necessary
column absorbs or decomposes analytes	check capillary ends; check intact deactivation using the test mixture; for poor results shorten both column ends by about 10 cm; or replace column; if column test does not show any defects: a) use a column with thicker film b) use phase with better deactivation c) use column with special selectivity

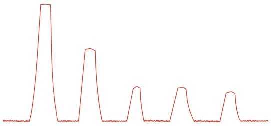
Observation / Possible causes	Suggested remedy

Broad peaks



poor focussing	decrease start temperature of the programme
flow too high or too low	measure flow, control and adjust it if necessary
split rate too low	increase split rate
column overloaded	decrease injection volume, dilute sample or increase split flow
no solvent focussing effect	decrease oven temperature or use solvent with higher boiling point

Cut tops of peaks, broad peaks



detector overload	decrease injection volume; dilute sample; increase the split flow
column overload	decrease injection volume; increase split flow
zero point is outside the display	change scale

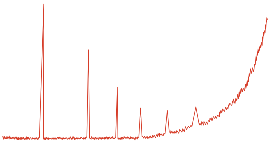
Strong noise, waves

leak at column entrance or injection septum	check column installation; search for leaks; replace ferrules
bleeding of septum / injector contaminated	make a run with lower injector temperature; if the baseline improves, replace liner, use low bleed or high temperature septa
septum particles in column entrance	cut 1 turn from column entrance; replace injection septum
column contaminated	cut two turns from column entrance; rinse column with solvent (only chemically bonded phases); otherwise replace column or use guard column
column not properly conditioned	condition column according to manufacturers' instructions (while column is not connected to the detector)
hardware defect	check temperature programme, oven temperature (external thermometer); contact your GC manufacturer
detector contaminated	clean detector
increase of temperature too fast	decrease temperature gradient and end temperature
poor gas quality	use gas grades recommended for GC; for longer supply lines from gas source to GC use gas purification cartridges directly connected to the GC

Do's and don'ts in GC

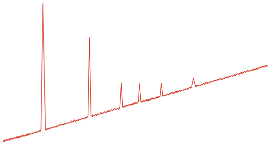
Observation / Possible causes | Suggested remedy

Increasing baseline, at high temperature bleeding or noise



Observation / Possible causes	Suggested remedy
septum particles in column entrance	cut one turn from column entrance; replace injection septum
column contaminated	cut two turns from column entrance; rinse column with solvent (only chemically bonded phases); otherwise replace column or use guard column
increase of temperature too fast / end temperature too high	decrease temperature gradient and end temperature
column not properly conditioned	condition column according to manufacturers' instructions (while column is not connected to the detector)
detector contaminated	clean detector
poor gas quality	use gas grades recommended for GC; for longer supply lines from gas source to GC use gas purification cartridges directly connected to the GC
film thickness in column too high	use column with thinner film
column stability not sufficient for detector sensitivity	use special low bleed column types

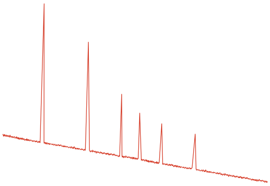
Constantly rising baseline



Observation / Possible causes	Suggested remedy
leak at column entrance or injection septum	check column installation; search for leaks; replace ferrules
bleeding of septum / injector contaminated	make a run at lower injector temperature; if the baseline improves, replace liner, use low bleed or high temperature septa
septum particles in column entrance	cut one turn from column entrance; replace injection septum
column contaminated	cut two turns from column entrance; rinse column with solvent (only chemically bonded phases); otherwise replace column or use guard column
detector contaminated	clean detector
increase of temperature too fast	decrease temperature gradient and end temperature
poor gas quality	use gas grades recommended for GC; for longer supply lines from gas source to GC use gas purification cartridges directly connected to the GC

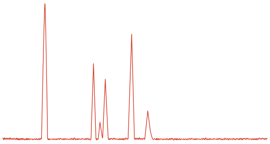
Observation / Possible causes	Suggested remedy

Constantly declining baseline



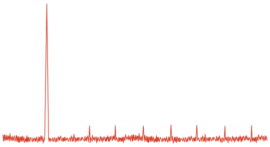
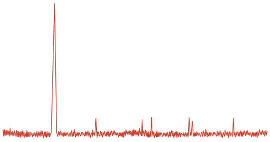
gas flow changes with temperature gradient	check gas content in gas cylinder; pressure must be a few bar above the required pressure at max. temperature; otherwise exchange gas cylinder

Short lifetime, poor resolution, lack of separation efficiency



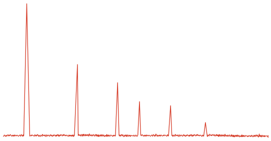
impurities on the column	cut two turns from column entrance; rinse column with solvent (only chemically bonded phases); otherwise replace column or use guard column
contamination from vials / septa or sample preparation	check SPE and / or autosampler vials; use low bleed or high temperature septa
polymerisation on the column	use guard column (at least 10 m)
separation efficiency decreases for repeated injections, improves after reconditioning	use guard column; reduce injection volume; modify temperature programme; for repeated injections increase end temperature (if possible) and use longer temperature programme
temperature too high / temperature increase too fast	decrease oven temperature and / or temperature gradient (should not be higher than 25 °C/min)
cooling too fast	do not open oven door at high temperatures
temperature too low / condensation	increase injector temperature and/or start temperature
poor deactivation	check capillary ends; check intact deactivation using the test mixture; for poor results shorten both column ends by about 10 cm; or replace column; if column test does not show any defects: a) use a column with thicker film b) use phase with better deactivation c) use column with special selectivity
air in the system	use oxygen absorber or gas grade with less oxygen
water content too high	reduce water content
head-space analysis: permanent air injections	displace oxygen from vials with an inert gas

Do's and don'ts in GC

Observation / Possible causes	Suggested remedy
Regular interfering peaks	
bleeding of silicon septa	replace injection septum, use low bleed or high temperature septa
poor gas quality	use gas grades recommended for GC; for longer supply lines from gas source to GC use gas purification cartridges directly connected to the GC
FID: dust or contaminants in the detector	clean detector; if particles are visible in the column or column ends are not cut precisely (frayed edges), cut two turns from the column entrance
electronic defect, damaged cable or detector	replace cable, contact your GC manufacturer
Irregular interfering peaks, spikes, ghost peaks	
contamination from vials / septa or sample preparation	control SPE and / or autosampler vials; use low bleed or high temperature septa
derivatisation not quantitative	check derivatisation protocol; use more reactive derivatisation reagents
dirty syringe	use a different syringe or clean it
sample decomposes	check temperature programme, oven temperature (external thermometer); if analytes are not temperature-stable, reduce injector temperature; replace liner
column absorbs or decomposes analytes	check capillary ends; check intact deactivation using the test mixture; for poor results shorten both column ends by about 10 cm; or replace column; if column test does not show any defects: a) use a column with thicker film b) use phase with better deactivation c) use column with special selectivity
sample volume too high, double injection	reduce sample volume or add a blank run after a high volume injection
poor gas quality	use gas grades recommended for GC; for longer supply lines from gas source to GC use gas purification cartridges directly connected to the GC

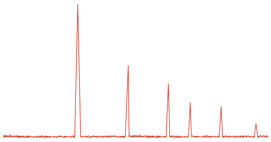
Observation / Possible causes — Suggested remedy

Decreased or differing retention times



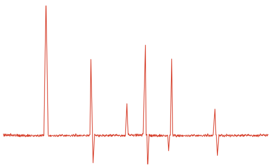
speed of gas too high	compare flow at column entrance and outlet with preset flow; check and / or clean gas tubes; in case of pressure build-up cut and remove one turn (20 cm) from the column or replace column
oven temperature too high	check temperature programme, oven temperature (external thermometer); decrease temperature

Increased or differing retention times / low gas flow



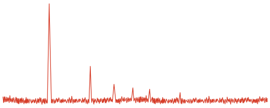
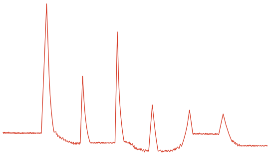
speed of gas too low	increase flow
column connection leaks, column not properly installed	check column installation; search for leaks; replace ferrules.
oven temperature too low	check temperature programme, oven temperature (external thermometer); if the analytes are stable, increase temperature
strong decrease of gas pressure	replace septum; for an instrument with pressure / temperature control, flow must be higher than 15 psi above the demand at max. temperature of the programme
tubes / capillaries / column constricted or blocked	compare flow at column entrance and outlet with preset flow; check and / or clean gas tubes; in case of pressure build-up cut and remove one turn (20 cm) from the column or replace column

Negative peaks, negative signals



polarity of integrator is inverted	invert polarity at the instrument
sample injected into wrong column	inject sample in proper column
column overload	decrease injection volume; dilute sample
pressure fluctuations	check gas tubes, valves, seals; test gas flow; change injection septum; contact hardware manufacturer
detector contaminated	clean detector

Do's and don'ts in GC

Observation / Possible causes	Suggested remedy
Peaks too small, poor quantification, concentrations not reproducible	
dirty syringe	use a different syringe or clean it
concentration of sample too low	increase injection volume; concentrate sample
split too high	reduce split
sensitivity of detector too low	inject standard in order to test detector sensitivity
column connection leaks, column not properly installed	check column installation; search for leaks; replace ferrules
injector temperature too low	check temperature programme, increase injector temperature
dirty ECD	clean ECD
FID, TCD gas flow too low	correct flow according to manufacturers' instructions
sample decomposes	check capillary ends; check intact deactivation using the test mixture; for poor results shorten both column ends by about 10 cm; or replace column; if column test does not show any defects: a) use a column with thicker film b) use phase with better deactivation c) use column with special selectivity
Baseline increases or decreases before or after a peak	
injection volume too high	decrease injection volume; dilute sample; clean injection system
column bleeding due to poor conditioning	condition column according to manufacturers' instructions (while column is not connected to the detector)
pressure fluctuations	check gas tubes, valves, seals; test gas flow; change injection septum; contact hardware manufacturer
baseline not properly adjusted	readjust baseline; calibrate integrator
injector temperature too low	check injector temperature; if the analytes are stable, increase temperature
injection septum perforated	replace septum
wrong TCD gas flow	adjust flow according to manufacturers' instructions

Environmental Pollutants

hydrocarbons · PAH

PCB · phenols

pesticides

Environmental pollutants

Separation of PAH, PCB, pesticides and phthalates (EPA 525)

MN Appl. No. 212810

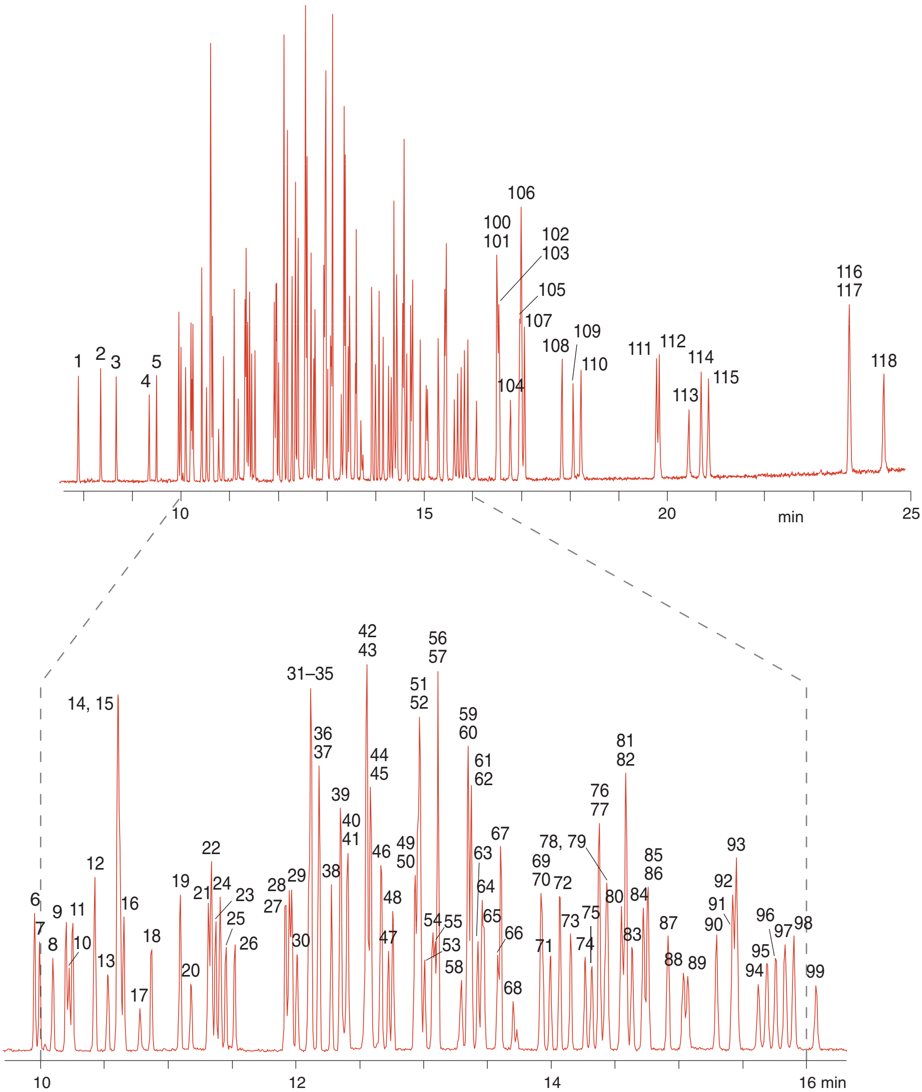
Column: OPTIMA® XLB, 30 m x 0.25 mm ID, 0.25 μm film, REF 725850.30, max. temperature 340/360 °C
Sample: standard according to EPA method 525, 5 ng per component
Injection: 1 μl, 300 °C, pressure pulsed (0.4 min 30 psi), splitless for 0.4 min
Carrier: 1.0 ml/min He
Temperature: 35 °C (2 min) $\xrightarrow{20\ °C/min}$ 260 °C $\xrightarrow{6\ °C/min}$ 330 °C (5 min)
Detector: MSD, 280 °C, scan range 45 – 550 amu

Peaks:

1. Isophorone
2. 2-Nitro-m-xylene
3. Dichlorvos
4. Hexachlorocyclopentadiene
5. EPTC = S-ethyl N,N-dipropyl-thiocarbamate
6. Butylate
7. Mevinphos
8. Vernolate
9. Pebulate
10. Etridiazole (terrazole)
11. Dimethyl phthalate
12. Acenaphthene
13. 2,6-Dinitrotoluene
14. Acenaphthene-d_{10}
15. PCB-1
16. Chloroneb
17. Tebuthiuron
18. Molinate
19. Diethyl phthalate
20. 2,4-Dinitrotoluene
21. Propachlor
22. Fluorene
23. Ethoprop
24. Cycloate
25. Trifluralin
26. Chlorpropham
27. PCB-5
28. Atraton
29. Prometon
30. α-BHC
31. Hexachlorobenzene
32. Propazine
33. Simazin
34. Atrazine
35. Metribuzin
36. Diazinon
37. Terbufos
38. Pronamide (propyzamide)
39. Pentachlorophenol
40. β-BHC
41. Disulfoton
42. Terbacil
43. Phenanthrene-d_{10}
44. Parathion-methyl
45. Phenanthrene
46. Anthracene
47. γ-BHC (lindane)
48. PCB-29
49. Alachlor
50. Prometryn
51. Ametryn
52. Simetryn
53. δ-BHC
54. Heptachlor
55. Chlorothalonil
56. Di-*n*-butyl phthalate
57. Terbutryn
58. Bromacil
59. Chlorpyrifos
60. Metolachlor
61. Chlorthal-methyl
62. PCB-47
63. Aldrin
64. Triadimefon
65. Cyanazine (Bladex)
66. MGK-264 (N-octyl bicyclo-heptene dicarboximide)
67. Diphenamid
68. Merphos
69. PCB-98
70. Heptachlor epoxide B
71. Heptachlor epoxide A
72. Butachlor
73. Stirofos (tetrachlorvinphos)
74. Fenamiphos
75. α-Chlordane
76. Napropamide
77. γ-Chlordane
78. Endosulfan I
79. *trans*-Nonachlor
80. Pyrene-d_{10}
81. Pyrene
82. 4,4'-DDE
83. PCB-154
84. *p*-Terphenyl-d_{14}
85. Dieldrin
86. Carboxin
87. Chlorobenzilate
88. Tricyclazole
89. Endrin
90. 4,4'-DDD
91. Bis(2-ethylhexyl) adipate
92. Butyl benzyl phthalate
93. Endosulfan II
94. Endrin aldehyde
95. Norflurazon
96. 4,4'-DDT
97. Triphenyl phosphate
98. Hexazinone
99. Endosulfan sulphate
100. Bis(2-ethylhexyl) phthalate
101. Methoxychlor
102. PCB-201
103. PCB-171
104. Endrin ketone
105. Benz[a]anthracene
106. Chrysene-d_{12}
107. Chrysene
108. Fenarimol
109. *cis*-Permethrin
110. *trans*-Permethrin
111. Benzo[b]fluoranthene
112. Benzo[k]fluoranthene
113. Fluridone (Sonar®)
114. Benzo[a]pyrene
115. Perylene-d_{12}
116. Dibenz[ah]anthracene
117. Indeno[1,2,3-cd]pyrene
118. Benzo[ghi]perylene

For formulas of selected compounds see structure index from page 291.

Complex mixture

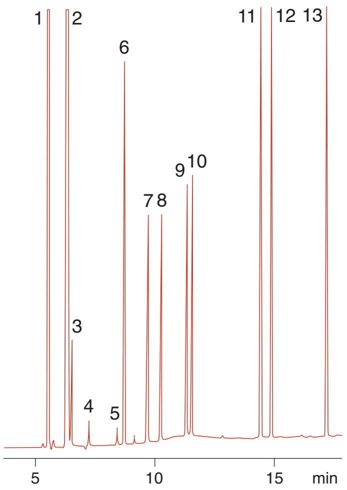


Environmental pollutants

Analysis of volatile halogenated hydrocarbons
MN Appl. No. 210560

Column: OPTIMA® 5, 60 m x 0.32 mm ID, 1.0 μm film, REF 726325.60, max. temperature 340/360 °C
Injection: 0.1 μl
Carrier gas: 56 ml/min N_2
Temperature: 50 °C (5 min) $\xrightarrow{10\ °C/min}$ 200 °C
Detector: ECD 300 °C

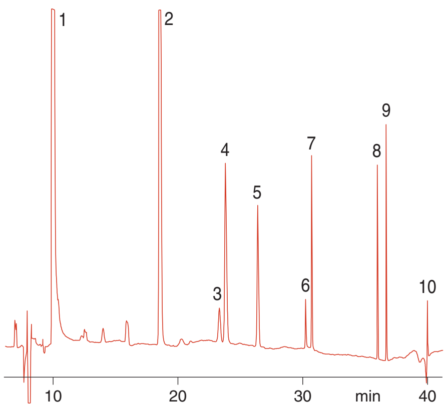
Peaks:
1. Trichlorofluoromethane (F11)
2. 1,1,2-Trichlorotrifluoroethane (F113)
3. Dichloromethane
4. *trans*-1,2-Dichloroethene
5. *cis*-1,2-Dichloroethene
6. Trichloromethane
7. 1,1,1-Trichloroethane + 1,2-dichloroethane
8. Tetrachloromethane
9. Trichloroethene
10. Bromodichloromethane
11. Dibromochloromethane
12. Tetrachloroethene
13. Tribromomethane



Analysis of a haloform test mixture
MN Appl. No. 212480

Column: PERMABOND® SE-54-HKW, 50 m x 0.32 mm ID, REF 723945.50, max. temperature 300/320 °C
Injection: 1 μl, split ~1:30
Carrier gas: 0.9 bar He
Temperature: 35 °C (25 min) $\xrightarrow{10\ °C/min}$ 160 °C (5 min)
Detector: ECD 300 °C

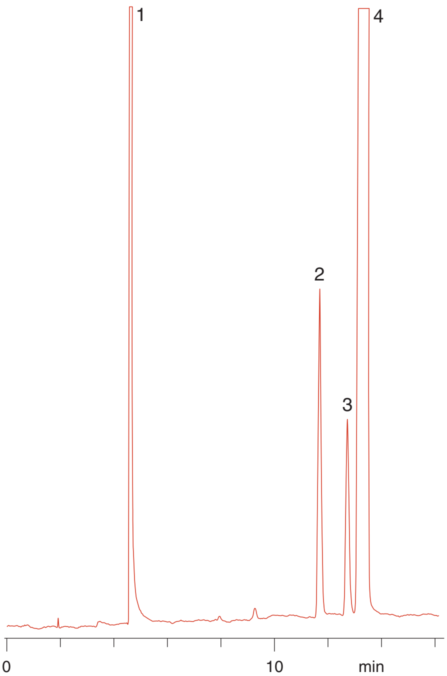
Peaks [ng/ml]**:**
1. Dichloromethane [795]
2. Trichloromethane [75]
3. 1,1,1-Trichloroethane [67]
4. 1,2-Dichloroethane [100]
5. Tetrachloromethane [15.9]
6. Trichloroethene [14.6]
7. Bromodichloromethane [20]
8. Dibromochloromethane [122]
9. Tetrachloroethene [81]
10. Tribromomethane [28.9]



Separation of *cis*-1,2-dichloroethene and bromochloromethane from excess trichloromethane (1:1:1000)
MN Appl. No. 212570

Column:	OPTIMA® 624 LB, 30 m x 0.32 mm ID, 1.8 µm film, REF 726786.30 max. temperature 280/300 °C
Injection:	1 µl, 280 °C, split 300 ml/min
Carrier gas:	55 kPa He (1.7 ml/min)
Temperature:	isothermal, 40 °C
Detector:	FID 280 °C

Peaks:
1. Ethanol (stabilizer)
2. *cis*-1,2-Dichloroethene
3. Bromochloromethane
4. Trichloromethane



Please note that for such a long isothermal separation little differences in film thickness may result in longer or shorter retention times. In this case it may be necessary to adjust pressure or flow rate.

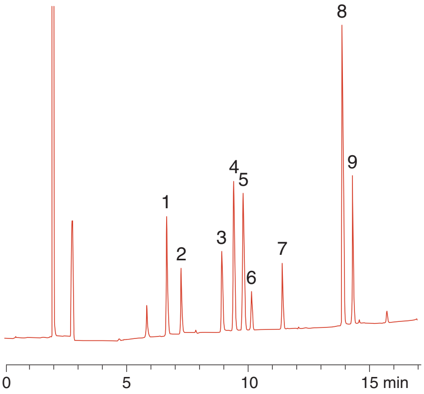
Environmental pollutants

Analysis of volatile hydrocarbons with headspace GC

MN Appl. No. 210330

Column: OPTIMA® 624, 50 m x 0.32 mm ID, 1.8 μm film, REF 726787.50, max. temperature 280/300 °C
Injection: HS Cryofocussion, splitless, 150 °C
Carrier gas: 2.11 ml/min N_2
Temperature: 36 °C (4 min) $\xrightarrow{10\ °C/min}$ 200 °C (2 min)
Detector: ECD 260 °C

Peaks:
1. Dichloromethane
2. *trans*-1,2-Dichloroethene
3. *cis*-1,2-Dichloroethene
4. Trichloromethane
5. 1,1,1-Trichloroethane
6. Tetrachloromethane
7. Trichloroethene
8. 1,1,2-Trichloroethane
9. Tetrachloroethene



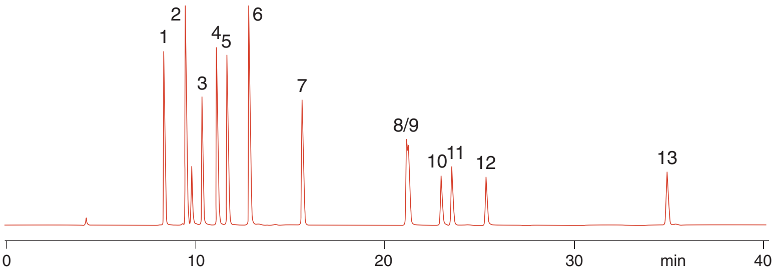
Courtesy of R. Mueller, G&P Torsten Plaar Umweltanalytik, Oldenburg, Germany

Analysis of chlorinated hydrocarbons

MN Appl. No. 210080

Column: OPTIMA® 624, 30 m x 0.25 mm ID, 1.4 μm film, REF 726785.30, max. temperature 280/300 °C
Sample: 6.25 μl/l
Temperature: 35 °C (4 min) $\xrightarrow{4\ °C/min}$ 180 °C (8 min)
Detector: FID

Peaks:
1. Isoallyl chloride
2. 1-Chloro-2-methylpropane
3. 1-Chloropropene
4. 3-Chloropropene
5. 1-Chloropropane
6. 1,5-Hexadiene
7. 2,2-Dichloropropane
8. 1,1-Dichloropropane
9. 2,3-Dichloropropene
10. (*Z*)-1,3-Dichloropropene
11. 2-Chloromethyloxirane (Epichlorohydrine)
12. (*E*)-1,3-Dichloropropene
13. 1,2,3-Trichloropropane



Courtesy of Mrs. Kehl, DOW, Stade, Germany

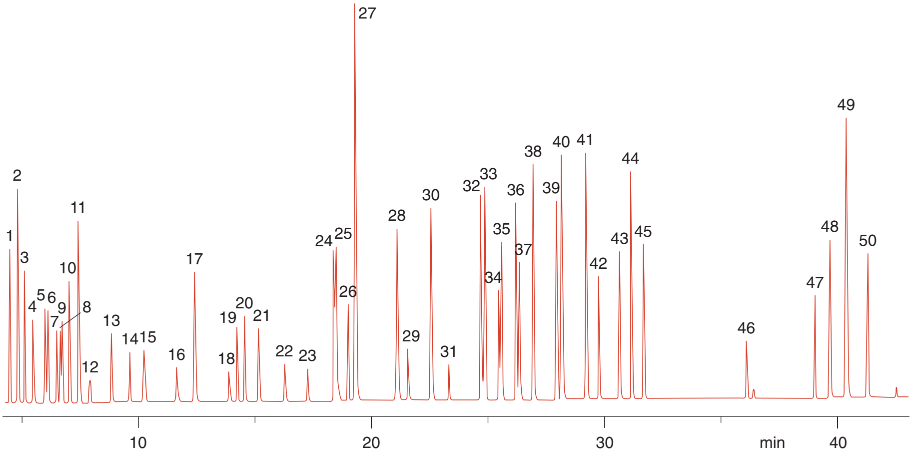
Analysis of volatile organic compounds (EPA 502/524)

MN Appl. No. 250461

Column:	OPTIMA® δ-6, 50 m x 0.20 mm ID, 0.2 µm film, REF 726465.50, max. temperature 340/360 °C
Sample:	EPA 502 Volatile Organics Calibration Mix, 20 µg/ml per component in methanol
Injection:	1 µl, split 20 ml/min
Carrier gas:	1.5 bar He
Temperature:	40 °C (5 min) $\xrightarrow{2.5\ °C/min}$ 70 °C $\xrightarrow{3\ °C/min}$ 100 °C $\xrightarrow{4\ °C/min}$ 160 °C (10 min)
Detector:	MSD

Peaks:

1. 1,1-Dichloroethene
2. Dichloromethane
3. *trans*-1,2-Dichloroethene
4. 1,1-Dichloroethane
5. 2,2-Dichloropropane
6. *cis*-1,2-Dichloroethene
7. Trichloromethane
8. Bromochloromethane
9. 1,1,1-Trichloroethane
10. 1,1-Dichloroprop-1-ene + tetrachloromethane
11. Benzene
12. 1,2-Dichloroethane
13. Trichloroethene
14. 1,2-Dichloropropane
15. Dibromomethane + bromodichloromethane
16. *cis*-1,3-Dichloropropene
17. Toluene
18. *trans*-1,3-Dichloropropene
19. 1,1,2-Trichloroethane
20. Tetrachloroethene
21. 1,3-Dichloropropane
22. Dibromochloromethane
23. 1,2-Dibromoethane
24. Chlorobenzene
25. Ethylbenzene
26. 1,1,1,2-Tetrachloroethane
27. *m*-Xylene + *p*-xylene
28. *o*-Xylene
29. Styrene
30. Isopropylbenzene
31. Tribromomethane
32. *n*-Propylbenzene
33. Bromobenzene + 1,1,2,2-tetrachloroethane
34. 1,2,3-Trichloropropane
35. 2-Chlorotoluene
36. 1,3,5-Trimethylbenzene
37. 4-Chlorotoluene
38. *t*-Butylbenzene
39. 1,2,4-Trimethylbenzene
40. *sec*-Butylbenzene
41. *p*-Isopropyltoluene
42. 1,3-Dichlorobenzene
43. 1,4-Dichlorobenzene
44. *n*-Butylbenzene
45. 1,2-Dichlorobenzene
46. 1,2-Dibromo-3-chloropropane
47. Hexachlorobutadiene
48. 1,2,4-Trichlorobenzene
49. Naphthalene
50. 1,2,3-Trichlorobenzene



Environmental pollutants

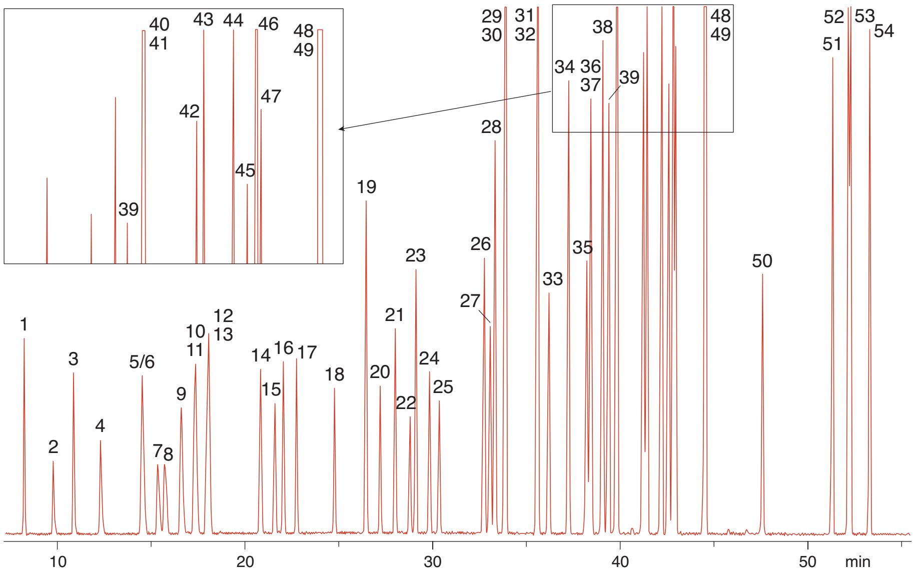
Analysis of volatile organic compounds (EPA 502/524)

MN Appl. No. 211280

Column: OPTIMA® 624, 50 m x 0.25 mm ID, 1.4 µm film, REF 726785.50, max. temperature 280/300 °C
Sample: EPA 502 Volatile Organics Calibration Mix, Supelco 502 111, 2000 µg/ml per component in methanol
Injection: 1 µl, split 1:50
Carrier gas: 1.5 bar He
Temperature: 40 °C (5 min) —2.5 °C/min→ 70 °C —3 °C/min→ 100 °C —4 °C/min→ 220 °C (5 min)
Detector: MSD

Peaks:

1. 1,1-Dichloroethene
2. Dichloromethane
3. *trans*-1,2-Dichloroethene
4. 1,1-Dichloroethane
5. 2,2-Dichloropropane
6. *cis*-1,2-Dichloroethene
7. Bromochloromethane
8. Trichloromethane
9. 1,1,1-Trichloroethane
10. 1,1-Dichloropropene
11. Tetrachloromethane
12. 1,2-Dichloroethane
13. Benzene
14. Trichloroethene
15. 1,2-Dichloropropane
16. Dibromomethane
17. Bromodichloromethane
18. *cis*-1,3-Dichloropropene
19. Toluene
20. *trans*-1,3-Dichloropropene
21. 1,1,2-Trichloroethane
22. 1,3-Dichloropropane
23. Tetrachloroethene
24. Dibromochloromethane
25. 1,2-Dibromoethane
26. Chlorobenzene
27. 1,1,1,2-Tetrachloroethane
28. Ethylbenzene
29. *m*-Xylene
30. *p*-Xylene
31. *o*-Xylene
32. Styrene
33. Tribromomethane
34. Isopropylbenzene
35. 1,1,2,2-Tetrachloroethane
36. 1,2,3-Trichloropropane
37. Bromobenzene
38. *n*-Propylbenzene
39. 2-Chlorotoluene
40. 1,3,5-Trimethylbenzene
41. 4-Chlorotoluene
42. *t*-Butylbenzene
43. 1,2,4-Trimethylbenzene
44. *sec*-Butylbenzene
45. 1,3-Dichlorobenzene
46. *p*-Isopropyltoluene
47. 1,4-Dichlorobenzene
48. *n*-Butylbenzene
49. 1,2-Dichlorobenzene
50. 1,2-Dibromo-3-chloropropane
51. 1,2,4-Trichlorobenzene
52. Hexachlorobutadiene
53. Naphthalene
54. 1,2,3-Trichlorobenzene



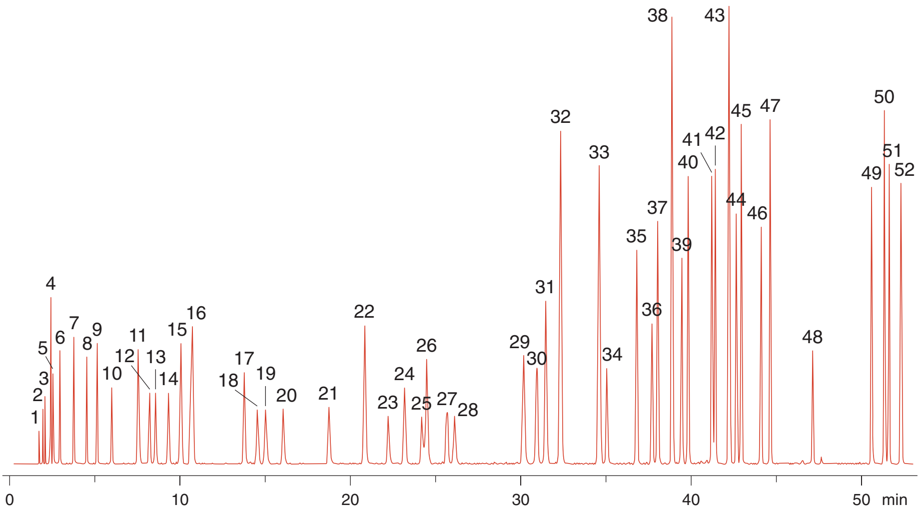
Analysis of volatile organic compounds (EPA 624)

MN Appl. No. 250200

Column:	OPTIMA® 624, 25 m x 0.20 mm ID, 1.1 μm film, REF 726784.25, max. temperature 280/300 °C
Sample:	EPA 624 Volatile Organics, 20 μg/ml per component in methanol
Injection:	1 μl, split 1:50
Carrier gas:	20 cm/s He
Temperature:	40 °C (8 min) $\xrightarrow{1.5\ °C/min}$ 70 °C $\xrightarrow{4\ °C/min}$ 180 °C
Detector:	MSD, EI

Peaks:

1. Dichlorofluoromethane
2. Chloromethane
3. Vinyl chloride
4. Bromomethane
5. Chloroethane
6. Trichlorofluoromethane
7. 1,1-Dichloroethene
8. Dichloromethane
9. *trans*-1,2-Dichloroethene
10. 1,1-Dichloroethane
11. *cis*-1,2-Dichloroethene
12. Bromochloromethane + 2,2-dichloropropane
13. Trichloromethane
14. 1,1,1-Trichloroethane
15. Tetrachloromethane + 1,1-dichloropropene
16. Benzene + 1,2-dichloroethane
17. Trichloroethene
18. 1,2-Dichloropropane
19. Dibromomethane
20. Bromodichloromethane
21. *cis*-1,3-Dichloropropene
22. Toluene
23. *trans*-1,3-Dichloropropene
24. 1,1,2-Trichloroethane
25. 2-Chloro-1-propene
26. Tetrachloroethene
27. Dibromochloromethane
28. 1,2-Dibromoethane
29. Chlorobenzene
30. 1,1,1,2-Tetrachloroethane
31. Ethylbenzene
32. *m*-Xylene + *p*-xylene
33. Styrene + *o*-xylene
34. Tribromomethane
35. Isopropylbenzene
46. Bromobenzene
37. 1,2,3-Trichloropropane + 1,1,2,2-tetrachloroethane
38. Benzyl chloride
39. 2-Chlorotoluene + 3-chlorotoluene
40. 1,3,5-Trimethylbenzene
41. *t*-Butylbenzene
42. 1,2,4-Trimethylbenzene
43. *sec*-Butylbenzene + 1,3-dichlorobenzene
44. 1,4-Dichlorobenzene
45. *o*-Isopropyltoluene
46. 1,2-Dichlorobenzene
47. *n*-Butylbenzene
48. 1,2-Dibromo-3-chloropropane
49. 1,2,4-Trichlorobenzene
50. Naphthalene
51. Hexachloro-1,3-butadiene
52. 1,2,3-Trichlorobenzene



Environmental pollutants

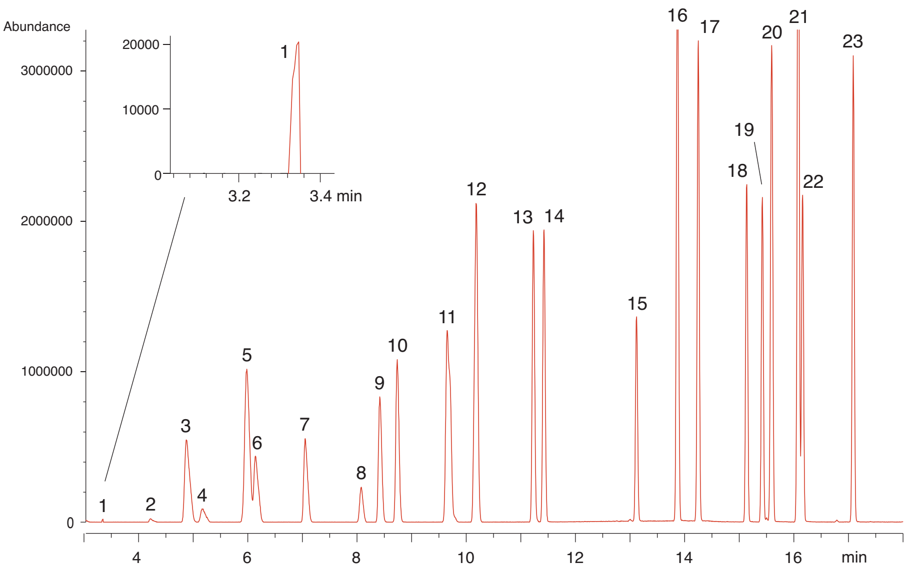
Analysis of volatile halogenated hydrocarbons and BTX

MN Appl. No. 200150

Column: PERMABOND® SE-54-HKW, 50 m x 0.32 mm ID, REF 723945.50, max. temperature 300/320 °C
Injection: 1 μl, 0.2 % in methanol, split 15 ml/min
Carrier gas: 1.5 ml/min He (constant flow)
Temperature: 40 °C (5 min) → 10 °C/min → 160 °C
Detector: MSD

Peaks:

1. Vinyl chloride
2. Ethanol
3. Trichlorofluoromethane (F 11)
4. Pentane
5. 1,1,2-Trichlorotrifluoroethane (F 113)
6. Dichloromethane
7. *trans*-1,2-Dichloroethene
8. Hexane
9. *cis*-1,2-Dichloroethene
10. Trichloromethane
11. 1,1,1-Trichloroethane + 1,2-dichloroethane
12. Tetrachloromethane + benzene
13. Trichloroethene
14. Dichlorobromomethane
15. Toluene
16. Chlorodibromomethane
17. Tetrachloroethene
18. Chlorobenzene
19. Ethylbenzene
20. *m*- + *p*-Xylene
21. Tribromomethane
22. *o*-Xylene
23. Bromobenzene



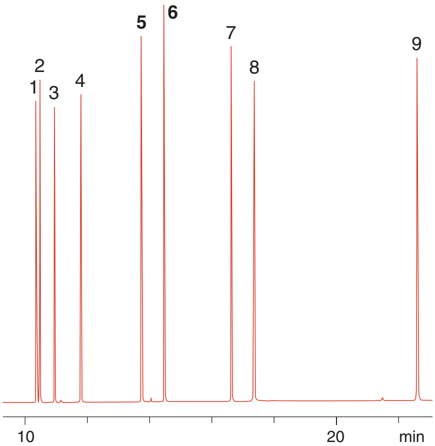
Analysis of chlorinated hydrocarbons (EPA 612)

Peaks:

1. 1,3-Dichlorobenzene
2. 1,4-Dichlorobenzene
3. 1,2-Dichlorobenzene
4. Hexachloroethane
5. 1,2,4-Trichlorobenzene
6. Hexachlorobutadiene
7. Hexachlorocyclopentadiene
8. 2-Chloronaphthalene
9. Hexachlorobenzene

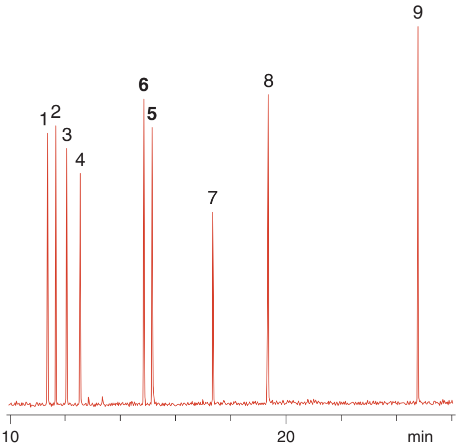
MN Appl. No. 211290

Column:	OPTIMA® 5, 50 m x 0.20 mm ID, 0.20 μm film, REF 726857.50, max. temperature 340/360 °C
Sample:	chlorinated hydrocarbon standard EPA 612, 2000 μg/ml per component in isooctane
Injection:	1 μl , split 1:20
Carrier gas:	2.5 bar He
Temperature:	50 °C $\xrightarrow{8\ °C/min}$ 260 °C (10 min)
Detector:	MSD



MN Appl. No. 250440

Column:	OPTIMA® δ-6, 50 m x 0.20 mm ID, 0.20 μm film, REF 726465.50, max. temperature 340/360 °C
Sample:	chlorinated hydrocarbon standard EPA 612, 200 μg/ml per component in isooctane
Injection:	1 μl, split 1:20
Carrier gas:	2.0 bar He
Temperature:	50 °C $\xrightarrow{8\ °C/min}$ 260 °C (10 min)
Detector:	MSD



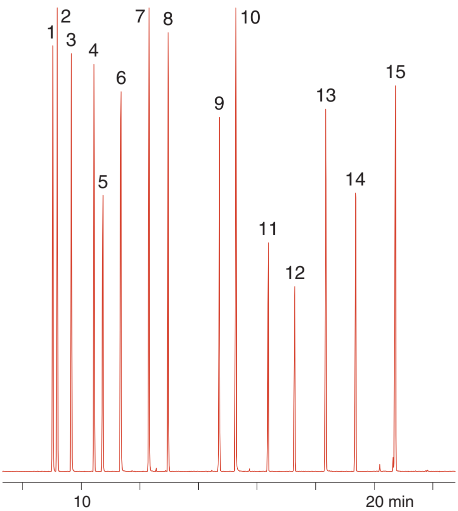
Environmental pollutants

Analysis of a mixture of neutral and basic organic compounds

MN Appl. No. 200320

Column: OPTIMA® 5, 25 m x 0.20 mm ID, 0.2 µm film, REF 726857.25, max. temperature 340/360 °C
Sample: 200 µg/ml each in 2-propanol
Injection: 1.0 µl; split 1:150
Carrier gas: 25 cm/s He
Temperature: 50 °C (5 min) $\xrightarrow{10\ °C/min}$ 220 °C $\xrightarrow{20\ °C/min}$ 330 °C
Detector: MSD

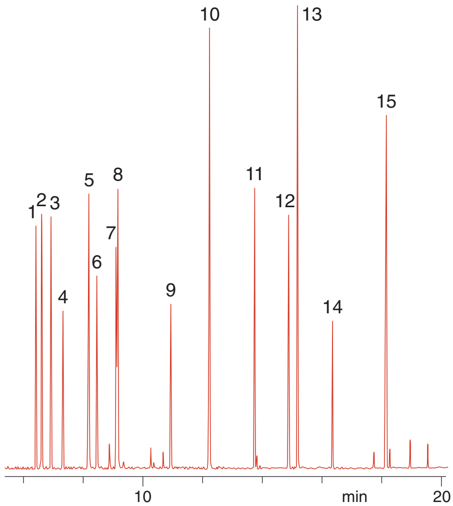
Peaks:
1. 1,3-Dichlorobenzene
2. 1,4-Dichlorobenzene
3. 1,2-Dichlorobenzene
4. Hexachloroethane
5. Nitrobenzene
6. Isophorone
7. 1,2,4-Trichlorobenzene
8. Hexachlorobutadiene
9. Hexachlorocyclopentadiene
10. 1-Chloronaphthalene
11. 2-Methyl-1,3-dinitrobenzene
12. 1-Methyl-2,4-dinitrobenzene
13. Azobenzene
14. Hexachlorobenzene
15. Carbazole



MN Appl. No. 250070

Column: OPTIMA® δ-3, 25 m x 0.20 mm ID, 0.20 µm film, REF 726400.25, max. temperature 340/360 °C
Injection: 1 µl, split 1:150
Carrier gas: 25 cm/s He
Temperature: 50 °C (5 min) $\xrightarrow{10\ °C/min}$ 220 °C $\xrightarrow{20\ °C/min}$ 330 °C
Detector: MSD

Peaks:
1. 1,4-Dichlorobenzene
2. 1,3-Dichlorobenzene
3. 1,2-Dichlorobenzene
4. Hexachloroethane
5. Nitrobenzene
6. Isophorone
8. 1,2,4-Trichlorobenzene
7. Hexachlorobutadiene
9. Hexachlorocyclopentadiene
10. 1-Chloronaphthalene
11. 2-Methyl-1,3-dinitrobenzene
12. 1-Methyl-2,4-dinitrobenzene
13. Azobenzene
14. Hexachlorobenzene
15. Carbazole



Halogenated hydrocarbons

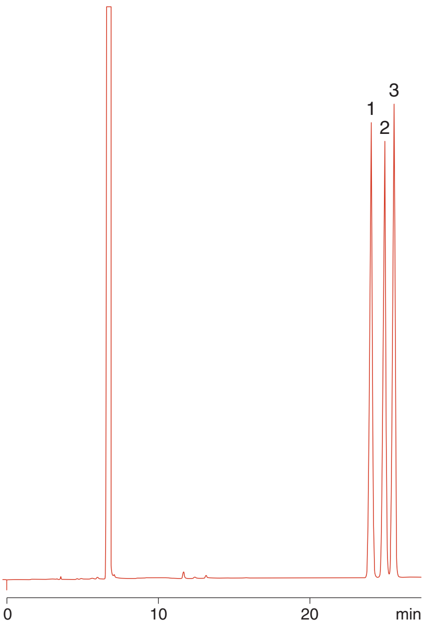
Analysis of chlorotoluene isomers

Column: OPTIMA® 624, 50 m x 0.32 mm ID, 1.8 µm film, REF 726787.50, max. temperature 280/300 °C
Carrier gas: 150 kPa H_2 (7.7 ml/min)
Temperature: 70 °C
Detector: FID 250 °C

MN Appl. No. 200340

Injection: 1 µl (1 % each in toluene) split 220 ml/min

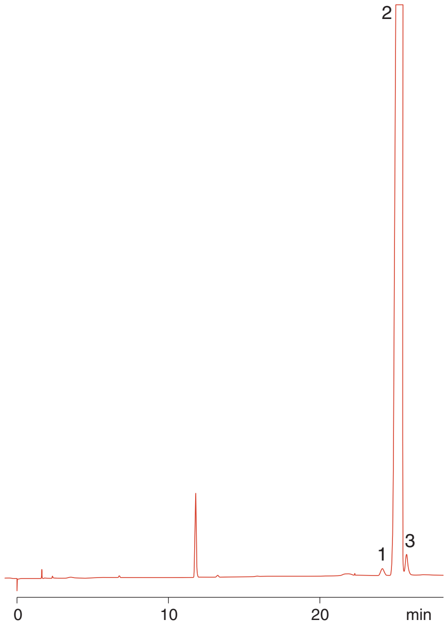
Peaks:
1. *o*-Chlorotoluene
2. *m*-Chlorotoluene
3. *p*-Chlorotoluene



MN Appl. No. 200350

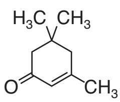
Injection: 1 µl (undiluted sample) split 220 ml/min

Peaks:
1. *o*-Chlorotoluene [0.16 %]
2. *m*-Chlorotoluene [98.31 %]
3. *p*-Chlorotoluene [0.39 %]

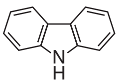


Structures of miscellaneous organics

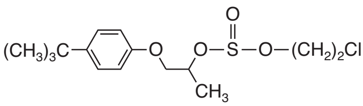
Isophorone



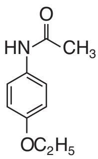
Carbazole



Aramite



Phenacetin



Environmental pollutants

Analysis of semivolatile organics (EPA 8270)

MN Appl. No. 212790

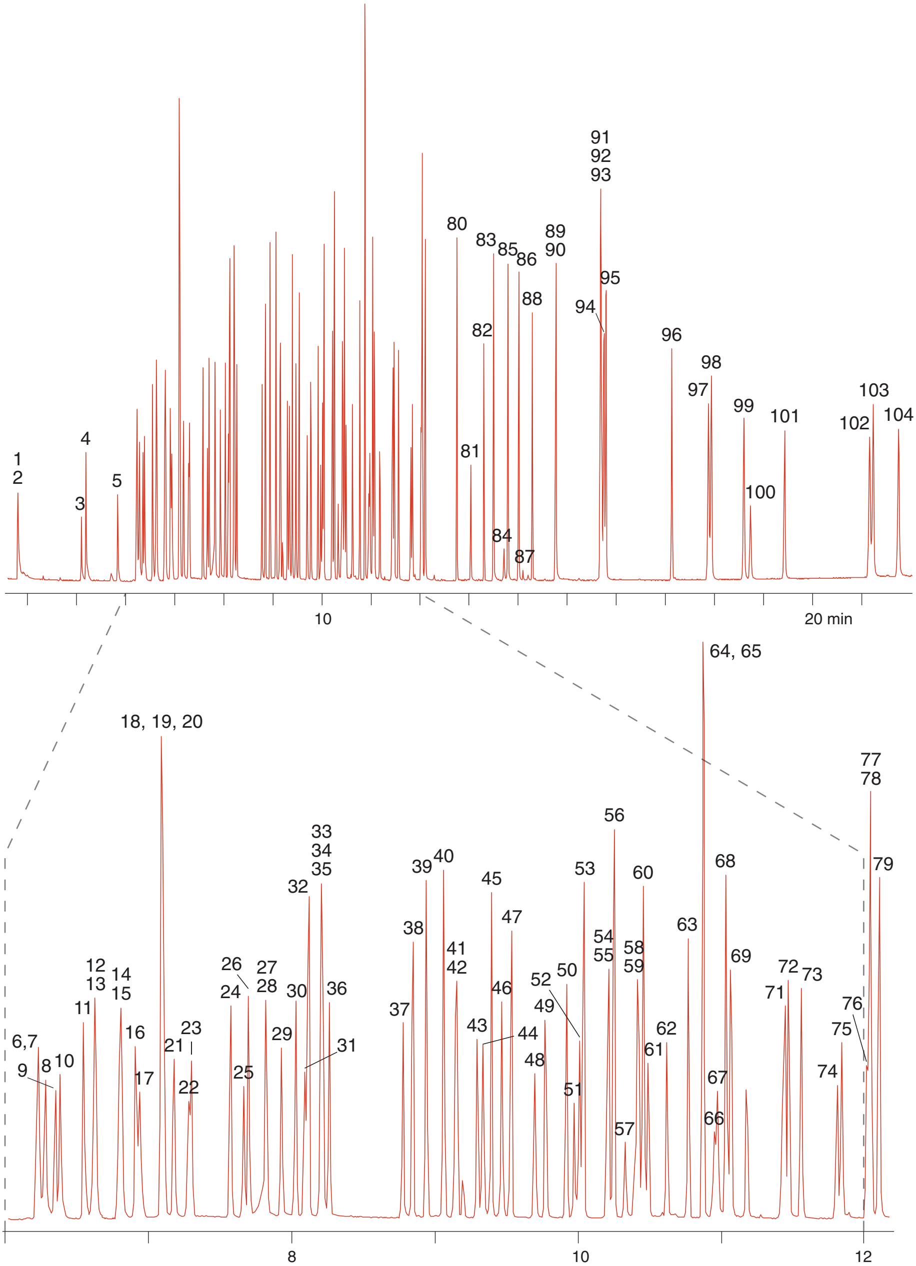
Column: OPTIMA® 5 MS Accent, 30 m x 0.25 mm ID, 0.25 µm film, REF 725820.30, max. temperature 340/360 °C
Sample: 16 µg/ml in CH_2Cl_2
Injection: 1 µl splitless (hold 0.4 min), 300 °C
Carrier gas: 1.0 ml/min He
Temperature: 35 °C (2 min) $\xrightarrow{20\ °C/min}$ 260 °C $\xrightarrow{6\ °C/min}$ 330 °C (1 min)
Detection: MSD 280 °C

Peaks:

1. *N*-Nitrosodimethylamine
2. Pyridine
3. Methyl methanesulfonate
4. 2-Fluorophenol
5. Ethyl methanesulfonate
6. Phenol-d_6
7. Phenol
8. Aniline
9. Bis(2-chloroethyl) ether
10. 2-Chlorophenol
11. 1,3-Dichlorobenzene
12. 1,4-Dichlorobenzene-d_4
13. 1,4-Dichlorobenzene
14. 1,2-Dichlorobenzene
15. Benzyl alcohol
16. 2-Methylphenol
17. Bis(2-chloroisopropyl) ether
18. Acetophenone

19a. 4-Methylphenol
19b. 3-Methylphenol

20. *N*-Nitroso-di-*n*-propylamine
21. Hexachloroethane
22. Nitrobenzene-d_5
23. Nitrobenzene
24. Isophorone
25. 2-Nitrophenol
26. 2,4-Dimethylphenol
27. Bis(2-chloroethoxy)methane
28. Benzoic acid
29. 2,4-Dichlorophenol
30. 1,2,4-Trichlorobenzene
31. Naphthalene-d_8
32. Naphthalene
33. 2,6-Dichlorophenol
34. 4-Chloroaniline
35. Hexachloropropene
36. Hexachlorobutadiene
37. 4-Chloro-3-methylphenol
38. Isosafrole
39. 2-Methylnaphthalene
40. 1-Methylnaphthalene
41. Hexachlorocyclopentadiene
42. 1,2,4,5-Tetrachlorobenzene
43. 2,4,6-Trichlorophenol
44. 2,4,5-Trichlorophenol
45. 2-Fluorobiphenyl
46. Safrole
47. 2-Chloronaphthalene
48. 2-Nitroaniline
49. 1,4-Naphthoquinone
50. Dimethyl phthalate
51. 1,3-Dinitrobenzene
52. 2,6-Dinitrotoluene
53. Acenaphthylene
54. Acenaphthene-d_{10}
55. 3-Nitroaniline
56. Acenaphthene
57. 2,4-Dinitrophenol
58. Pentachlorobenzene
59. 4-Nitrophenol
60. Dibenzofuran
61. 2,4-Dinitrotoluene
62. 2,3,4,6-Tetrachlorophenol
63. Diethyl phthalate
64. Fluorene
65. 4-Chlorophenyl phenyl ether
66. 4-Nitroaniline
67. 2-Methyl-4,6-dinitrophenol
68. Diphenylamine
69. Azobenzene
70. 2,4,6-Tribromophenol
71. Phenacetin
72. 4-Bromophenyl phenyl ether
73. Hexachlorobenzene
74. Pentachlorophenol
75. Pentachloronitrobenzene
76. Phenanthrene-d_{10}
77. Dinoseb
78. Phenanthrene
79. Anthracene
80. Di-*n*-butyl phthalate
81. 4-Nitro-quinoline 1-oxide
82. Isodrin
83. Fluoranthene
84. Benzidine
85. Pyrene
86. *p*-Terphenyl-d_{14}
87. Aramite
88. Chlorobenzilate
89. Kepone
90. Butyl benzyl phthalate
91. Benz[a]anthracene
92. 3,3'-Dichlorobenzidine
93. Chrysene-d_{12}
94. Chrysene
95. Bis(2-ethylhexyl) phthalate
96. Di-*n*-octyl phthalate
97. Benzo[b]fluoranthene
98. Benzo[k]fluoranthene
99. Benzo[a]pyrene
100. Perylene-d_{12}
101. 3-Methylcholanthrene
102. Indeno[1,2,3-cd]pyrene
103. Dibenz[ah]anthracene
104. Benzo[ghi]perylene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Environmental pollutants

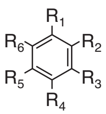
Analysis of semivolatile organics (EPA 625)

MN Appl. No. 212830

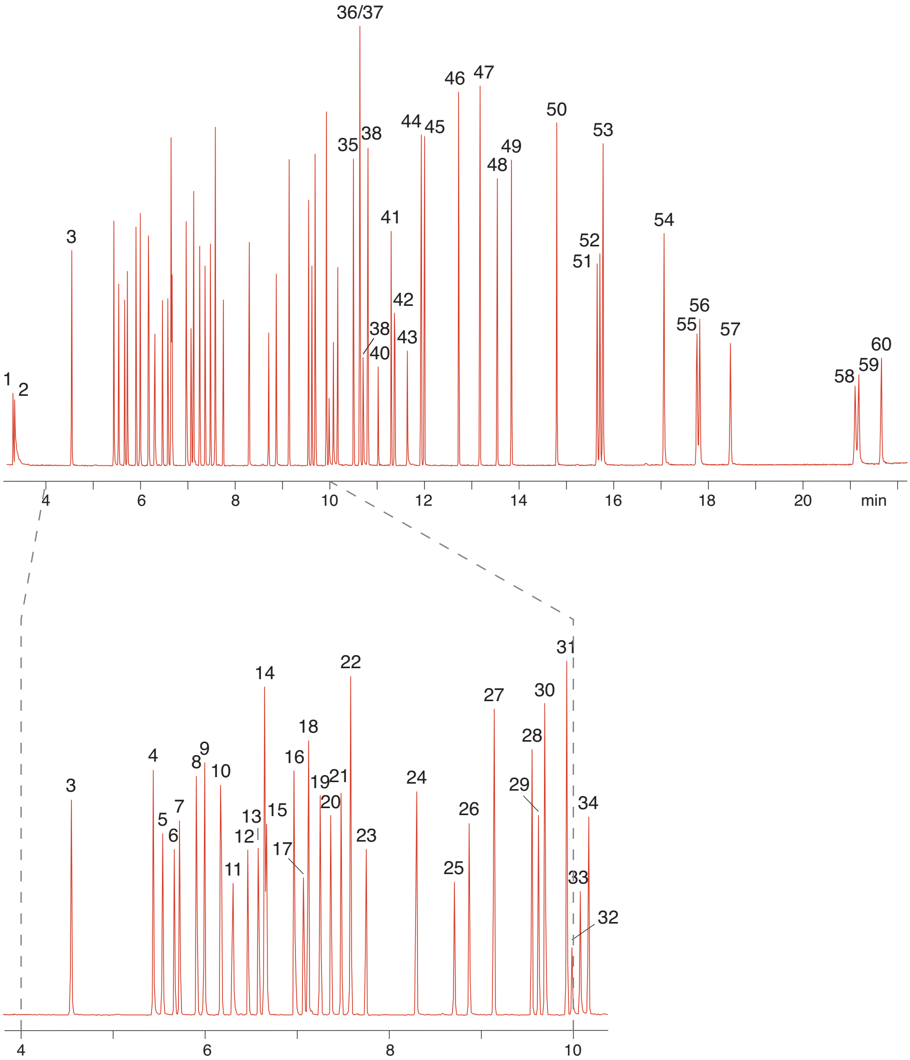
Column: OPTIMA® 5 MS Accent, 30 m x 0.25 mm ID, 0.25 µm film, REF 725820.30, max. temperature 340/360 °C
Injection: 1.0 µl, 10 ppm (20 ppm int. std.), 20 psi 0.3 min, pulsed splitless (hold 0.3 min), 300 °C
Carrier gas: 1.0 ml/min He
Temperature: 35 °C (1 min) $\xrightarrow{18\ °C/min}$ 270 °C $\xrightarrow{5\ °C/min}$ 305 °C $\xrightarrow{30\ °C/min}$ 330 °C (1 min)
Detector: MSD 280 °C

Peaks:
1. N-Nitrosodimethylamine
2. Pyridine-d_5
3. 2-Fluorophenol (surrogate std.)
4. Pentafluorophenol (int. std.)
5. Phenol
6. Bis(2-chloroethyl) ether
7. 2-Chlorophenol
8. 1,3-Dichlorobenzene
9. 1,4-Dichlorobenzene
10. 1,2-Dichlorobenzene
11. Bis(2-chloroisopropyl) ether
12. N-Nitroso-di-n-propylamine
13. Hexachloroethane
14. Nitrobenzene-d_5 (int. std.)
15. Nitrobenzene
16. Isophorone
17. 2-Nitrophenol
18. 2,4-Dimethylphenol
19. Bis(2-chloroethoxy)methane
20. 2,4-Dichlorophenol
21. 1,2,4-Trichlorobenzene
22. Naphthalene
23. Hexachlorobutadiene
24. 4-Chloro-3-methylphenol
25. Hexachlorocyclopentadiene
26. 2,4,6-Trichlorophenol
27. 2-Chloronaphthalene
28. Dimethyl phthalate
29. 2,6-Dinitrotoluene
30. Acenaphthylene
31. Acenaphthene
32. 2,4-Dinitrophenol
33. 4-Nitrophenol
34. 2,4-Dinitrotoluene
35. Diethyl phthalate
36. Fluorene
37. 4-Chlorophenyl phenyl ether
38. 4,6-Dinitro-2-methylphenol
39. Diphenylamine
40. 4,4'-Dibromooctafluoro-biphenyl
41. 4-Bromophenyl phenyl ether
42. Hexachlorobenzene
43. Pentachlorophenol
44. Phenanthrene
45. Anthracene
46. Di-n-butyl phthalate
47. 4,4'-Dibromobiphenyl (int. std.)
48. Fluoranthene
49. Pyrene
50. Butyl benzyl phthalate
51. Benz[a]anthracene
52. Chrysene
53. Bis(2-ethylhexyl) phthalate
54. Di-n-octyl phthalate
55. Benzo[b]fluoranthene
56. Benzo[k]fluoranthene
57. Benzo[a]pyrene
58. Indeno[1,2,3-cd]pyrene
59. Dibenz[ah]anthracene
60. Benzo[ghi]perylene

Substituted benzene common names



Structure	Compound	R_1	R_2	R_3	R_4	R_5	R_6
	HCB = Hexachlorobenzene	Cl	Cl	Cl	Cl	Cl	Cl
	Chloroneb	Cl	OCH_3	H	Cl	OCH_3	H
	Chlorthal	Cl	COOH	Cl	Cl	COOH	Cl
	Dichlobenil	Cl	CN	Cl	H	H	H
	Chlorothalonil	Cl	CN	Cl	CN	Cl	Cl
	Tecnazene	Cl	Cl	NO_2	Cl	Cl	H
	Quintozene	Cl	Cl	NO_2	Cl	Cl	Cl
	Dicloran	Cl	NH_2	Cl	H	NO_2	H
	Dinoseb	OH	*sec*-C_4H_9	H	NO_2	H	NO_2



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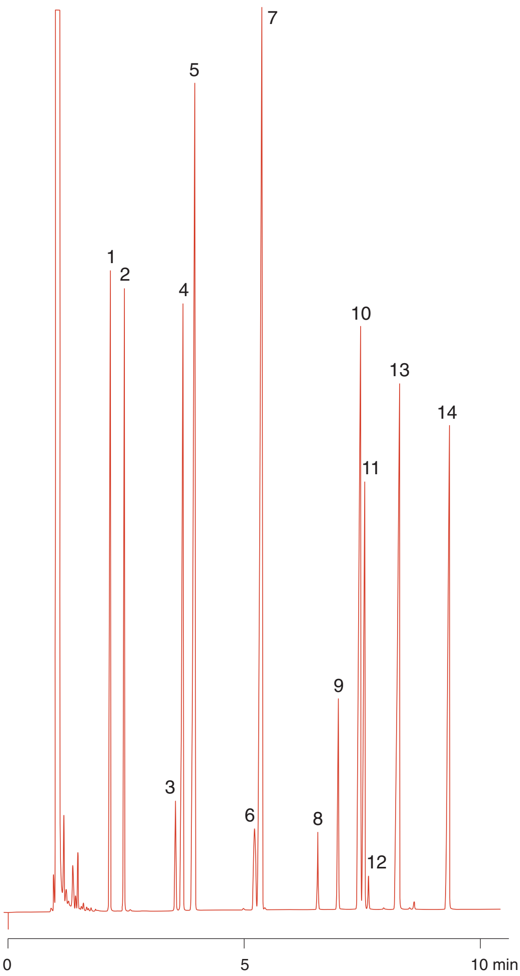
Environmental pollutants

Analysis of nitro- and chloronitroaromatics

MN Appl. No. 200300

Column: OPTIMA® 1301, 25 m x 0.32 mm ID, 0.25 μm film, REF 726777.25, max. temperature 300/320 °C
Injection: 0.5 μl, split 55 ml/min
Carrier gas: 60 kPa H_2 (3.3 ml/min)
Temperature: 120 °C (3 min) $\xrightarrow{15\ °C/min}$ 230 °C
Detector: FID 250 °C

Peaks:
1. Nitrobenzene
2. Isophorone
3. 3-Nitrochlorobenzene
4. 2-Nitrochlorobenzene
5. 4-Nitrochlorobenzene
6. 2,5- and 2,6-Dichloronitrobenzene
7. 2,4-Dichloronitrobenzene
8. 2,6-Dinitrotoluene
9. 2,5-Dinitrotoluene
10. 2,4-Dinitrotoluene
11. 2,3-Dinitrotoluene
12. 3,5-Dinitrotoluene
13. 3,4-Dinitrotoluene
14. 2,4,6-Trinitrotoluene



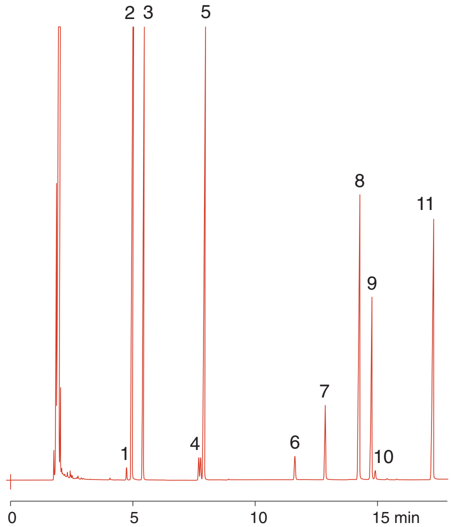
Analysis of nitro- and chloronitro-aromatics

MN Appl. No. 200290

Column:	OPTIMA® 1701, 50 m x 0.32 mm ID, 0.25 µm film, REF 726318.50, max. temperature 300/320 °C
Injection:	1 µl, split 125 ml/min
Carrier gas:	100 kPa H_2
Temperature:	140 °C (6 min) $\xrightarrow{4\ °C/min}$ 190 °C
Detector:	FID 250 °C

Peaks:

1. 3-Nitrochlorobenzene
2. 4-Nitrochlorobenzene
3. 2-Nitrochlorobenzene
4. 2,5- and 2,6-Dichloronitrobenzene
5. 2,4-Dichloronitrobenzene
6. 2,6-Dinitrotoluene
7. 2,5-Dinitrotoluene
8. 2,4-Dinitrotoluene
9. 2,3-Dinitrotoluene
10. 3,5-Dinitrotoluene
11. 3,4-Dinitrotoluene



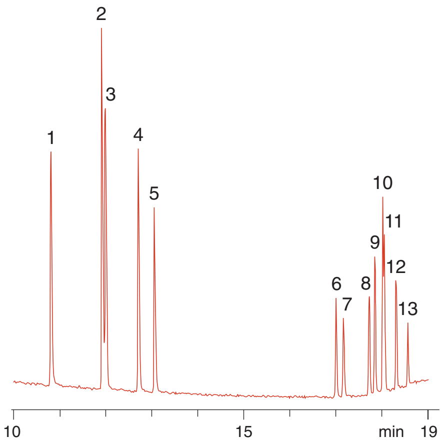
Analysis of nitroaromatic compounds (explosives)

MN Appl. No. 210350

Column:	OPTIMA® δ-3, 30 m x 0.25 mm ID, 0.25 µm film, REF 726420.30, max. temperature 340/360 °C
Injection:	1.0 µl, on column, 250 °C
Carrier gas:	15 psi He
Temperature:	40 °C (1 min) $\xrightarrow{10\ °C/min}$ 250 °C
Detector:	MSD

Peaks:

1. Nitrobenzene
2. 2-Nitrotoluene-D_7
3. 2-Nitrotoluene
4. 3-Nitrotoluene
5. 4-Nitrotoluene
6. 2,6-Dinitrotoluene
7. 1,3-Dinitrobenzene
8. 2,5-Dinitrotoluene
9. 2,3-Dinitrotoluene
10. 2,4-Dinitrotoluene-D_3
11. 2,4-Dinitrotoluene
12. 3,5-Dinitrotoluene
13. 3,4-Dinitrotoluene



Courtesy of Mr. Steinbach, Inst. of Organic Chemistry, Univ. of Marburg, Germany

Environmental pollutants

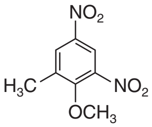
Analysis of nitromusk compounds in domestic dust

MN Appl. No. 211851

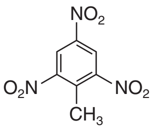
Column: OPTIMA® δ-3, 30 m x 0.25 mm ID, 0.25 μm film, REF 726420.30, max. temperature 340/360 °C
Sample: 100 μl/l standard with 2-methyl-4,6-dinitroanisole in *n*-hexane
Injection: 260 °C, split 10 ml/min
Carrier gas: H_2
Temperature: 150 °C (5 min) $\xrightarrow{7\ °C/min}$ 290 °C (5 min)
Detector: ECD 320 °C

Peaks for applications 211851 – 211853:

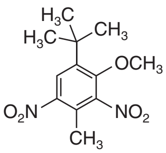
1. 2-Methyl-4,6-dinitroanisole



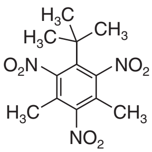
2. 2,4,6-Trinitrotoluene (TNT)



3. Musk ambrette (MA)



4. Musk xylene (MX)



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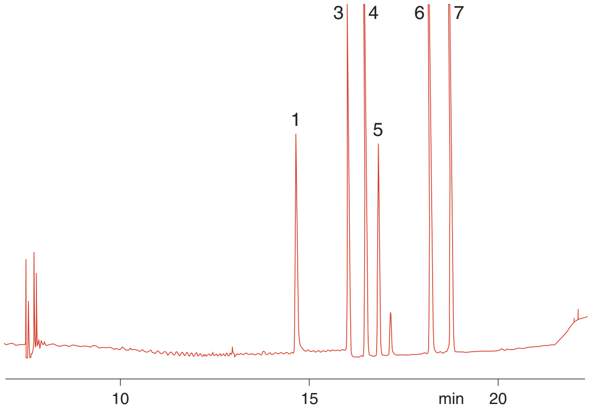
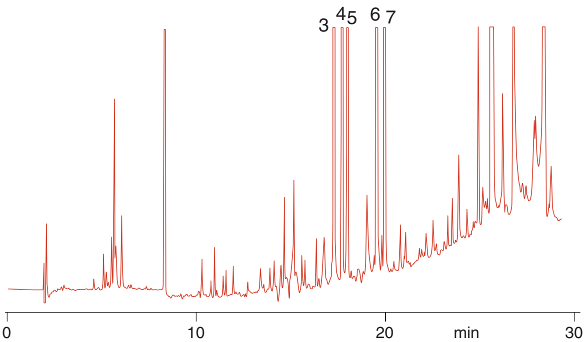


MN Appl. No. 211852

Column: OPTIMA® δ-6, 30 m x 0.25 mm ID, 0.25 μm film, REF 726470.30, max. temperature 340/360 °C
Sample: pooled dust sample extracted by steam distillation with *t*-butyl methyl ether, spiked with 50 μg/l standard and 2-methyl-4,6-dinitroanisole
Other conditions as above



Analysis of nitromusk compounds in domestic dust (cont.)

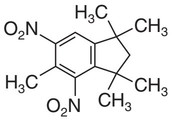
MN Appl. No. 211853

Samples: a) hexane extract of a single dust sample, spiked with 100 µg/l standard and 50 µg/l 2-methyl-4,6-dinitroanisole
b) hexane extract of a pooled dust sample, spiked with 50 µg/l standard, 2-methyl-4,6-dinitroanisole and 2,4,6-trinitrotoluene (TNT)

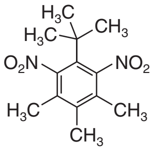
Other conditions as in application 211851

Peaks for applications 211851 – 211853 (cont.)**:**

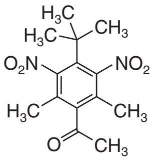
5. Musk moskene (MM)

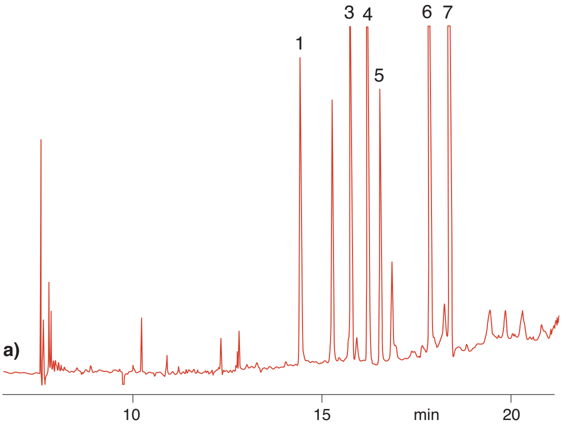


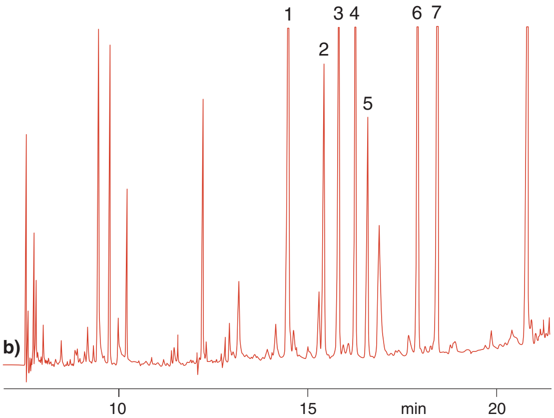
6. Musk tibetene (MT)



7. Musk ketone (MK)







Courtesy of Sven Heegmann, AK Prof. Butte, Diplomarbeit, University of Oldenburg, Germany

Environmental pollutants

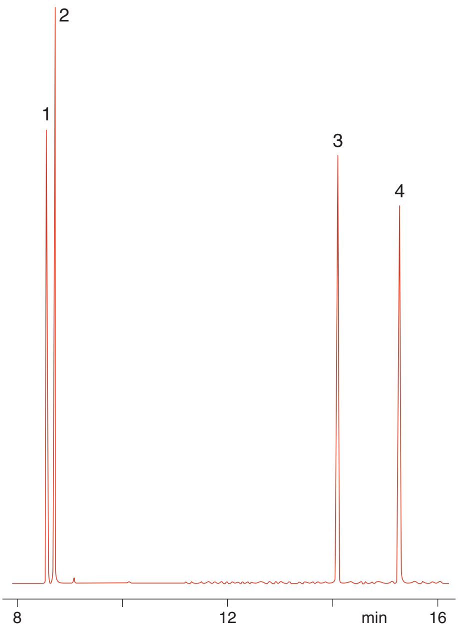
Analysis of nitroaromatics (EPA 609)

MN Appl. No. 250450

Column:	OPTIMA® δ-6, 50 m x 0.20 mm ID, 0.20 μm film, REF 726465.50, max. temperature 340/360 °C
Sample:	EPA 609 Nitroaromatics and Isophorone Mix, 2000 μg/ml per substance in hexane
Injection:	1.0 μl, split 1:50
Carrier gas:	2.0 bar He
Temperature:	100 °C (1 min) → 10 °C/min → 300 °C (5 min)
Detector:	MSD

Peaks:

1. Nitrobenzene
2. Isophorone
3. 2,6-Dinitrotoluene
4. 2,4-Dinitrotoluene



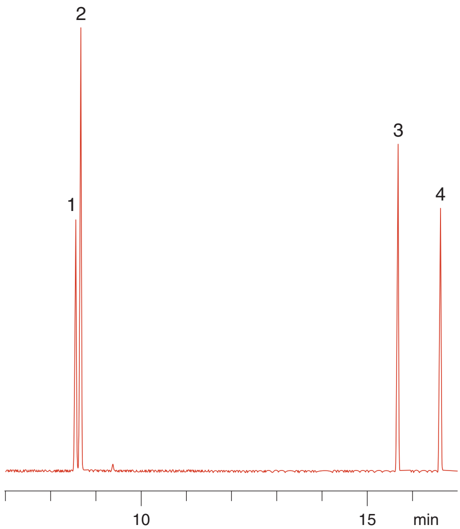
Analysis of nitroaromatics (EPA 609)

MN Appl. No. 213200

Column:	OPTIMA® 35 MS, 30 m x 0.25 mm ID, 0.25 μm film, REF 726154.30, max. temperature 360/370 °C
Injection:	1.0 μl, split 1:50
Carrier gas:	1 ml/min He
Temperature:	60 °C → 8 °C/min → 250 °C
Detector:	MSD

Peaks:

1. Nitrobenzene
2. Isophorone
3. 2,6-Dinitrotoluene
4. 2,4-Dinitrotoluene



Analysis of aromatic hydrocarbons

MN Appl. No. 200370

Column: OPTIMA® 210, 50 m x 0.25 mm ID, 0.5 μm film, REF 726874.50, max. temperature 260/280 °C

Injection: 0.5 μl, split 64 ml/min

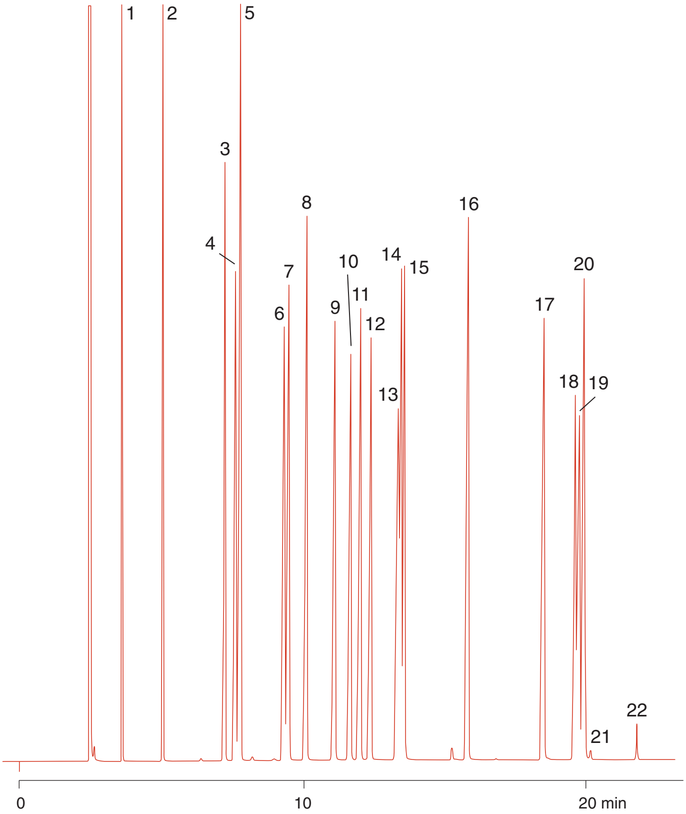
Carrier gas: 120 kPa H_2 (1.5 ml/min)

Temperature: 60 °C (10 min) $\xrightarrow{5\ °C/min}$ 120 °C

Detector: FID 250 °C

Peaks:

1. Benzene
2. Toluene
3. Ethylbenzene
4. *p*-Xylene
5. Chlorobenzene + *m*-xylene
6. *o*-Xylene
7. *i*-Propylbenzene
8. Styrene
9. *n*-Propylbenzene
10. Bromobenzene
11. 1,3,5-Trimethylbenzene
12. *o*-Chlorotoluene
13. *m*-Chlorotoluene
14. *p*-Chlorotoluene
15. *p*-Isopropyltoluene
16. *n*-Butylbenzene
17. 2-Methylphenol
18. 2,6-Dichlorotoluene
19. 3-Methylphenol
20. 2,4-Dichlorotoluene + 3-methylphenol
21. 2,5-Dichlorotoluene
22. 2,3-Dichlorotoluene



Environmental pollutants

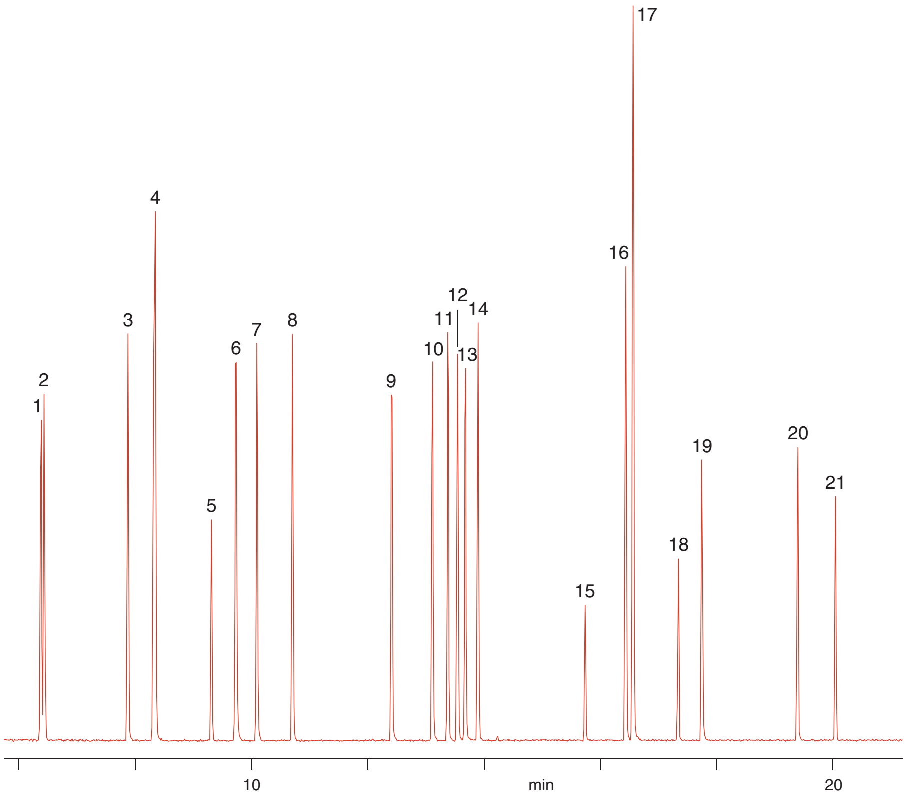
Analysis of phenols (EPA 8040 A)

MN Appl. No. 200410

Column: OPTIMA® 5, 25 m x 0.20 mm ID, 0.2 µm film, REF 726857.25, max. temperature 340/360 °C
Sample: phenols (EPA 8040 A), 50 µg/ml in 2-propanol
Injection: 1.0 µl, split 1:150
Carrier gas: 25 cm/s He
Temperature: 60 °C (3 min) $\xrightarrow{8\ °C/min}$ 330 °C
Detector: MSD

Peaks:

1. Phenol
2. 2-Chlorophenol
3. 2-Methylphenol
4. 4-Methylphenol
5. 2-Nitrophenol
6. 2,4-Dimethylphenol
7. 2,4-Dichlorophenol
8. 2,6-Dichlorophenol
9. 4-Chloro-3-methylphenol
10. 2,3,5-Trichlorophenol
11. 2,4,6-Trichlorophenol
12. 2,4,5-Trichlorophenol
13. 2,3,4-Trichlorophenol
14. 2,3,6-Trichlorophenol
15. 2,4-Dinitrophenol
16. 2,3,4,6-Tetrachlorophenol
17. 2,3,5,6-Tetrachlorophenol
18. 2-Methyl-4,6-dinitrophenol
19. 3,4,5-Trichlorophenol
20. Pentachlorophenol
21. 2-Isopropyl-4,6-dinitrophenol



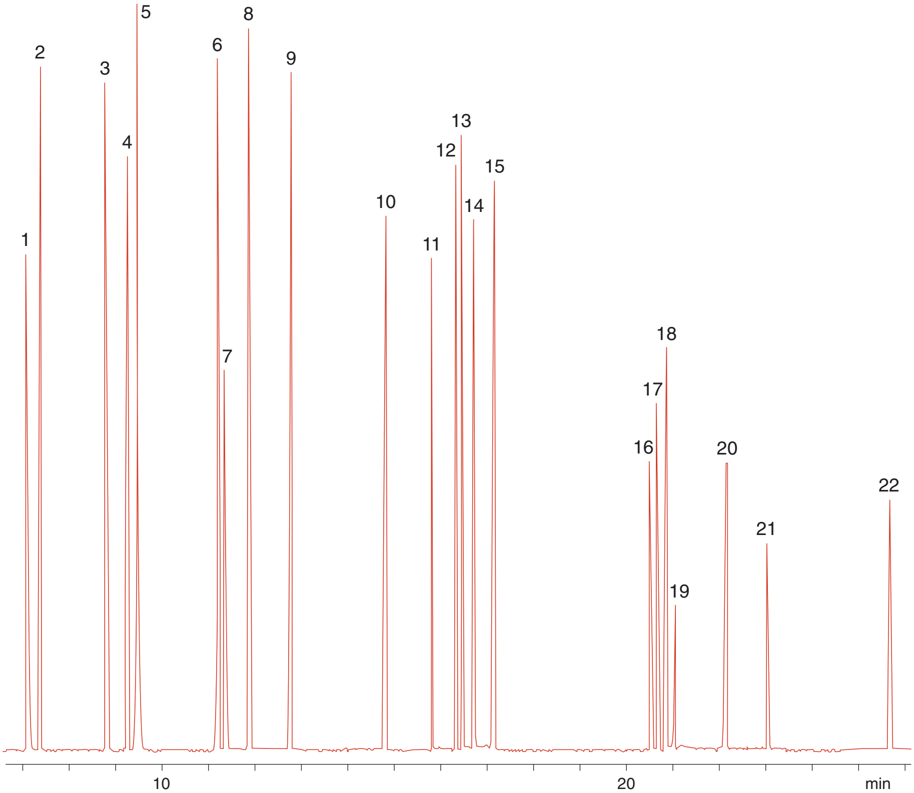
Analysis of isomeric phenols (EPA 8040 A)

MN Appl. No. 250060

Column: OPTIMA® δ-3, 60 m x 0.25 mm ID, 0.25 μm film, REF 726420.60, max. temperature 340/360 °C
Injection: 1.0 μl, split 1:80
Carrier gas: 1.3 bar He
Temperature: 60 °C (3 min) $\xrightarrow{6\ °C/min}$ 320 °C
Detector: MSD

Peaks:

1. Phenol
2. 2-Chlorophenol
3. 2-Methylphenol
4. 4-Methylphenol
5. 3-Methylphenol
6. 2,4-Dimethylphenol
7. 2-Nitrophenol
8. 2,4-Dichlorophenol
9. 2,6-Dichlorophenol
10. 4-Chloro-3-methylphenol
11. 2,3,5-Trichlorophenol
12. 2,4,6-Trichlorophenol
13. 2,4,5-Trichlorophenol
14. 2,3,4-Trichlorophenol
15. 2,3,6-Trichlorophenol
16. 2,3,5,6-Tetrachlorophenol
17. 2,3,4,5-Tetrachlorophenol
18. 2,3,4,6-Tetrachlorophenol
19. 2,4-Dinitrophenol
20. 3,4,5-Trichlorophenol
21. 2-Methyl-4,6-dinitrophenol
22. 2-Isopropyl-4,6-dinitrophenol



Environmental pollutants

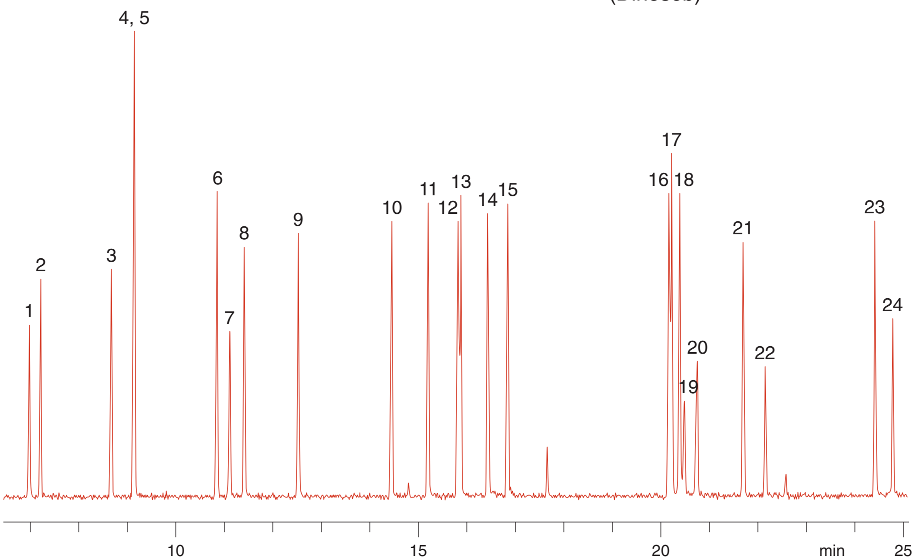
Analysis of phenols (EPA 8040)

MN Appl. No. 213240

Column: OPTIMA® 35 MS, 30 m x 0.25 mm ID, 0.25 μm film, REF 726154.30, max. temperature 360/370 °C
Sample: phenols (EPA 8040)
Injection: 1.0 μl, 280 °C, split 20 ml/min
Carrier gas: 0.8 ml/min He
Temperature: 60 °C —6 °C/min→ 280 °C
Detector: MSD

Peaks:

1. Phenol
2. 2-Chlorophenol
3. 2-Methylphenol
4. 3-Methylphenol
5. 4-Methylphenol
6. 2,4-Dimethylphenol
7. 2-Nitrophenol
8. 2,4-Dichlorophenol
9. 2,6-Dichlorophenol
10. 4-Chloro-3-methylphenol
11. 2,3,5-Trichlorophenol
12. 2,4,6-Trichlorophenol
13. 2,4,5-Trichlorophenol
14. 2,3,4-Trichlorophenol
15. 2,3,6-Trichlorophenol
16. 2,3,5,6-Tetrachlorophenol
17. 2,3,4,5-Tetrachlorophenol
18. 2,3,4,6-Tetrachlorophenol
19. 2,4-Dinitrophenol
20. 4-Nitrophenol
21. 3,4,5-Trichlorophenol
22. 2-Methyl-4,6-dinitrophenol
23. Pentachlorophenol
24. Methylpropyl-4,6-dinitrophenol (Dinoseb)



Analysis of phenols (EPA 528)

MN Appl. No. 212840

Column: OPTIMA® 5 MS Accent, 30 m x 0.25 mm ID, 0.25 μm film, REF 725820.30, max. temperature 340/360 °C

Sample: 1 μl, 5 ppm, 5 ng/compound

Injection pulsed splitless (hold 0.5 min), pulsed pressure 50 psi (hold 0.5 min)

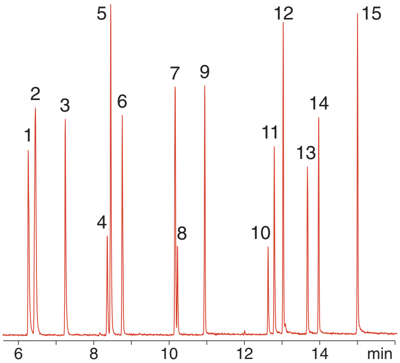
Carrier gas: 1.3 ml/min He

Temperature: 40 °C (1 min) $\xrightarrow{12\ °C/min}$ 200 °C $\xrightarrow{30\ °C/min}$ 300 °C (1 min)

Detector: MSD 280 °C

Peaks:

1. Phenol
2. 2-Chlorophenol-3,4,5,6-d_4 + 2-chlorophenol
3. 2-Methylphenol
4. 2-Nitrophenol
5. 2,4-Dimethylphenol-3,5,6-d_3 + 2,4-dimethyl-phenol
6. 2,4-Dichlorophenol
7. 4-Chloro-3-methylphenol
8. 1,2-Dimethyl-3-nitrobenzene (int. std. 1)
9. 2,4,6-Trichlorophenol
10. 2,4-Dinitrophenol
11. 4-Nitrophenol
12. 2,3,4,5-Tetrachlorophenol (int. std. 2)
13. 2-Methyl-4,6-dinitrophenol
14. 2,4,6-Tribromophenol (surrogate std.)
15. Pentachlorophenol



Analysis of phenols (EPA 604)

MN Appl. No. 213170

Column: OPTIMA® 35 MS, 30 m x 0.25 mm ID, 0.25 μm film, REF 726154.30, max. temperature 360/370 °C

Injection: 1.0 μl, split 1:20

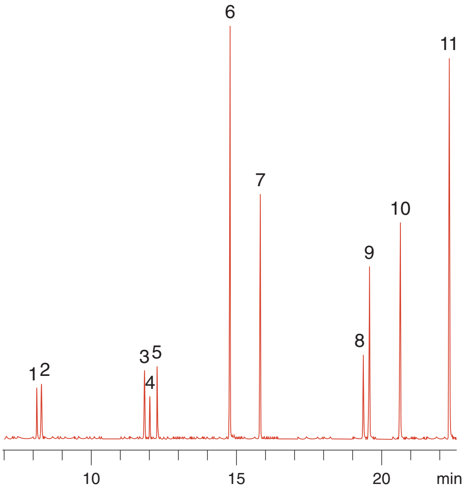
Carrier gas: 1.5 ml/min He

Temperature: 60 °C (4 min) $\xrightarrow{5\ °C/min}$ 230 °C

Detector: MSD

Peaks:

1. Phenol
2. 2-Chlorophenol
3. 2,4-Dimethylphenol
4. 2-Nitrophenol
5. 2,4-Dichlorophenol
6. 4-Chloro-3-methylphenol
7. 2,4,6-Trichlorophenol
8. 2,4-Dinitrophenol
9. 4-Nitrophenol
10. 2-Methyl-4,6-dinitrophenol
11. Pentachlorophenol



Environmental pollutants

Analysis of various phenols

MN Appl. No. 210110

Column: OPTIMA® 5 MS,
30 m x 0.25 mm ID, 0.25 μm film,
REF 726220.30,
max. temperature 340/360 °C

Sample: 5 ppm of each compound except *N-i*-propylaniline (9.4 ppm)

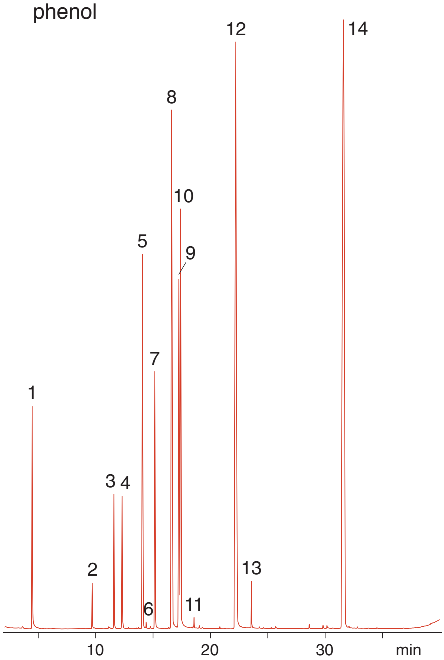
Method: SPME

Temperature: 40 °C (2 min) $\xrightarrow{6\ °C/min}$ 240 °C $\xrightarrow{20\ °C/min}$ 320 °C

Detector: MSD

Peaks:

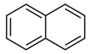
1. Toluene-D_8
2. Phenol
3. 2-Methylphenol (*o*-Cresol)
4. Nitrobenzene-D_5
5. *N-i*-Propylaniline
6. 2,4-Dichlorophenol
7. 4-Chlorophenol
8. 4-Bromo-2-chloro-phenol
9. 3-Bromophenol
10. 4-Chloro-3-methyl-phenol
11. 2,4-Dibromophenol
12. 2-Hydroxybiphenyl
13. 2-Cyclohexylphenol
14. Hexafluorobis-phenol A



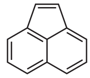
Courtesy of Riedel-de-Haën, Seelze, Germany

PAH structures

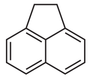
Naphthalene



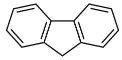
Acenaphthylene



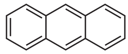
Acenaphthene



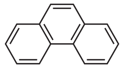
Fluorene



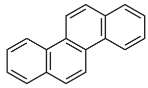
Anthracene



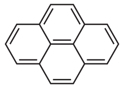
Phenanthrene



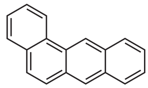
Chrysene



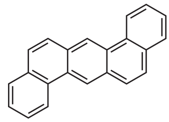
Pyrene



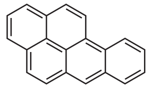
Benz[a]anthracene



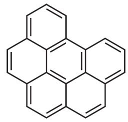
Dibenz[ah]anthracene



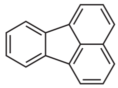
Benzo[a]pyrene



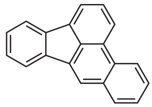
Benzo[ghi]perylene



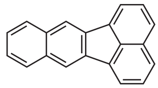
Fluoranthene



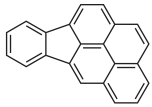
Benzo[b]fluoranthene



Benzo[k]fluoranthene



Indeno[1,2,3-cd]pyrene

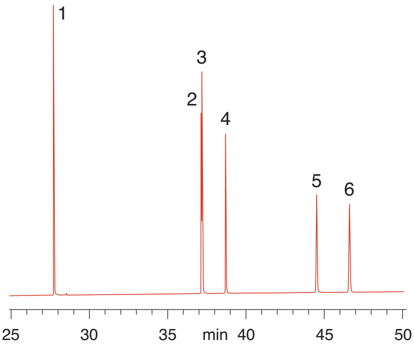


Analysis of 6 PAH according to German drinking water specifications

MN Appl. No. 212540

Column: OPTIMA® δ-6, 50 m x 0.2 mm, 0.2 µm film, REF 726465.50, max. temperature 340/360 °C
Sample: test mixture acc. to German drinking water specifications (REF 722331), 20 µg/ml in toluene
Injection: 1 µl, 300 °C, splitless
Carrier gas: 0.7 ml/min He
Temperature: 100 °C (1 min) $\xrightarrow{7\ °C/min}$ 340 °C (15 min)
Detector: MSD 280 °C

Peaks:
1. Fluoranthene
2. Benzo[b]fluoranthene
3. Benzo[k]fluoranthene
4. Benzo[a]pyrene
5. Indeno[1,2,3-cd]pyrene
6. Benzo[ghi]perylene

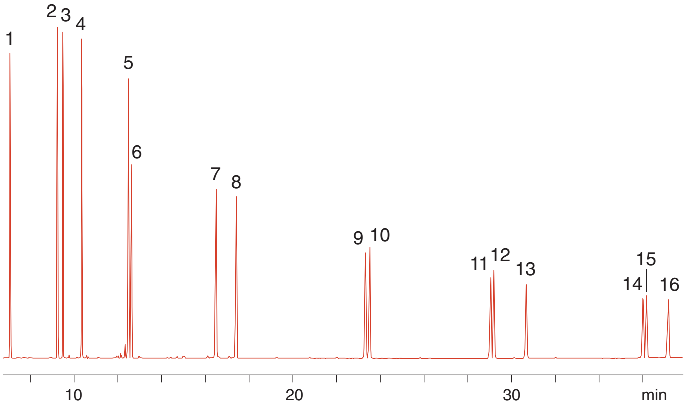


Analysis of 16 PAH (EPA 610)

MN Appl. No. 212800

Column: OPTIMA® 5 MS Accent, 30 m x 0.25 mm ID, 0.25 µm film, REF 725820.30, max. temperature 340/360 °C
Injection: 0.1 µl (20 µg/ml in toluene), 300 °C, splitless (hold 1 min)
Carrier gas: 40 cm/s H_2
Temperature: 40 °C (1 min) $\xrightarrow{20\ °C/min}$ 200 °C $\xrightarrow{4\ °C/min}$ 310 °C (5 min)
Detector: FID 310 °C

Peaks:
1. Naphthalene
2. Acenaphthylene
3. Acenaphthene
4. Fluorene
5. Phenanthrene
6. Anthracene
7. Fluoranthene
8. Pyrene
9. Benz[a]anthracene
10. Chrysene
11. Benzo[b]fluoranthene
12. Benzo[k]fluoranthene
13. Benzo[a]pyrene
14. Indeno[1,2,3-cd]pyrene
15. Dibenz[ah]anthracene
16. Benzo[ghi]perylene



Environmental pollutants

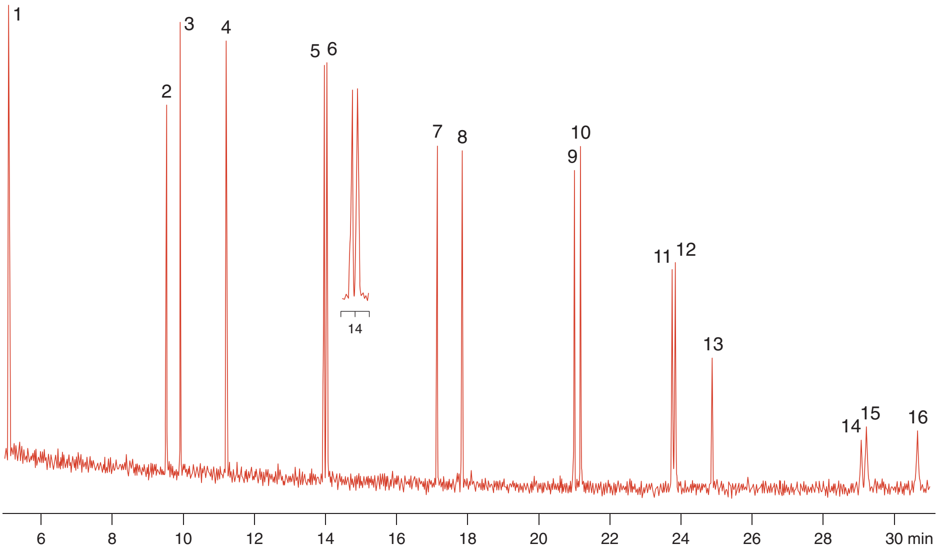
Analysis of 16 PAH (EPA 610)

MN Appl. No. 213190

Column: OPTIMA® 35 MS, 30 m x 0.25 mm ID, 0.25 µm film, REF 726154.30, max temperature 360/370 °C
Injection: 1 µl, split 1:10
Carrier gas: 0.6 bar H_2
Temperature: 100 °C (3 min) $\xrightarrow{6\ °C/min}$ 300 °C (10 min)
Detector: MSD

Peaks:

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



Rapid separation of PCB and PAH

MN Appl. No. 212920/ 212930

Column: OPTIMA® XLB, 30 m x 0.25 mm ID, 0.25 µm film, REF 725850.30
max. temperature 340/360 °C

Injection: 1 µl, standard 0.005 ng/µl; 250 °C, pulsed, splitless, pulse 1.38 bar in 1 min

Purge flow: He with purge flow 60 ml/min

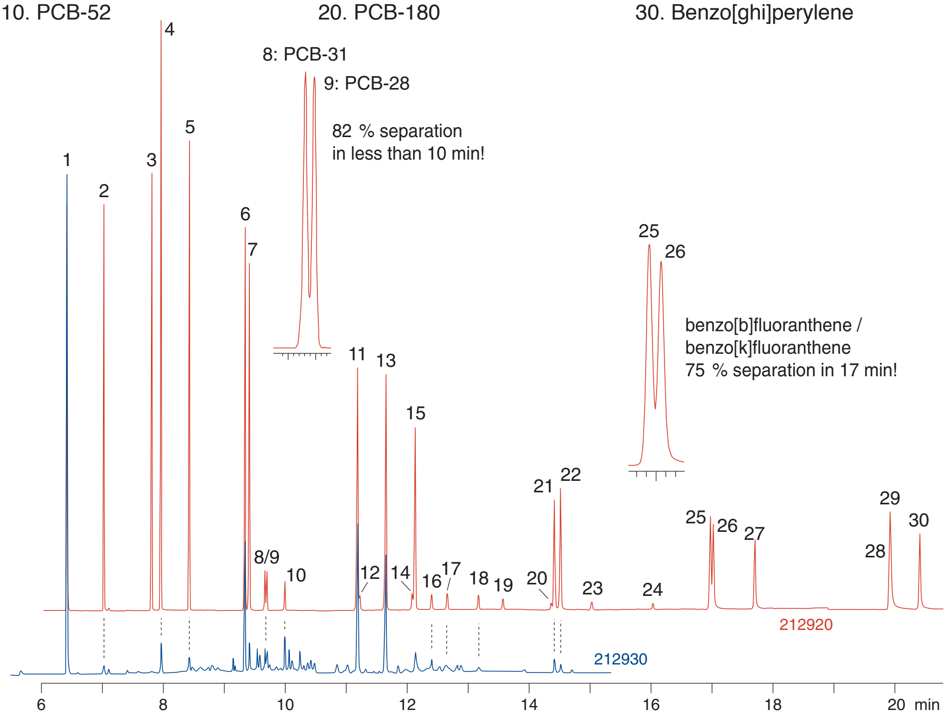
Temperature: 40 °C (2 min) $\xrightarrow{30\ °C/min}$ 240 °C (2 min) $\xrightarrow{10\ °C/min}$ 340 °C (5 min)

Detection: MS source 230 °C, interface 280 °C, quadrupol 150 °C

a) application 212920: standard; b) application 212930 PCB and PAH from slag

Peaks:

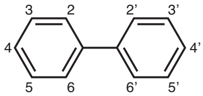
1. Naphthalene
2. 2-Methylnaphthalene
3. Acenaphthylene
4. Acenaphthene
5. Fluorene
6. Phenanthrene
7. Anthracene
8. PCB-31
9. PCB-28
10. PCB-52
11. Fluoranthene
12. PCB-101
13. Pyrene
14. PCB-77
15. 2-Methylfluoranthene
16. PCB-118
17. PCB-153
18. PCB-138
19. PCB-126
20. PCB-180
21. Benz[a]anthracene
22. Chrysene
23. PCB-169
24. PCB-194
25. Benzo[b]fluoranthene
26. Benzo[k]fluoranthene
27. Benzo[a]pyrene
28. Dibenz[ah]anthracene
29. Indeno[1,2,3-cd)pyrene
30. Benzo[ghi]perylene



Courtesy of Centre d'Analyses de Recherche, Lab. d'Hydrologie, Illkirch, France

Environmental pollutants

PCB nomenclature

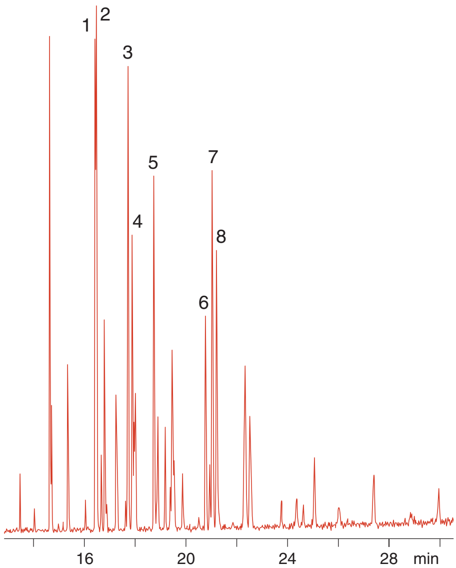
BZ	
1	2-Chlorobiphenyl
5	2,3-Dichlorobiphenyl
18	2,2',5-Trichlorobiphenyl
20	2,3,3'-Trichlorobiphenyl
28	2,4,4'-Trichlorobiphenyl
29	2,4,5-Trichlorobiphenyl
31	2,4',5-Trichlorobiphenyl
44	2,2',3,5'-Tetrachlorobiphenyl
47	2,2',4,4'-Tetrachlorobiphenyl
49	2,2',4,5'-Tetrachlorobiphenyl
52	2,2',5,5'-Tetrachlorobiphenyl
61	2,3,4,5-Tetrachlorobiphenyl
66	2,3',4,4'-Tetrachlorobiphenyl
70	2,3',4',5-Tetrachlorobiphenyl
98	2,2',3',4,6-Pentachlorobiphenyl
99	2,2',4,4',5-Pentachlorobiphenyl
101	2,2',4,5,5'-Pentachlorobiphenyl
103	2,2',4,5',6-Pentachlorobiphenyl
105	2,3,3',4,4'-Pentachlorobiphenyl
114	2,3,4,4',5-Pentachlorobiphenyl
118	2,3',4,4',5-Pentachlorobiphenyl
128	2,2',3,3',4,4'-Hexachlorobiphenyl
138	2,2',3,4,4',5'-Hexachlorobiphenyl
149	2,2',3,4',5',6-Hexachlorobiphenyl
153	2,2',4,4',5,5'-Hexachlorobiphenyl
154	2,2',4,4',5,6'-Hexachlorobiphenyl
156	2,3,3',4,4',5-Hexachlorobiphenyl
170	2,2',3,3',4,4',5-Heptachlorobiphenyl
171	2,2',3,3',4,4',6-Heptachlorobiphenyl
180	2,2',3,4,4',5,5'-Heptachlorobiphenyl
183	2,2',3,4,4',5',6-Heptachlorobiphenyl
189	2,3,3',4,4',5,5'-Heptachlorobiphenyl
194	2,2',3,3',4,4',5,5'-Octachlorobiphenyl
201	2,2',3,3',4,5',6,6'-Octachlorobiphenyl
209	Decachlorobiphenyl

Analysis of PCB (Aroclor 1248)

MN Appl. No. 210510

Column:	OPTIMA® δ-3, 50 m x 0.20 mm ID, 0.20 µm film, REF 726400.50, max. temperature 340/360 °C
Injection:	1.0 µl, split 1:25
Carrier gas:	25 cm/s He
Temperature:	100 °C $\xrightarrow{12\ °C/min}$ 220 °C $\xrightarrow{1\ °C/min}$ 260 °C
Detector:	MSD

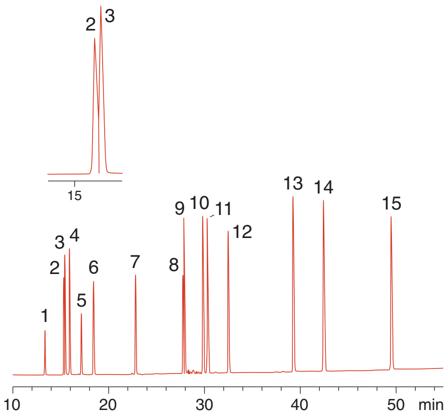
Peaks:
1. PCB-31
2. PCB-28
3. PCB-52
4. PCB-49
5. PCB-44
6. PCB-61
7. PCB-70
8. PCB-66



Analysis of PCB (W22 congener mix)
MN Appl. No. 211180

Column:	OPTIMA® 5 MS, 50 m x 0.20 mm ID, 0.2 μm film, REF 726210.50, max. temperature: 340/360 °C
Injection:	1 μl PCB W22 congener mix, 10 μl/ml, split 80 ml/min
Carrier gas:	0.5 bar He
Temperature:	220 °C $\xrightarrow{1.5\ °C/min}$ 300 °C (15 min)
Detector:	ECD 300 °C

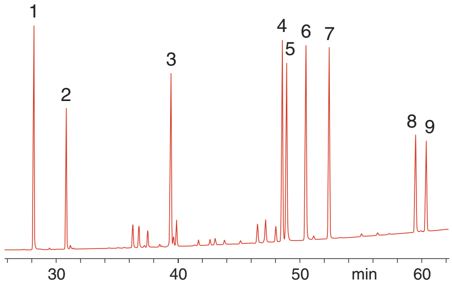
Peaks:
1. PCB-18
2. PCB-31
3. PCB-28
4. PCB-20
5. PCB-52
6. PCB-44
7. PCB-101
8. PCB-149
9. PCB-118
10. PCB-153
11. PCB-105
12. PCB-138
13. PCB-180
14. PCB-170
15. PCB-194



Analysis of PCB
MN Appl. No. 210770

Column:	OPTIMA® δ-3, 60 m x 0.25 mm ID, 0.25 μm film, REF 726420.60, max. temperature 340/360 °C
Injection:	1 μl, splitless, 36 pg/45 pg, depending on component
Carrier gas:	2.6 ml/min He
Temperature:	60 °C (1 min) $\xrightarrow{20\ °C/min}$ 200 °C $\xrightarrow{1.5\ °C/min}$ 290 °C (3 min)
Detector:	ECD 300 °C, 25 ml/min Ar/CH_4 5 %

Peaks:
1. PCB-28
2. PCB-52
3. PCB-101
4. PCB-114
5. PCB-153
6. PCB-105
7. PCB-138
8. PCB-156
9. PCB-180



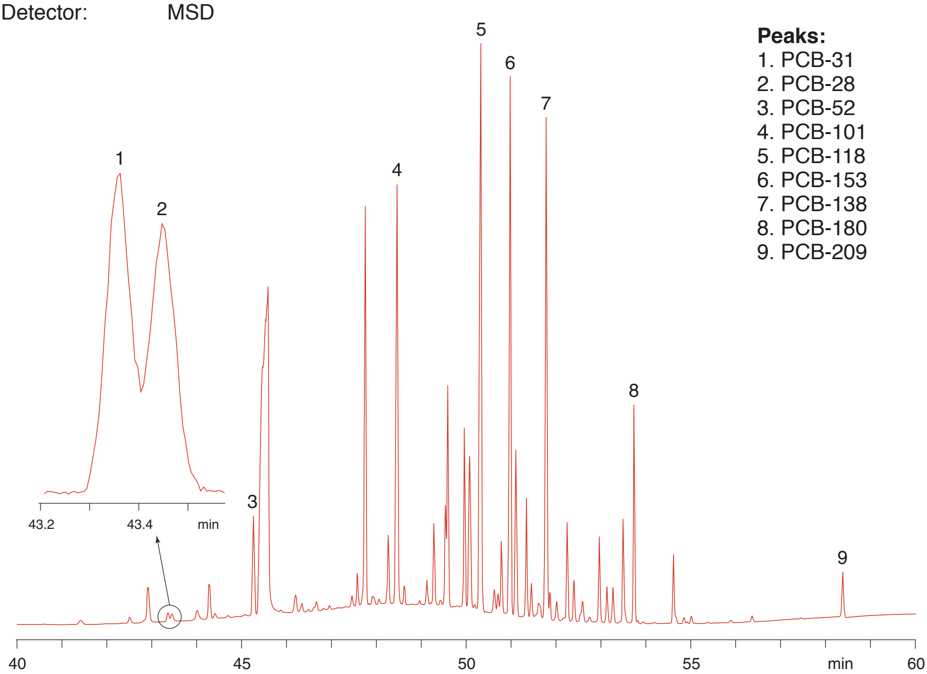
Courtesy of Mr. Bauer, Mr. Drichelt, Zentr. Inst. d. San.dienstes BW, Kiel, Germany

Environmental pollutants

Analysis of PCB from window putty

MN Appl. No. 212071

Column:	OPTIMA® 5 MS, 50 m x 0.20 mm ID, 0.2 μm film, REF 726210.50, max. temperature 340/360 °C
Injector temp.:	200 °C
Carrier gas:	32 psi He
Temperature:	120 °C (1 min) $\xrightarrow{10\ °C/min}$ 200 °C $\xrightarrow{15\ °C/min}$ 290 °C (5 min) $\xrightarrow{20\ °C/min}$ 320 °C
Detector:	MSD



Peaks:
1. PCB-31
2. PCB-28
3. PCB-52
4. PCB-101
5. PCB-118
6. PCB-153
7. PCB-138
8. PCB-180
9. PCB-209

Courtesy of N. Bertram, LTA Labor f. Toxikol. u. Analytik, Königswinter, Germany

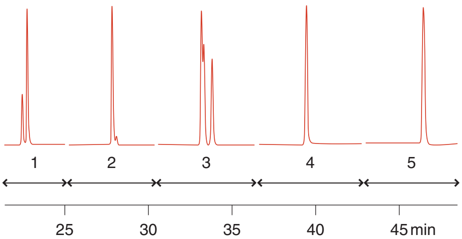
Analysis of polychlorinated dibenzodioxins (PCDDs)

MN Appl. No. 210180

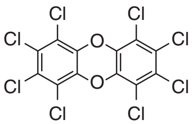
Column:	OPTIMA® δ-3, 60 m x 0.32 mm ID, 0.25 μm film, REF 726440.60, max. temperature 340/360 °C
Sample:	^{13}C-labelled standards
Injection:	1.0 μl, splitless
Carrier gas:	He
Temperature:	200 °C → (4 °C/min) 280 °C → (2 °C/min) 320 °C (10 min)
Detector:	MSD

Peaks:

	m/z
1. Tetrachlorodibenzodioxins	333.9
2. Pentachlorodibenzodioxins	367.9
3. Hexachlorodibenzodioxins	401.9
4. Heptachlorodibenzodioxins	435.8
5. Octachlorodibenzodioxin	471.8



Courtesy of Dr. Klostermann, Mr. Ludwig, SGS Intercontrol, Wismar, Germany



Octachlorodibenzodioxin

Analysis of polychlorinated dibenzofurans (PCDFs) in dust

MN Appl. No. 250520

Column:	OPTIMA® δ-3, 60 m x 0.25 mm ID, 0.25 μm film, REF 726420.60 max. temperature 340/360 °C
Injection:	2.0 μl, 6 – 160 pg/μl depending on component
Carrier gas:	1.4 ml/min He
Temperature:	120 °C (1 min) → (25 °C/min) 220 °C → (3 °C/min) 300 °C (25 min)
Detector:	MSD

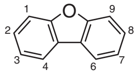
Peaks:

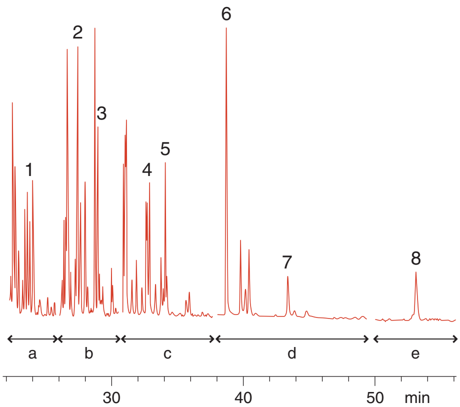
1. 2,3,7,8-Tetrachlorodibenzofuran
2. 1,2,3,7,8-Pentachlorodibenzofuran
3. 2,3,4,7,8-Pentachlorodibenzofuran
4. 1,2,3,4,7,8-Hexachlorodibenzofuran + 1,2,3,6,7,8-hexachlorodibenzofuran
5. 2,3,4,6,7,8-Hexachlorodibenzofuran
6. 1,2,3,4,6,7,8-Heptachlorodibenzofuran
7. 1,2,3,4,7,8,9-Heptachlorodibenzofuran
8. Octachlorodibenzofuran

m/z:

a) 307
b) 341
c) 375
d) 409
e) 443

Dibenzofuran





Courtesy of A. Dockwiller, Tredi, Strassbourg, France

Environmental pollutants

Analysis of halogenated hydrocarbons, organochlorine pesticides and PCB

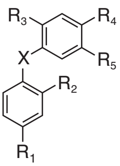
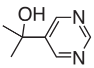
MN Appl. No. 200530

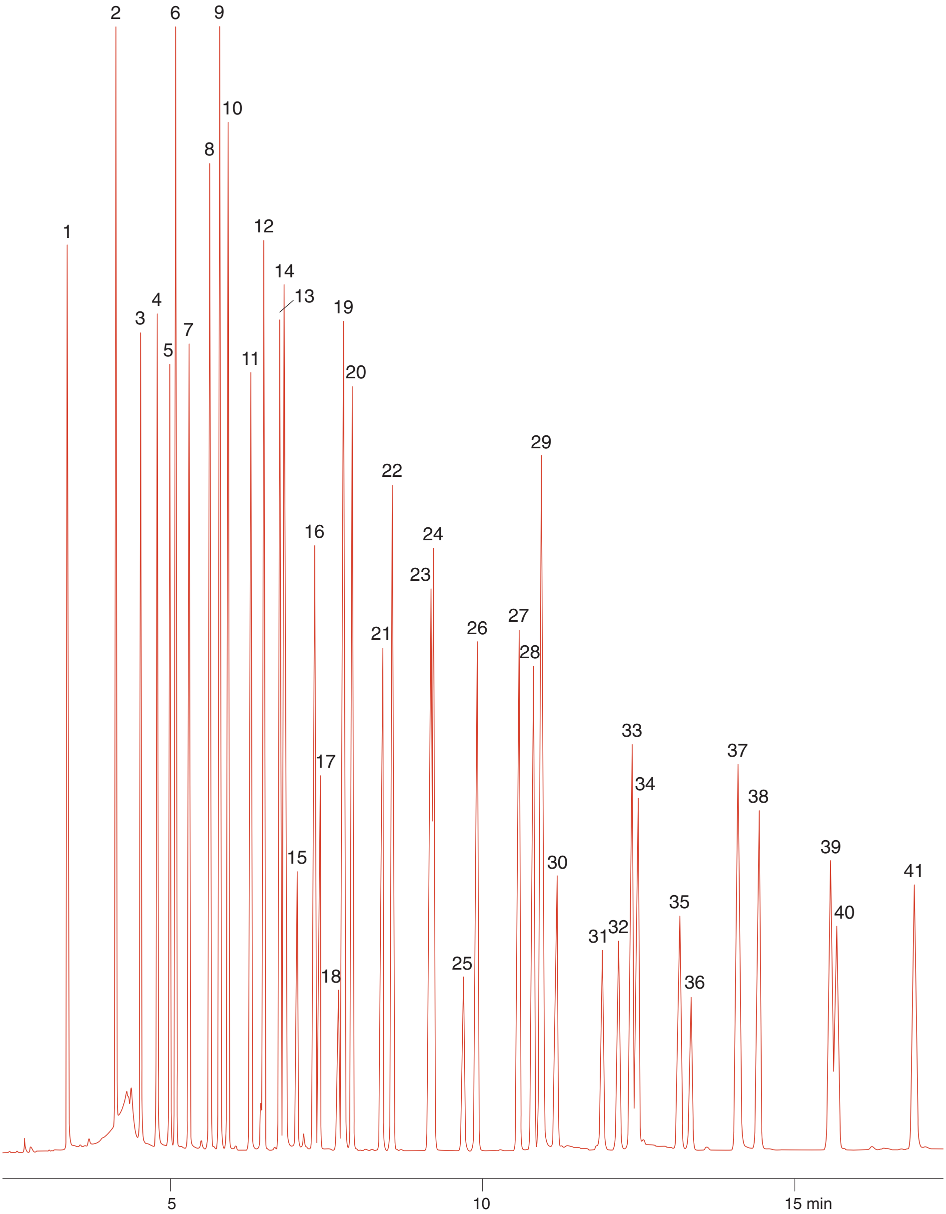
Column: OPTIMA® 1301, 25 m x 0.32 mm ID, 0.25 μm film, REF 726777.25, max. temperature 300/320 °C
Injection: 0.8 μl on column
Carrier gas: 50 kPa H_2
Temperature: 80 °C $\xrightarrow{30\ °C/min}$ 200 °C $\xrightarrow{4\ °C/min}$ 270 °C
Detector: ECD 310 °C

Peaks: [pg]

1. Hexachlorocyclopentadiene [160]
2. Etridiazole [160]
3. α-2,4-Trichloroacetophenone [80]
4. 2,4,5,6-Tetrachloroxylene [80]
5. Tecnazene [80]
6. 2,3,5,6-Tetrachloroaniline [240]
7. Trifluralin [320]
8. HCB [80]
9. Pentachloroanisole [80]
10. α-BHC [80]
11. Quintozene [80]
12. Lindane [80]
13. Bromocyclen [80]
14. 2,3,4,5-Tetrachloroaniline [160]
15. PCB-28 [80]
16. Heptachlor epoxide [80]
17. β-BHC [80]
18. PCB-52 [80]
19. Methyl pentachlorophenyl sulphide [80]
20. δ-BHC [80]
21. Telodrin [80]
22. Octachlorostyrene [80]
23. *cis*-Heptachlor epoxide [80]
24. Alodan (int. std.) [80]
25. PCB-101 [80]
26. Endosulfan α [80]
27. *p,p'*-DDE [80]
28. Dieldrin [80]
29. Chlorfenson [160]
30. *o,p'*-DDD [80]
31. *o,p'*-DDT [80]
32. PCB-153 [80]
33. Endosulfan β [80]
34. *p,p'*-DDD [80]
35. PCB-138 [80]
36. *p,p'*-DDT [80]
37. Chlorbenside sulphone [80]
38. Endosulfan sulphate [80]
39. PCB-180 [80]
40. Mirex [80]
41. Tetradifon [80]

Pesticide structures: bridged diphenyl derivatives

Structure	Compound	X	R_1	R_2	R_3	R_4	R_5
	Bifenox	–O–	Cl	Cl	H	NO_2	CO-O-CH_3
	Fluorodifen	–O–	CF_3	NO_2	H	NO_2	H
	Tetrasul	–S–	Cl	H	Cl	Cl	Cl
	Tetradifon	–SO_2–	Cl	H	Cl	Cl	Cl
	Chlorbenside sulphone	–CH_2-SO_2–	Cl	H	H	Cl	H
	Chlorfenson	–O–SO_2–	Cl	H	H	Cl	H
	*o,p'*-DDD	>CH–$CHCl_2$	H	Cl	H	Cl	H
	p,p'-DDD	>CH–$CHCl_2$	Cl	H	H	Cl	H
	o,p'-DDE	>C=CCl_2	H	Cl	H	Cl	H
	p,p'-DDE	>C=CCl_2	Cl	H	H	Cl	H
	o,p'-DDT	>CH–CCl_3	H	Cl	H	Cl	H
	p,p'-DDT	>CH–CCl_3	Cl	H	H	Cl	H
	p,p'-Methoxychlor	>CH–CCl_3	OCH_3	H	H	OCH_3	H
	Chlorobenzilate	>C(OH)–CO–O–C_2H_5	Cl	H	H	Cl	H
	Bromopropylate	>C(OH)–CO–O–*i*-C_3H_7	Br	H	H	Br	H
	Fenarimol		Cl	H	Cl	H	H
	Nuarimol		F	H	Cl	H	H



Courtesy of Mr. Lembacher, Hipp Nährmittel, Pfaffenhofen, Germany

Environmental pollutants

Analysis of pesticides and PCB

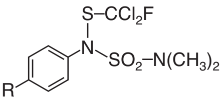
MN Appl. No. 210690

Column: OPTIMA® δ-6, 50 m x 0.20 mm ID, 0.20 µm film, REF 726465.50, max. temperature 340/360 °C
Injection: 0.03 – 0.5 µg/ml depending on component, splitless, purge time 0.8 min, 270 °C
Carrier gas: 2.3 ml/min He
Temperature: 130 °C (1 min) $\xrightarrow{25\ °C/min}$ 180 °C (5 min) $\xrightarrow{2\ °C/min}$ 260 °C $\xrightarrow{6\ °C/min}$ 310 °C (14 min)
Detector: ECD 300 °C

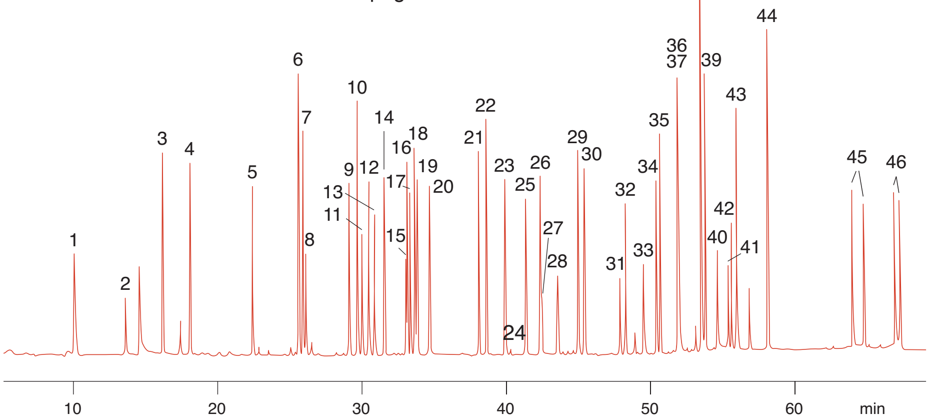
Peaks:

1. Dichlobenil
2. Chloroneb
3. Trifluralin
4. Tecnazene
5. α-BHC
6. Dichloran
7. γ-BHC
8. Quintozene
9. β-BHC
10. Vinclozolin
11. PCB-28 + heptachlor
12. *p*-Chloroaniline
13. S 421
14. δ-BHC
15. PCB-52
16. Aldrin
17. Chlorothalonil
18. Chlorpyrifos-ethyl
19. Dichlofluanid
20. Triadimefon
21. Fluorochloridone
22. Tolylfluanid
23. Procymidone
24. Anilazine
25. PCB-101
26. α-Endosulfan
27. Captan
28. Folpet
29. Dieldrin
30. *o,p'*-DDD
31. Endrin
32. *o,p'*-DDT
33. PCB-153
34. Tetrasul
35. β-Endosulfan
36. *p,p'*-DDT
37. PCB-138
38. Nuarimol
39. Endosulfan sulphate
40. Bromopropylate
41. Captafol
42. Methoxychlor
43. PCB-180
44. Tetradifon
45. Flucythrinate (2 isomers
46. Fluvalinate (2 isomers)

Phenylsulfamides

Structure	Compound	R
	Dichlofluanid Tolylfluanid	H CH_3

Other formulas see structure index from page 291.



Courtesy of Mr. Grabher, CLUA, Sigmaringen, Germany

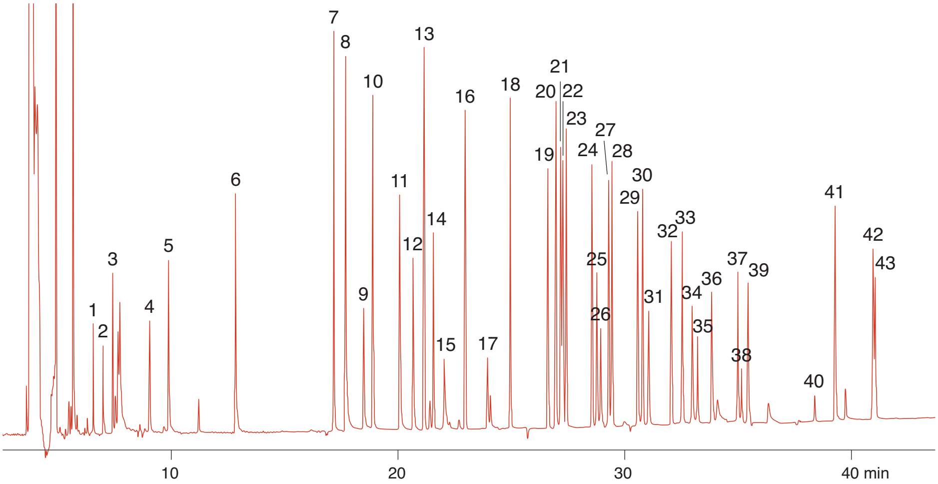
Analysis of chlorinated hydrocarbons, organochlorine pesticides and PCB acc. to German Health Administration (BGA 1988)

MN Appl. No. 200700

Column: OPTIMA® 5, 60 m x 0.25 mm ID, 0.25 µm film, REF 726056.60, max. temperature 340/360 °C
Split: 64 ml/min
Carrier gas: 160 kPa H_2 (2.3 ml/min)
Temperature: 60 °C $\xrightarrow{40\ °C/min}$ 150 °C (1 min) $\xrightarrow{3.5\ °C/min}$ 300 °C (5 min)
Detector: ECD 320 °C

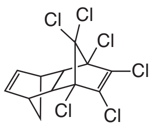
Peaks:

1. 1,2,3-Trichlorobenzene
2. 1,2,4-Trichlorobenzene
3. 1,3,5-Trichlorobenzene
4. 1,2,4,5-Tetrachlorobenzene
5. 1,2,3,4-Tetrachlorobenzene
6. Pentachlorobenzene
7. α-BHC
8. HCB
9. β-BHC
10. γ-BHC (lindane)
11. δ-BHC
12. ε-BHC
13. Bromocyclen
14. Musk xylene
15. PCB-28
16. Heptachlor
17. PCB-52
18. Aldrin
19. Isodrin (int. std.)
20. Octachlorostyrene
21. *cis*-Heptachlor epoxide
22. Oxychlordane
23. *trans*-Heptachlor epoxide
24. *trans*-Chlordane
25. *o,p'*-DDE
26. PCB-101
27. Endosulfan α
28. *cis*-Chlordane
29. *p,p'*-DDE
30. Dieldrin
31. *o,p'*-DDD
32. Endrin
33. Endosulfan β
34. *p,p'*-DDD
35. *o,p'*-DDT
36. PCB-153
37. Endosulfan sulphate
38. *p,p'*-DDT
39. PCB-138
40. Methoxychlor
41. PCB-180
42. PCB-170
43. Mirex

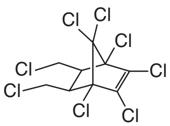


Organochlorine pesticide structures

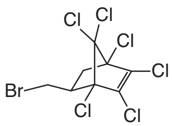
Aldrin



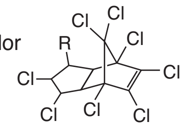
Alodan



Bromocyclen



Chlordane
R = H
Nonachlor
R = Cl



Environmental pollutants

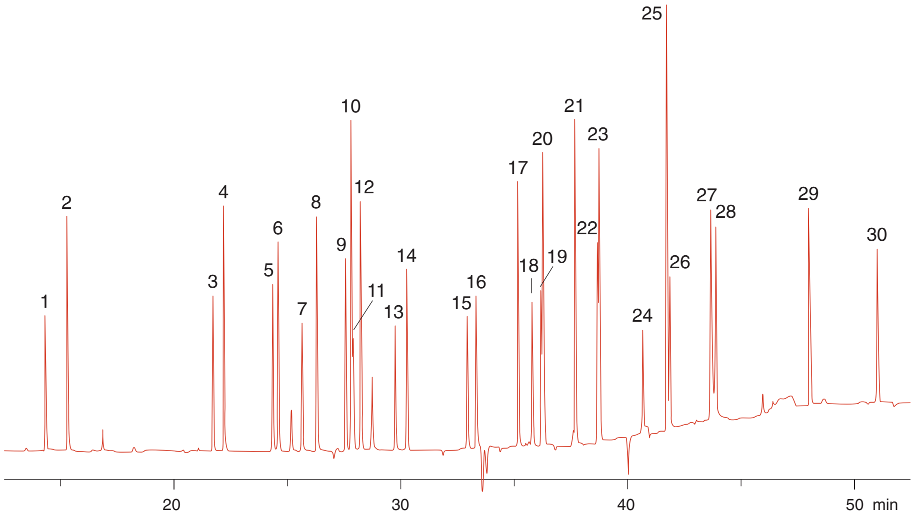
Analysis of organochlorine pesticides and PCB

MN Appl. No. 210230

Column: OPTIMA® δ-3, 50 m x 0.20 mm ID, 0.20 µm film, REF 726400.50, max. temperature 340/360 °C
Injection: 0.01 – 0.15 µg/ml depending on component, splitless, purge time 0.5 min
Carrier gas: 1.37 ml/min He
Temperature: 130 °C (1 min) $\xrightarrow{25\ °C/min}$ 180 °C (5 min) $\xrightarrow{3\ °C/min}$ 260 °C (2 min) $\xrightarrow{4\ °C/min}$ 300 °C (20 min)
Detector: ECD

Peaks:

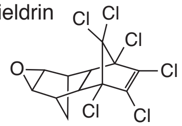
1. Chloroneb
2. Pentachlorobenzene
3. α-BHC
4. HCB
5. γ-BHC
6. Quintozene
7. Bromocyclen
8. β-BHC
9. PCB-28
10. *p*-Chloroaniline
11. Heptachlor
12. δ-BHC
13. PCB-52
14. Aldrin
15. Isodrin
16. Oxychlordane
17. *o,p'*-DDE
18. PCB-101
19. *trans*-Nonachlor
20. *cis*-Chlordane
21. *p,p'*-DDE
22. Dieldrin
23. *o,p'*-DDD
24. Endrin
25. *p,p'*-DDD
26. PCB-153
27. *p,p'*-DDT
28. PCB-138
29. PCB-180
30. Mirex



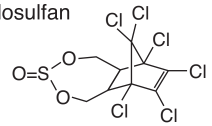
Courtesy of Mr. Grabher, CLUA, Sigmaringen, Germany

Organochlorine pesticide structures

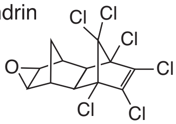
Dieldrin



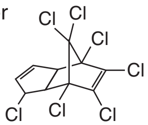
Endosulfan



Endrin



Heptachlor



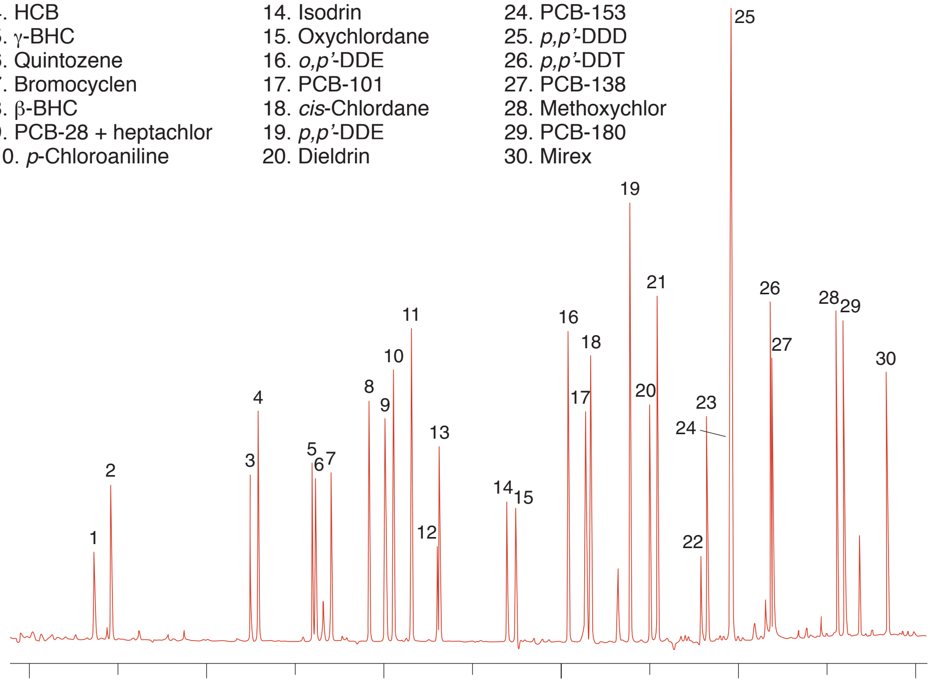
Analysis of organochlorine pesticides and PCB

MN Appl. No. 210700

Column:	OPTIMA® δ-6, 50 m x 0.20 mm ID, 0.20 µm film, REF 726465.50, max. temperature 340/360 °C
Injection:	0.03 – 0.5 µg/ml depending on component, splitless, purge time 0.8 min, 270 °C
Carrier gas:	2.3 ml/min He
Temperature:	130 °C (1 min) —25 °C/min→ 180 °C (5 min) —2 °C/min→ 260 °C —6 °C/min→ 310 °C (14 min)
Detector:	ECD 300 °C

Peaks:

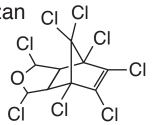
1. Chloroneb
2. Pentachlorobenzene
3. α-BHC
4. HCB
5. γ-BHC
6. Quintozene
7. Bromocyclen
8. β-BHC
9. PCB-28 + heptachlor
10. *p*-Chloroaniline
11. δ-BHC
12. PCB-52
13. Aldrin
14. Isodrin
15. Oxychlordane
16. *o,p'*-DDE
17. PCB-101
18. *cis*-Chlordane
19. *p,p'*-DDE
20. Dieldrin
21. *o,p'*-DDD
22. Endrin
23. *o,p'*-DDT
24. PCB-153
25. *p,p'*-DDD
26. *p,p'*-DDT
27. PCB-138
28. Methoxychlor
29. PCB-180
30. Mirex



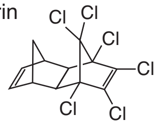
Courtesy of Mr. Grabher, CLUA, Sigmaringen, Germany

Organochlorine pesticide structures

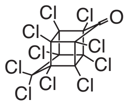
Isobenzan



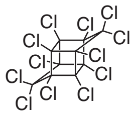
Isodrin



Kepone



Mirex



Environmental pollutants

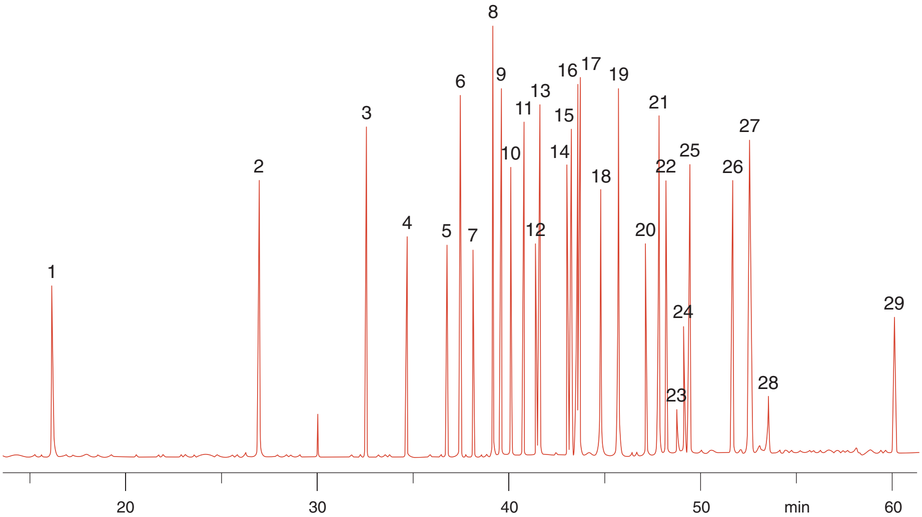
Analysis of halogenated hydrocarbons, organochlorine pesticides and PCB

MN Appl. No. 250220

Column:	OPTIMA® 1701, 50 m x 0.20 mm ID, 0.20 µm film, REF 726841.50, max. temperature 300/320 °C
Injection:	accu-pesticide test mixture, 20 µg/ml, split 1:10
Carrier gas:	1.1 bar He
Temperature:	100 °C (3 min) $\xrightarrow{4\ °C/min}$ 250 °C, then isothermal
Detector:	MSD EI

Peaks:

1. Hexachlorobutadiene
2. Pentachlorobenzene
3. Hexachlorobenzene
4. α-BHC
5. β-BHC
6. PCB-28
7. Heptachlor
8. PCB-52
9. Aldrin
10. γ-BHC
11. Isobenzan
12. δ-BHC
13. Isodrin
14. Heptachlor epoxide A
15. Heptachlor epoxide B
16. PCB-101
17. *o,p'*-DDE
18. Endosulfan 1
19. *p,p'*-DDE
20. Dieldrin
21. *o,p'*-DDD
22. PCB-118
23. Endrin
24. *p,p'*-DDD
25. PCB-138
26. *o,p'*-DDT
27. PCB-153 + endosulfan 2
28. *p,p'*-DDT
29. PCB-180



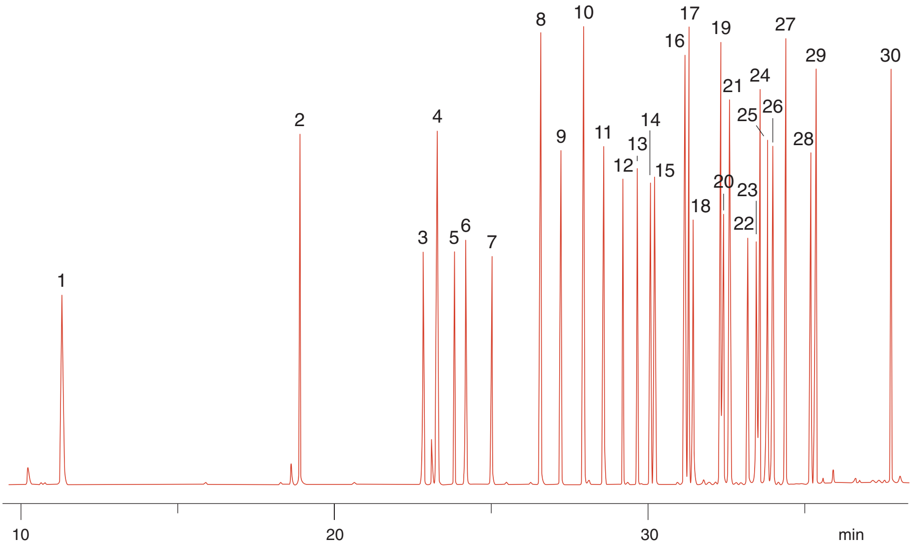
Analysis of halogenated hydrocarbons, organochlorine pesticides and PCB

MN Appl. No. 250350

Column:	OPTIMA® 5 MS, 25 m x 0.20 mm ID, 0.35 µm film, REF 726215.25, max. temperature 340/360 °C
Sample:	accu-pesticide test mixture, 10 ng/peak
Injection:	1 µl, 1 min splitless
Carrier gas:	30 cm/s He
Temperature:	75 °C (1 min) $\xrightarrow{5\ °C/min}$ 280 °C
Detector:	MSD

Peaks:

1. Hexachlorobutadiene
2. Pentachlorobenzene
3. α-BHC
4. Hexachlorobenzene
5. β-BHC
6. γ-BHC
7. δ-BHC
8. PCB-28
9. Heptachlor
10. PCB-52
11. Aldrin
12. Isobenzan
13. Isodrin
14. Heptachlor epoxide A
15. Heptachlor epoxide B
16. *o,p'*-DDE
17. PCB-101
18. Endosulfan 1
19. *p,p'*-DDE
20. Dieldrin
21. *o,p'*-DDD
22. Endrin
23. Endosulfan 2
24. PCB-118
25. *p,p'*-DDD
26. *o,p'*-DDT
27. PCB-153
28. *p,p'*-DDT
29. PCB-138
30. PCB-180



Environmental pollutants

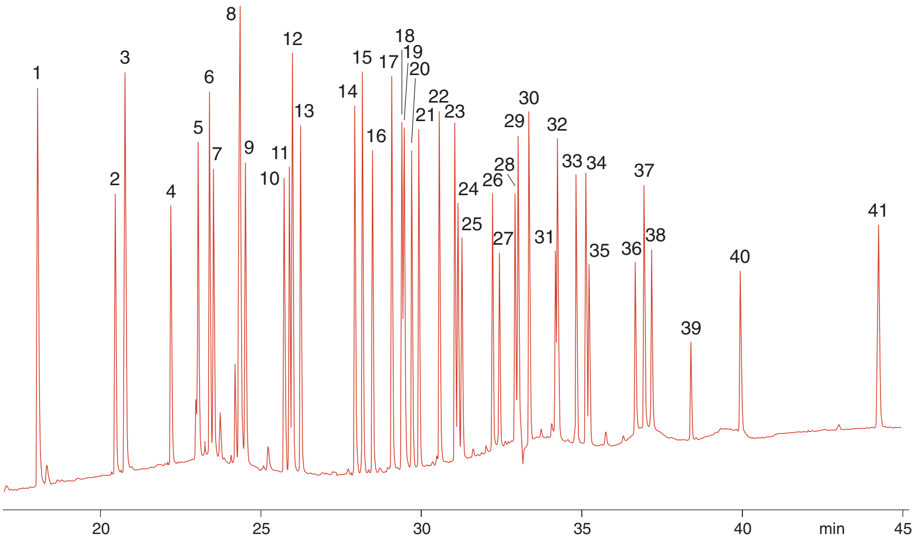
Analysis of organochlorine pesticides and PCB

MN Appl. No. 210500

Column:	OPTIMA® δ-3, 60 m x 0.25 mm ID, 0.25 µm film, REF 726420.60, max. temperature 340/360 °C
Injection:	1 µl, 3 – 18 pg/µl depending on component, 270 °C
Carrier gas:	1.37 ml/min H_2 (1.76 bar)
Temperature:	120 °C (1 min) $\xrightarrow{5\ °C/min}$ 300 °C (45 min)
Detector:	ECD 300 °C

Peaks:

1. TCNB = 1,2,4,5-Tetrachloro-3-nitrobenzene = Tecnazene
2. α-BHC
3. HCB
4. Lindane
5. Bromocyclen
6. Musk xylene
7. β-BHC
8. PCB-28/31
9. Heptachlor
10. PCB-52
11. PCB-49
12. Aldrin
13. Musk ketone
14. Oxychlordane
15. *cis*-Heptachlor epoxide
16. *trans*-Heptachlor epoxide
17. *o,p'*-DDE
18. *trans*-Chlordane
19. PCB-101
20. *cis*-Chlordane
21. α-Endosulfan
22. *p,p'*-DDE
23. Dieldrin
24. *o,p'*-DDD
25. Parlar 26
26. Endrin
27. *o,p'*-DDT
28. *p,p'*-DDD
29. PCB-153
30. β-Endosulfan
31. *p,p'*-DDT
32. PCB-138
33. PCB-183
34. Endosulfan sulphate
35. Parlar 50
36. PCB-156
37. PCB-180
38. Ketoendrin
39. Parlar 62
40. PCB-189
41. Deca-PCB = PCB-209



Courtesy of Mr. Münch, Staatl. Med. Lebensm. u. Vet. UA, Gießen, Germany

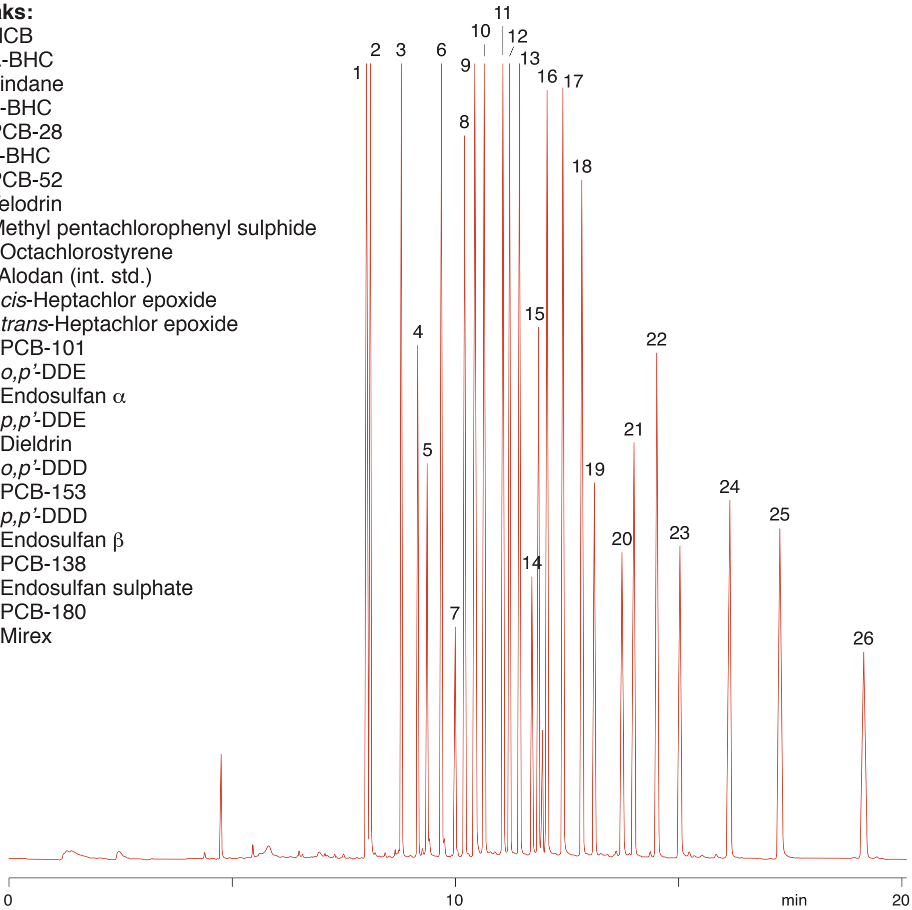
Analysis of organochlorine pesticides and PCB

MN Appl. No. 200610

Column:	OPTIMA® 17, 50 m x 0.25 mm ID, 0.25 µm film, REF 726022.50, max. temperature 320/340 °C
Injection:	0.5 µl (100 pg each), splitless, 280 °C
Carrier gas:	250 kPa H_2
Temperature:	80 °C $\xrightarrow{30\ °C/min}$ 240 °C $\xrightarrow{6\ °C/min}$ 280 °C
Detector:	ECD 310 °C

Peaks:

1. HCB
2. α-BHC
3. Lindane
4. β-BHC
5. PCB-28
6. δ-BHC
7. PCB-52
8. Telodrin
9. Methyl pentachlorophenyl sulphide
10. Octachlorostyrene
11. Alodan (int. std.)
12. *cis*-Heptachlor epoxide
13. *trans*-Heptachlor epoxide
14. PCB-101
15. *o,p'*-DDE
16. Endosulfan α
17. *p,p'*-DDE
18. Dieldrin
19. *o,p'*-DDD
20. PCB-153
21. *p,p'*-DDD
22. Endosulfan β
23. PCB-138
24. Endosulfan sulphate
25. PCB-180
26. Mirex



Courtesy of Mr. Lembacher, Hipp Nährmittel, Pfaffenhofen, Germany

Environmental pollutants

Separation of organochlorine pesticides (EPA 8081)

MN Appl. No. 250430

Column: OPTIMA® δ-6, 50 m x 0.20 mm ID, 0.2 μm film, REF 726465.50, max. temperature 340/360 °C

Sample: EPA 8081 organochlorine pesticide calibration mix (Restek), 200 μg/ml each in toluene – hexane (1:1, v/v)

Injection: 1 μl, split 1: 30

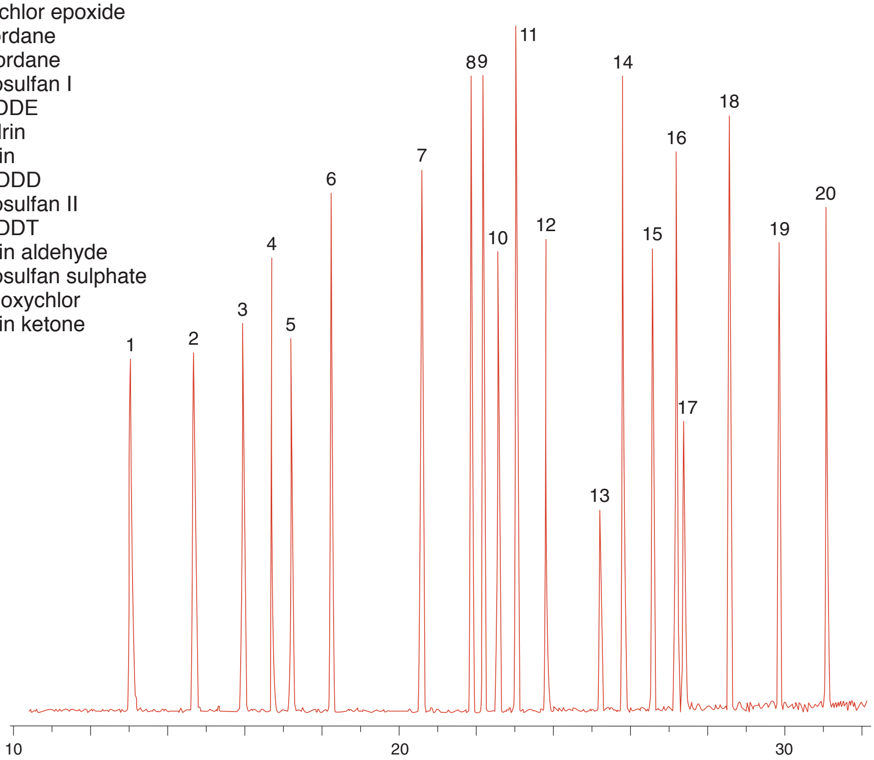
Carrier gas: 2.0 bar He

Temperature: 180 °C $\xrightarrow{4\ °C/min}$ 300 °C (10 min)

Detector: MSD

Peaks:

1. α-BHC
2. γ-BHC (lindane)
3. β-BHC
4. Heptachlor
5. δ-BHC
6. Aldrin
7. Heptachlor epoxide
8. γ-Chlordane
9. α-Chlordane
10. Endosulfan I
11. 4,4'-DDE
12. Dieldrin
13. Endrin
14. 4,4'-DDD
15. Endosulfan II
16. 4,4'-DDT
17. Endrin aldehyde
18. Endosulfan sulphate
19. Methoxychlor
20. Endrin ketone



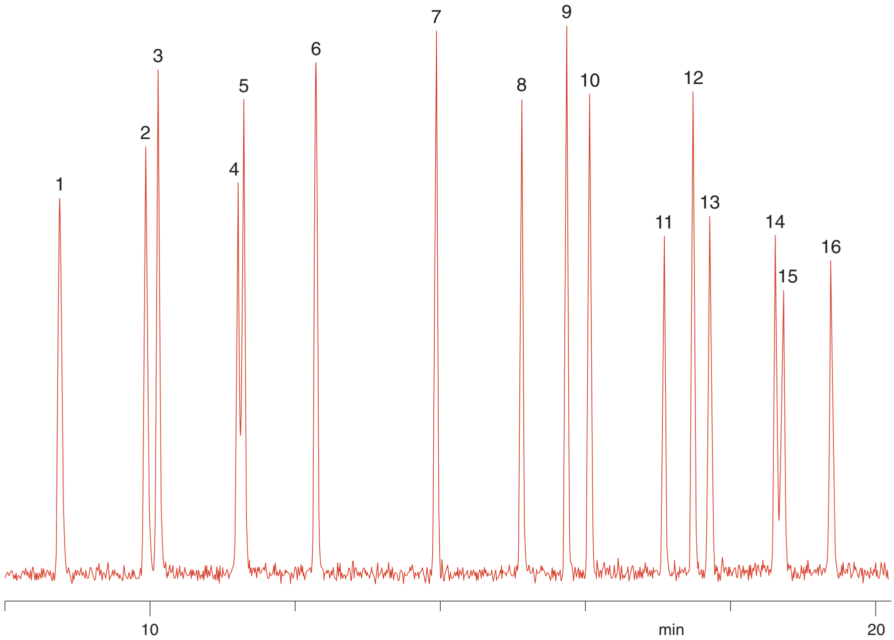
Separation of organochlorine pesticides (EPA 608)

MN Appl. No. 213220

Column: OPTIMA® 35 MS, 30 m x 0.25 mm ID, 0.25 µm film, REF 726154.30, max. temperature 360/370 °C
Sample: EPA 608 organochlorine pesticide mix
Injection: 1 µl, split 20 ml/min
Carrier gas: 0.8 ml/min He
Temperature: 160 °C → (6 °C/min) 260 °C (10 min)
Detector: MSD

Peaks:

1. α-BHC
2. γ-BHC (lindane)
3. β-BHC
4. Heptachlor
5. δ-BHC
6. Aldrin
7. Heptachlor epoxide
8. Endosulfan I
9. 4,4'-DDE
10. Dieldrin
11. Endrin
12. 4,4'-DDD
13. Endosulfan II
14. 4,4'-DDT
15. Endrin aldehyde
16. Endosulfan sulphate



Environmental pollutants

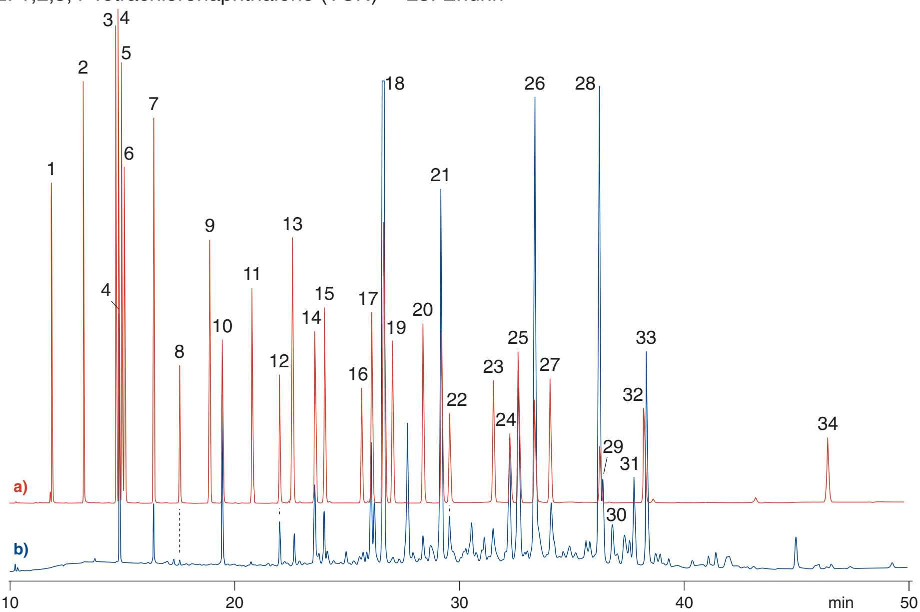
Analysis of organochlorine pesticides from cod liver oil

MN Appl. No. 213270

Column: OPTIMA® δ-3, 60 m x 0.25 mm ID, 0.25 μm film, REF 726420.60, max. temperature 340/360 °C
Sample: a) pesticide standard (150 pg/μl of each compound)
b) NP-HPLC group separation of NIST reference material SRM 1588 (semivolatile organohalogen compounds in cod liver oil) on 250 x 4 mm NUCLEOSIL® 100-10 NH_2 using 10 ml *n*-hexane (fraction 1) and 32 ml *n*-hexane – dichloromethane (90:10 v/v, fraction 2), flow rate 1 ml/min (see application 250510 for chromatogram of fraction 1)
Injection: 2 μl of fraction 2, on column
Carrier gas: 180 kPa H_2
Temperature: 80 °C (3 min) $\xrightarrow{20\ °C/min}$ 200 °C $\xrightarrow{1.5\ °C/min}$ 290 °C (5 min)
Detector: ECD 300 °C

Peaks:

1. Pentachlorobenzene
2. 2,4,6-Tribromoanisole
3. Tetrachloro-1,4-dimethoxybenzene
4. α-BHC
5. Pentachloroanisole
6. HCB
7. γ-BHC
8. β-BHC
9. Heptachlor
10. ε-BHC
11. Aldrin
12. 1,2,3,4-Tetrachloronaphthalene (TCN)
13. PCB-103
14. Oxychlordane
15. *cis*-Heptachlor epoxide
16. 2,4'-DDE
17. *trans*-Chlordane
18. *cis*-Chlordane + *trans*-nonachlor
19. Endosulfan 1
20. 4,4'-DDE
21. Dieldrin
22. 2,4'-DDD
23. Endrin
24. 2,4'-DDT
25. *cis*-Nonachlor
26. 4,4'-DDD
27. Endosulfan 2
28. 4,4'-DDT
29. Parlar 41
30. Parlar 40
31. Parlar 44
32. Endosulfan sulphate
33. Parlar 50
34. Mirex



R. Looser, K. Ballschmiter, J. Chromatogr. A **836** (1999) 271 – 284

Analysis of organohalogen compounds incl. PCB from cod liver oil

MN Appl. No. 250510

Column: OPTIMA® δ-3, 60 m x 0.25 mm ID, 0.25 μm film, REF 726420.60, max. temperature 340/360 °C

Sample: NP-HPLC group separation of NIST reference material SRM 1588 (semivolatile organohalogen compounds in cod liver oil) on 250 x 4 mm NUCLEOSIL® 100-10 NH_2 using 10 ml *n*-hexane (fraction 1) and 32 ml *n*-hexane – dichloromethane (90:10 v/v, fraction 2), flow rate 1 ml/min (see application 213270 for chromatogram of fraction 2)

Injection: 2 μl of fraction 1, on column

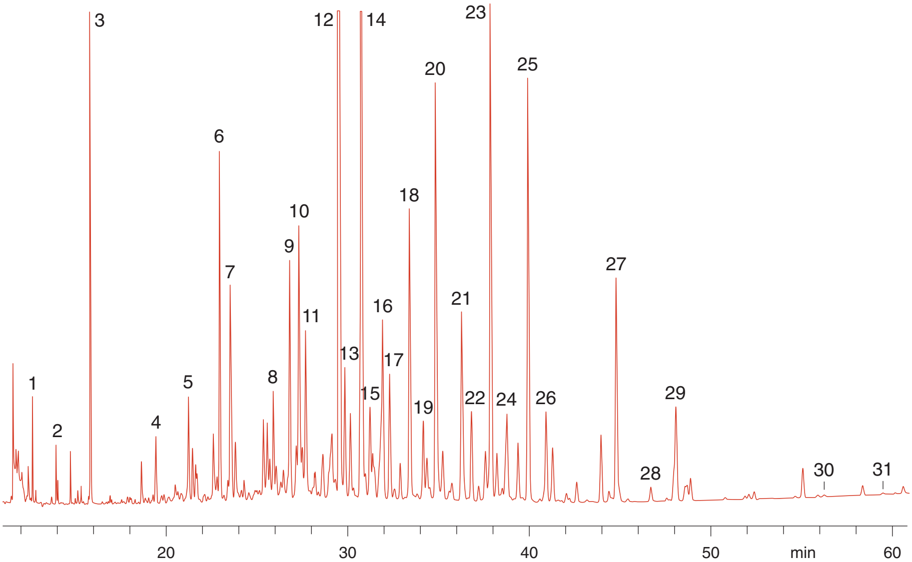
Carrier gas: 180 kPa H_2

Temperature: 80 °C (3 min) $\xrightarrow{20\ °C/min}$ 200 °C $\xrightarrow{1.5\ °C/min}$ 290 °C (5 min)

Detector: ECD 300 °C

Peaks:

1. Pentachlorobenzene
2. 2,4,6-Tribromoanisole
3. HCB
4. PCB-28
5. PCB-52
6. 1,2,3,4-Tetrachloronaphthalene (TCN, recovery standard)
7. PCB-103 (int. std.)
8. PCB-66
9. 2,4'-DDE
10. PCB-101
11. PCB-99
12. 4,4'-DDE
13. PCB-87
14. Parlar 26
15. PCB-151
16. PCB-82
17. PCB-139
18. PCB-118
19. PCB-146
20. PCB-153
21. PCB-105
22. PCB-137
23. PCB-138
24. PCB-187
25. Parlar 50
26. PCB-128
27. PCB-180
28. 2,2',4,4'-Tetrabromodiphenyl ether
29. Mirex
30. 2,2',4,4',6-Pentabromodiphenyl ether
31. 2,2',4,4',5-Pentabromodiphenyl ether



R. Looser, K. Ballschmiter, J. Chromatogr. A **836** (1999) 271 – 284

Environmental pollutants

Analysis of a pesticide mixture

MN Appl. No. 210710

Column: OPTIMA® δ-6, 50 m x 0.20 mm ID, 0.20 µm film, REF 726465.50, max. temperature 340/360 °C

Injection: 0.03 – 0.5 µg/ml, depending on component, splitless, purge time 0.8 min, 270 °C

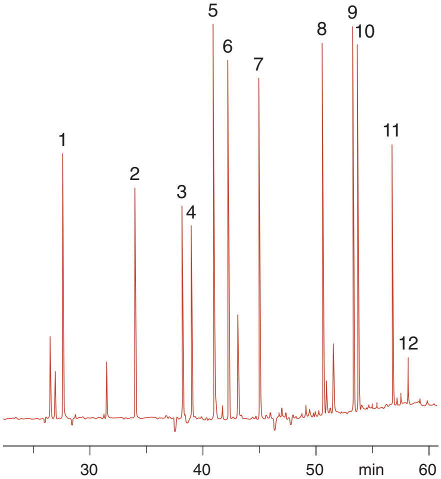
Carrier gas: 2.3 ml/min He

Temperature: 130 °C (1 min) → 25 °C/min → 180 °C (5 min) → 2 °C/min → 260 °C → 6 °C/min → 310 °C (14 min)

Detector: ECD 300 °C

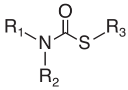
Peaks:

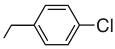
1. Musk xylene
2. Musk ketone
3. *cis*-Heptachlor epoxide
4. *trans*-Heptachlor epoxide
5. *trans*-Chlordane
6. α-Endosulfan
7. Toxaphene 26 = Parlar 26
8. β-Endosulfan
9. Toxaphene 50 = Parlar 50
10. Endosulfan sulphate
11. Ketoendrin
12. Toxaphene 62 = Parlar 62

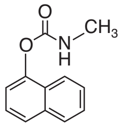
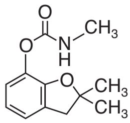
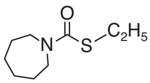
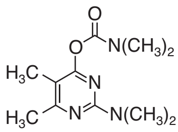


Courtesy of Mr. Grabher, CLUA, Sigmaringen, Germany

Pesticide structures: carbamates



Compound	R_1	R_2	R_3
Butylate	i-C_4H_9	i-C_4H_9	C_2H_5
Cycloate	C_2H_5	cyclohexyl	C_2H_5
EPTC	n-C_3H_7	n-C_3H_7	C_2H_5
Prothiocarb	H	$(CH_2)_3$–$N(CH_3)_2$	C_2H_5
Pebulate	C_2H_5	n-C_4H_9	n-C_3H_7
Vernolate	n-C_3H_7	n-C_3H_7	n-C_3H_7
Thiobencarb	C_2H_5	C_2H_5	

Compound	Structure
Carbaryl	
Carbofuran	
Molinate	
Pirimicarb	

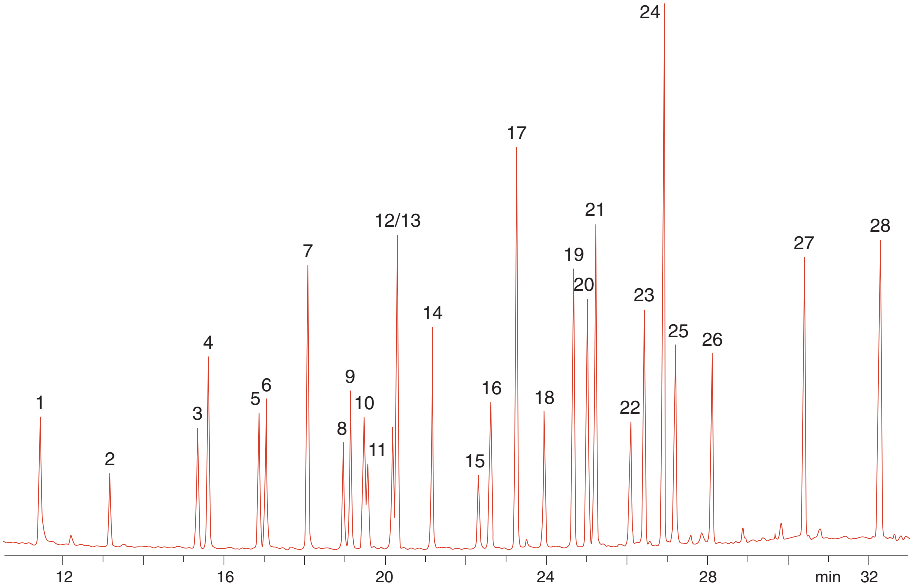
Analysis of 28 pesticides (Ökotex 100)

MN Appl. No. 210270

Column:	OPTIMA® δ-3, 30 m x 0.25 mm ID, 0.25 μm film, REF726420.30, max. temperature 340/360 °C
Injection:	250 °C, splitless, purge time 1 min
Carrier gas:	He
Pressure:	21.4 kPa (1 min) $\xrightarrow{9\ kPa/min}$ 42.9 kPa $\xrightarrow{1.1\ kPa/min}$ 72 kPa (20 min)
Temperature:	60 °C (1 min) $\xrightarrow{40\ °C/min}$ 150 °C $\xrightarrow{4.8\ °C/min}$ 280 °C (20 min)
Detector:	MSD 320 °C

Peaks:

1. Carbaryl
2. Trifluralin
3. α-BHC
4. HCB
5. Lindane
6. Quintozene
7. β-BHC
8. Heptachlor
9. δ-BHC
10. ε-BHC
11. Parathion-methyl
12. Malathion
13. Aldrin
14. Parathion
15. *cis*-Heptachlor epoxide
16. *trans*-Heptachlor epoxide
17. *o,p'*-DDE
18. α-Endosulfan
19. *p,p'*-DDE
20. Dieldrin
21. *o,p'*-DDD
22. Endrin
23. *o,p'*-DDT
24. *p,p'*-DDD
25. β-Endosulfan
26. *p,p'*-DDT
27. Methoxychlor
28. Mirex



Courtesy of K. Friedrichs, Chem. Untersuchungsamt, Bielefeld, Germany

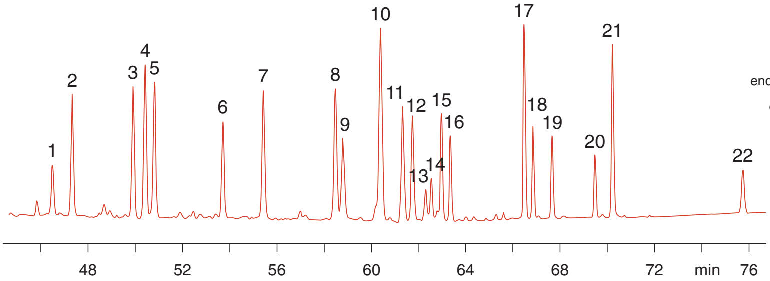
Analysis of toxaphenes

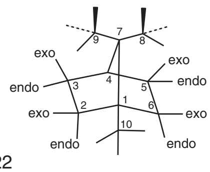
MN Appl. No. 211920

Column:	OPTIMA® 17, 50 m x 0.25 mm ID, 0.25 μm film, REF 726022.50, max. temperature 320/340 °C
Injection:	1 – 2 μl, 1.0 min splitless, 240 °C
Carrier gas:	He
Temperature:	70 °C (2 min) $\xrightarrow{15\ °C/min}$ 180 °C $\xrightarrow{1.5\ °C/min}$ 250 °C (5 min) $\xrightarrow{10\ °C/min}$ 290 °C (15 min)
Detector:	MSD

Peaks:

1.	Parlar 11	(±)-2,2,3-exo-Trichloro,5,5-bis(chloromethyl),6-(E)-chloromethylene-8,9,10-trinorbornane
2.	Parlar 12	(±)-5-exo,6-endo-Dichloro,2-endo-chloromethyl,3-(E)-chloromethylene-8,9,10-trinorbornane
3.	Parlar 15	(±)-5-exo,6-endo,7-anti-Trichloro,2,2-bis(chloromethyl),3-(E)-chloromethylene-8,9,10-trinorbornane
4.	Parlar 21	(±)-2,2,5,5-9c,10a,10b-Heptachlorobornane
5.	Parlar 26	(±)-2-endo,3-exo,5-endo,6-exo,8b,8c,10a,10c-Octachlorobornane
6.	Parlar 25	(±)-2,2,3,-exo-Trichloro,5-endo-chloromethyl,6-(E)-chloromethylene-5-dichloromethyl,8,9,10-trinorbornane
7.	Parlar 31	(±)-2,2,3-exo-Trichloro,6-(E)-chloromethylene,5,5-bis(dichloromethyl),8,9,10-trinorbornane
8.	Parlar 32	(±)-2,2,5-endo,6-exo,8c,9b,10a-Heptachlorobornane
9.	Parlar 38	(±)-2,2,5,5,9b,9c,10a,10b-Octachlorobornane
10.	Parlar 39	(±)-2,2,3-exo,5-endo,6-exo,8c,9b,10a-Octachlorobornane
11.	Parlar 41	(±)-2-exo,3-endo,5-exo,8c,9b,9c,10a,10b-Octachlorobornane
12.	Parlar 40	(±)-2-endo,3-exo,5-endo,6-exo,8b,9c,10a,10c-Octachlorobornane
13.	Parlar 42a	(±)-2,2,5-endo,6-exo,8b,8c,9c,10a-Octachlorobornane
14.	Parlar 42b	(±)-2,2,5-endo,6-exo,8c,9b,9c,10a-Octachlorobornane
15.	Parlar 44	(±)-2-exo,5,5,8c,9b,9c,10a,10b-Octachlorobornane
16.	Parlar 50	(±)-2-endo,3-exo,5-endo,6-exo,8b,8c,9c,10a,10c-Nonachlorobornane
17.	Parlar 51	(±)-2,2,5,5,8c,9b,10a,10b-Octachlorobornane
	+ Parlar 56	(±)-2,2,5-endo,6-exo,8b,8c,9c,10a,10b-Nonachlorobornane
18.	Parlar 58	(±)-2,2,3-exo,5,5,8c,9b,10a,10b-Nonachlorobornane
19.	Parlar 59	(±)-2,2,5,endo,6-exo,8c,9b,9c,10a,10b-Nonachlorobornane
20.	Parlar 62	(±)-2,2,5,5,8c,9b,9c,10a,10b-Nonachlorobornane
21.	Parlar 63	(±)-2-exo,3-endo,5-exo,6-exo,8b,8c,9c,10a,10c-Nonachlorobornane
22.	Parlar 69	(±)-2,2,5,5,6-exo,8c,9b,9c,10a,10b-Decachlorobornane



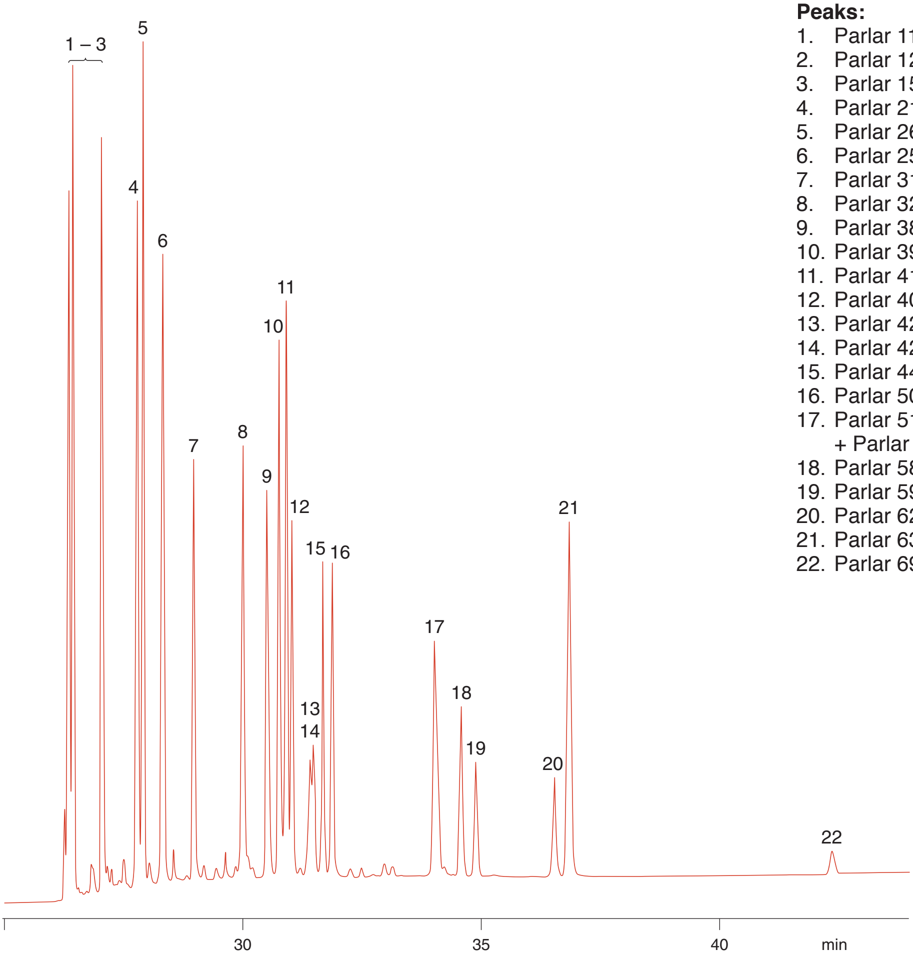


M. Kaltenecker, Dissertation, Universität Wuppertal, Germany and M. Kaltenecker, K.-H. Schwind, K.-H. Ueberschär, H. Hecht, M. Petz, Organohalogen Compounds **35** (1998) 281 – 285

Analysis of a complex toxaphene mixture

MN Appl. No. 250130

Column:	OPTIMA® δ-3, 40 m x 0.20 mm ID, 0.35 µm film, custom-made column we recommend REF 726400.50, max. temperature 340/360 °C
Injection:	1 µl, splitless
Carrier gas:	1.3 ml/min He
Temperature:	100 °C $\xrightarrow{7\ °C/min}$ 270 °C
Detector:	ECD



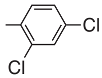
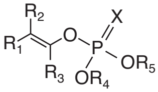
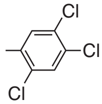
Peaks:

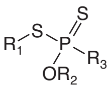
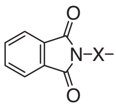
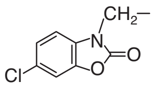
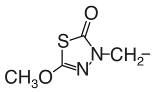
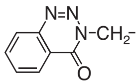
1. Parlar 11
2. Parlar 12
3. Parlar 15
4. Parlar 21
5. Parlar 26
6. Parlar 25
7. Parlar 31
8. Parlar 32
9. Parlar 38
10. Parlar 39
11. Parlar 41
12. Parlar 40
13. Parlar 42a
14. Parlar 42b
15. Parlar 44
16. Parlar 50
17. Parlar 51
    + Parlar 56
18. Parlar 58
19. Parlar 59
20. Parlar 62
21. Parlar 63
22. Parlar 69

Courtesy of R. Baycan-Keller, M. Oehme, Inst. Org. Anal. Chem., University of Basel, Switzerland

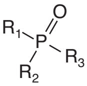
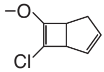
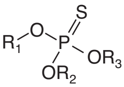
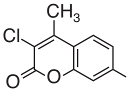
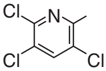
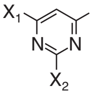
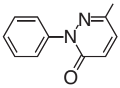
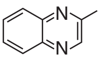
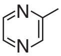
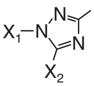
Environmental pollutants

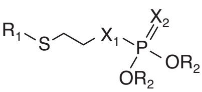
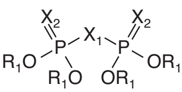
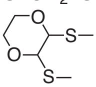
Structures of organophosphorus pesticides

Structure	Compound	X	R_1	R_2	R_3	R_4	R_5
	Chlorfenvinphos	O	Cl	H		C_2H_5	C_2H_5
	Crotoxyphos	O	CO–O–CH(C_6H_5)–CH_3	H	CH_3	CH_3	CH_3
	Dichlorphos	O	Cl	Cl	H	CH_3	CH_3
	Dicrotophos	O	CO–N(CH_3)$_2$	H	CH_3	CH_3	CH_3
	Mevinphos	O	CO–O–CH_3	H	CH_3	CH_3	CH_3
	Monocrotophos	O	CO–NH–CH_3	H	CH_3	CH_3	CH_3
	Phosphamidon	O	CO–N(C_2H_5)$_2$	Cl	CH_3	CH_3	CH_3
	Tetrachlorvinphos	O	Cl	H		CH_3	CH_3
	Methacrifos	S	CO–OCH_3	CH_3	H	C_2H_5	C_2H_5

Structure	Compound	R_1		R_2	R_3
	Chlormephos	CH_2Cl		C_2H_5	OC_2H_5
	Fonofos	C_6H_5		C_2H_5	C_2H_5
	Malathion	CH(CO–OC_2H_5)(CH_2–CO–OC_2H_5)		CH_3	OCH_3
	Dimethoate	CH_2–CO–NH–CH_3		CH_3	OCH_3
	Amidithion	CH_2–CO–NH–(CH_2)$_2$–OCH_3		CH_3	OCH_3
	Mecarbam	CH_2–CO–N(CH_3)–CO–OC_2H_5		C_2H_5	OC_2H_5
	Phorate	CH_2–S–C_2H_5		C_2H_5	OC_2H_5
	Terbufos	CH_2–S–C(CH_3)$_3$		C_2H_5	OC_2H_5
	Carbophenothion	CH_2–S–4-C_6H_4Cl		C_2H_5	OC_2H_5
	Phenkapton	CH_2–S–2,5-$C_6H_4Cl_2$		C_2H_5	OC_2H_5
	Disulfoton	(CH_2)$_2$–S–C_2H_5		C_2H_5	OC_2H_5
	Thiometon	(CH_2)$_2$–S–C_2H_5		CH_3	OCH_3
	Phosmet		X = CH_2	CH_3	OCH_3
	Dialifos		X = CH–CH_2Cl	C_2H_5	OC_2H_5
	Phosalone			C_2H_5	OC_2H_5
	Methidathion			CH_3	OCH_3
	Azinphos-methyl			CH_3	OCH_3
	Azinphos-ethyl			C_2H_5	OC_2H_5

Structures of organophosphorus pesticides

Structure	Compound	R_1		R_2	R_3
	Acephate	NH–CO–CH_3		OCH_3	SCH_3
	Dimefox	$N(CH_3)_2$		$N(CH_3)_2$	F
	Edifenphos	OC_2H_5		SC_6H_5	SC_6H_5
	Ethoprophos	OC_2H_5		S–n-C_3H_7	S–n-C_3H_7
	Heptenophos			OCH_3	OCH_3
	Naled	OCHBr–$CBrCl_2$		OCH_3	OCH_3
	Trichlorfon	CH(OH)–CCl_3		OCH_3	OCH_3
	Vamidothion	S–$(CH_2)_2$–S–$CH(CH_3)$–CO–NH–CH_3		OCH_3	OCH_3
	Coumaphos			C_2H_5	C_2H_5
	Chlorpyrifos			C_2H_5	C_2H_5
	Diazinon		$X_1 = CH_3$, $X_2 = i$-C_3H_7	C_2H_5	C_2H_5
	Etrimfos		$X_1 = OC_2H_5$, $X_2 = C_2H_5$	CH_3	CH_3
	Pirimiphos-ethyl		$X_1 = CH_3$, $X_2 = N(C_2H_5)_2$	C_2H_5	C_2H_5
	Pirimiphos-methyl		$X_1 = CH_3$, $X_2 = N(C_2H_5)_2$	CH_3	CH_3
	Pyridaphenthion			C_2H_5	C_2H_5
	Quinalphos			C_2H_5	C_2H_5
	Thionazin			C_2H_5	C_2H_5
	Isazofos		$X_1 = i$-C_3H_7, X_2 = Cl	C_2H_5	C_2H_5
	Triazophos		$X_1 = C_6H_7$, X_2 = H	C_2H_5	C_2H_5

Structure	Compound	X_1	X_2	R_1	R_2
	Demeton-O	O	S	C_2H_5	C_2H_5
	Demeton-S	S	O	C_2H_5	C_2H_5
	Demeton-O-methyl	O	S	C_2H_5	CH_3
	Demeton-S-methyl	S	O	C_2H_5	CH_3
	Demephion-O	O	S	CH_3	CH_3
	Demephion-S	S	O	CH_3	CH_3
	Sulfotep	O	S	C_2H_5	–
	TEPP	O	O	C_2H_5	–
	Ethion	S–CH_2–S	S	C_2H_5	–
	Dioxathion		S	C_2H_5	–

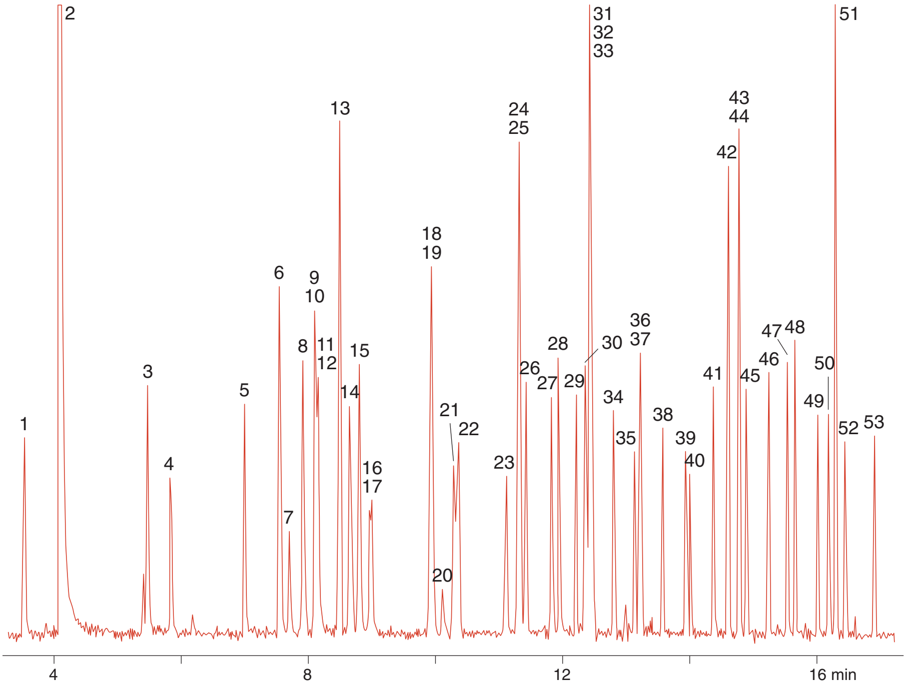
Analysis of organophosphorus pesticides (EPA 8140 / 8141 / 8141 A)

MN Appl. No. 213030

Column:	OPTIMA® 1 MS Accent, 30 m x 0.32 mm ID, 0.50 µm film, REF 725807.30
Sample:	0.2 µg/ml in hexane, 8140/8141 OP pesticides calibration mix A and 8141 OP pesticides calibration mix B; IS triphenyl phosphate and tributyl phosphate
Injection:	splitless (hold 1 min), 250 °C
Carrier gas:	He, 1 ml/min, constant pressure
Temperature:	100 °C $\xrightarrow{10\ °C/min}$ 180 °C (2 min) $\xrightarrow{18\ °C/min}$ 300 °C (3 min)
Detector:	FPD (Flame Photometric Detector), 280 °C

Peaks:

1. Dichlorvos, 2. Hexamethylphosphoramide, 3. Mevinphos, 4. Trichlorfon, 5. TEPP, 6. Thionazin, 7. Demeton-O, 8. Ethoprop 9. Tributyl phosphate (IS), 10. Dicrotophos, 11. Monocrotophos, 12. Naled, 13. Sulfotepp, 14. Phorate, 15. Dimethoate, 16. Demeton-S, 17. Dioxathion, 18. Terbufos, 19. Fonofos, 20. Phosphamidon isomer, 21. Diazinon, 22. Disulfoton, 23. Phosphamidon, 24. Dichlofenthion, 25. Parathion-methyl, 26. Chlorpyrifos methyl, 27. Ronnel, 28. Fenitrothion, 29. Malathion, 30. Fenthion, 31. Chlordane, 32. Parathion-ethyl, 33. Chlorpyrifos, 34. Trichloronate, 35. Chlorfenvinphos, 36. Merphos, 37. Crotoxyphos, 38. Stirofos, 39. Tokuthion (prothiophos), 40. Merphos oxidation product, 41. Fensulfothion, 42. Famphur, 43. Ethion, 44. Bolstar, 45. Carbophenothion, 46. Triphenyl phosphate (IS), 47. Phosmet, 48. EPN, 49. Azinphos-methyl, 50. Leptophos, 51. Tri-*o*-cresyl phosphate, 52. Azinphos-ethyl, 53. Coumaphos

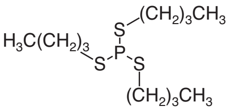


Separation of organophosphorus pesticides (EPA 8140 / 8141)

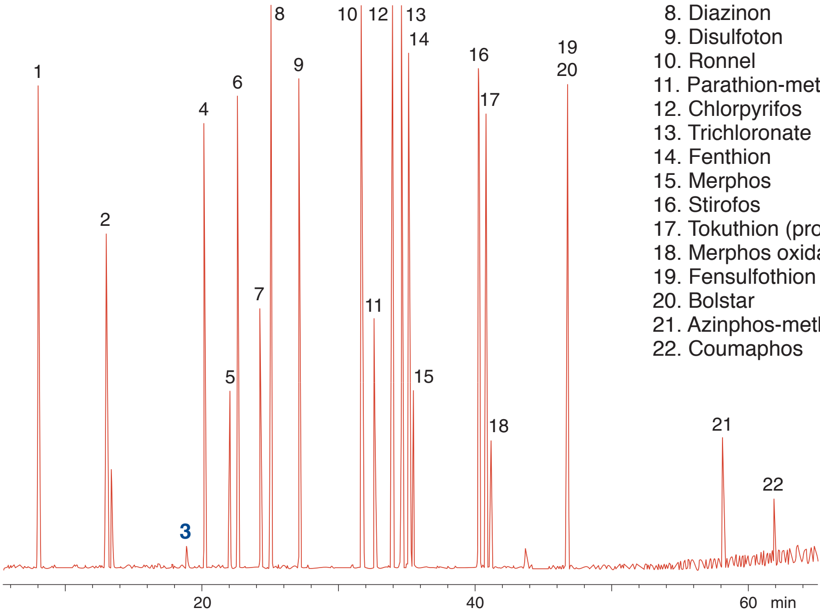
MN Appl. No. 250420

Column: OPTIMA® δ-6, 50 m x 0.20 mm ID, 0.2 μm film, REF 726465.50, max. temperature 340/360 °C
Sample: EPA 8140 OP pesticide calibration mix (Restek), 200 μg/ml each in hexane – acetone (95:5, v/v)
Injection: 1 μl, split 1:30
Carrier gas: 2.0 bar He
Temperature: 150 °C $\xrightarrow{2.5\ °C/min}$ 300 °C (10 min)
Detector: MSD

Merphos:



Peaks:
1. Dichlorvos
2. Mevinphos
3. Demeton-S
4. Ethoprop
5. Naled
6. Phorate
7. Demeton-O
8. Diazinon
9. Disulfoton
10. Ronnel
11. Parathion-methyl
12. Chlorpyrifos
13. Trichloronate
14. Fenthion
15. Merphos
16. Stirofos
17. Tokuthion (prothiophos)
18. Merphos oxidation product
19. Fensulfothion
20. Bolstar
21. Azinphos-methyl
22. Coumaphos



Environmental pollutants

Analysis of organophosphorus insecticides

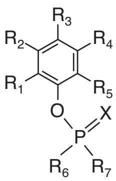
MN Appl. No. 200940

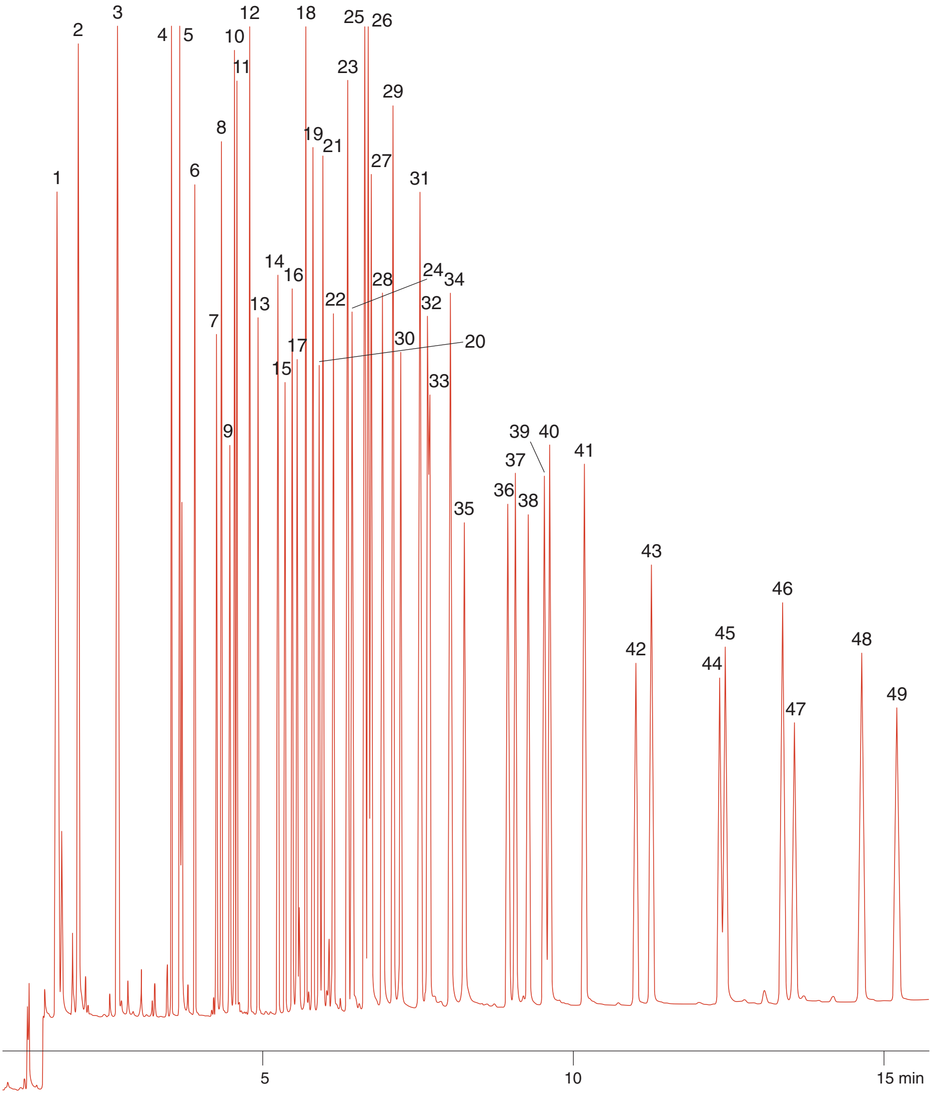
Column: OPTIMA® 1301, 25 m x 0.32 mm ID, 0.25 μm film, REF 726777.25, max. temperature 300/320 °C
Injection: 0.5 μl on column
Carrier gas: 80 kPa H_2
Temperature: 80 $\xrightarrow{30\ °C/min}$ 220 °C $\xrightarrow{4\ °C/min}$ 270 °C
Detector: PND

Peaks: [ng]

1. Dimefox [0.25]
2. Triethyl phosphate [0.25]
3. Dichlorvos [0.25]
4. Chlormephos [0.25]
5. Mevinphos [0.5]
6. Methacrifos [0.25]
7. Demephion [0.5]
8. Heptenophos [0.5]
9. TEPP [0.25]
10. Ethoprophos [0.25]
11. Tributyl phosphate [0.25]
12. Sulfotep [0.25]
13. Thiometon [0.25]
14. Diazinon [0.25]
15. Disulfoton [0.25]
16. Tris-2-chloroethyl phosphate [0.25]
17. Isazofos [0.25]
18. Dichlofenthion [0.5]
19. Dursban-methyl = Chlorpyrifos-methyl [0.5]
20. Tolclofos-methyl [0.25]
21. Fenchlorphos [0.5]
22. Pirimiphos-methyl [0.5]
23. Dursban-ethyl = Chlorpyrifos-ethyl [0.5]
24. Malathion [0.5]
25. Pirimiphos-ethyl [1.0]
26. Parathion-ethyl [0.5]
27. Amidithion [0.5]
28. Crufomate [0.5]
29. Quinalphos (0.5]
30. Bromophos-ethyl [0.5]
31. Methidathion [0.5]
32. Iodofenphos [0.5]
33. Prothiophos [0.5]
34. Fenamiphos [0.5]
35. Vamidothion [0.5]
36. Ethion [0.25]
37. Sulprofos [0.5]
38. Carbophenothion [0.5]
39. Edifenphos [0.5]
40. Triazophos [0.5]
41. Triphenyl phosphate [0.5]
42. Phenkapton [0.5]
43. Pyridaphenthion [0.5]
44. Azinphos-methyl [0.5]
45. Phosalone [0.5]
46. Azinphos-ethyl [0.5]
47. Dialifos [0.5]
48. Tri-p-cresyl phosphate [0.5]
49. Coumaphos [0.5]

Structures of organophosphorus pesticides

Structure	Compound	X	R_1	R_2	R_3	R_4	R_5	R_6	R_7
	Bromophos-ethyl	S	Cl	H	Br	Cl	H	OC_2H_5	OC_2H_5
	Chlorthion	S	H	Cl	NO_2	H	H	OCH_3	OCH_3
	Crufomate	O	Cl	H	$C(CH_3)_3$	H	H	OCH_3	$NH–CH_3$
	Dichlofenthion	S	Cl	H	Cl	H	H	OC_2H_5	OC_2H_5
	EPN	S	H	H	NO_2	H	H	OC_2H_5	C_6H_5
	Famphur	S	H	H	$SO_2–N(CH_3)_2$	H	H	OCH_3	OCH_3
	Fenamiphos	O	H	CH_3	SCH_3	H	H	OC_2H_5	NH–i-C_3H_7
	Fenchlorphos	S	Cl	H	Cl	Cl	H	OCH_3	OCH_3
	Fenitrothion	S	H	CH_3	NO_2	H	H	OCH_3	OCH_3
	Fensulfothion	S	H	H	SO-CH_3	H	H	OC_2H_5	OC_2H_5
	Fenthion	S	H	CH_3	SCH_3	H	H	OCH_3	OCH_3
	Iodofenphos	S	Cl	H	I	Cl	H	OCH_3	OCH_3
	Leptophos	S	Cl	H	Br	Cl	H	OCH_3	C_6H_5
	Parathion-ethyl	S	H	H	NO_2	H	H	OC_2H_5	OC_2H_5
	Profenofos	O	Cl	H	Br	H	H	OC_2H_5	S–n-C_3H_7
	Prothiofos	S	Cl	H	Cl	H	H	OC_2H_5	S–n-C_3H_7
	Sulprofos	S	H	H	SCH_3	H	H	OC_2H_5	S–n-C_3H_7
	Tolclofos-methyl	S	Cl	H	CH_3	H	Cl	OCH_3	OCH_3
	Trichloronat	S	Cl	H	Cl	Cl	H	OC_2H_5	C_2H_5



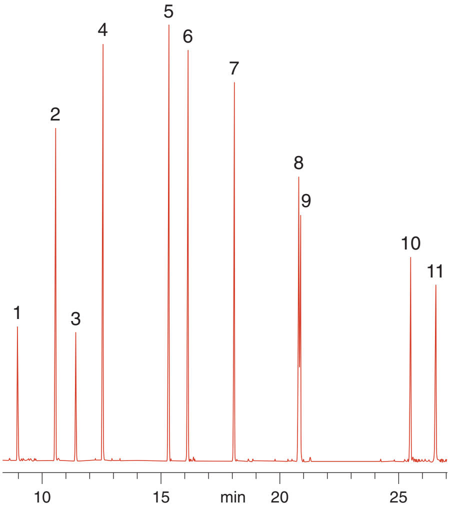
Courtesy of Mr. Lembacher, Hipp Nährmittel, Pfaffenhofen, Germany

Analysis of organophosphorus pesticides

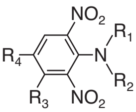
MN Appl. No. 213180

Column: OPTIMA® 35 MS, 30 m x 0.25 mm ID, 0.25 µm film, REF 726154.30, max. temperature 360/370 °C
Injection: 1.0 µl, 250 °C, split 1:25
Carrier gas: 1.5 ml/min He
Temperature: 130 °C → (6 °C/min) 300 °C
Detector: MSD

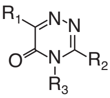
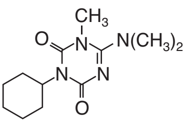
Peaks:
1. Demeton-O
2. Phorate
3. Demeton-S
4. Disulfoton
5. Trichloronate
6. Fenthion
7. Prothiophos
8. Sulprofos
9. Fensulfothion
10. Azinphos-methyl
11. Coumaphos



Pesticide structures: dinitroaniline herbicides

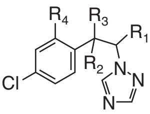
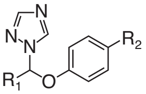
Structure	Compound	R_1	R_2	R_3	R_4
	Ethalfluralin	C_2H_5	$CH_2–C(CH_3)=CH_2$	H	CF_3
	Fluchloralin	C_2H_4Cl	n-C_3H_7	H	CF_3
	Isopropalin	n-C_3H_7	n-C_3H_7	H	$CH(CH_3)_2$
	Pendimethalin	H	$CH(C_2H_5)_2$	CH_3	CH_3
	Profluralin	n-C_3H_7	cyclopropylmethyl	H	CF_3
	Trifluralin	n-C_3H_7	n-C_3H_7	H	CF_3

Pesticide structures: triazines

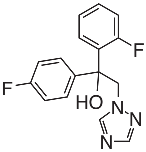
Structure	Compound	R_1	R_2	R_3
	Isomethiozin	$C(CH_3)_3$	SCH_3	$N=CH–CH(CH_3)_2$
	Metamitron	C_6H_5	CH_3	NH_2
	Metribuzin	$C(CH_3)_3$	SCH_3	NH_2
	Hexazinone	–	–	–

For more triazine structures see page 102.

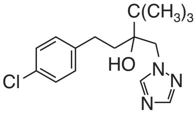
Pesticide structures: triazole and imidazole derivatives, conazoles

Structure	Compound	R_1	R_2	R_3	R_4
	Cyproconazole	H	OH	1-cyclopropylethyl	H
	Diclobutrazole	CH(OH)–C$(CH_3)_3$	H	H	Cl
	Hexaconazole	H	OH	n-C_4H_9	Cl
	Myclobutanil	H	CN	n-C_4H_9	H
	Penconazole	H	H	n-C_3H_7	Cl
	Bitertanol	CH(OH)–C$(CH_3)_3$	C_6H_5	–	–
	Triadimefon	CO–C$(CH_3)_3$	Cl	–	–
	Triadimenol	CH(OH)–C$(CH_3)_3$	Cl	–	–

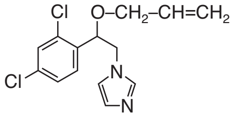
Flutriafol



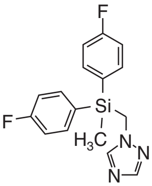
Tebuconazole



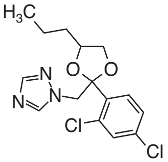
Imazalil



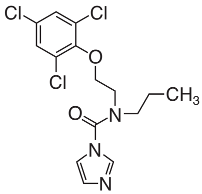
Flusilazole



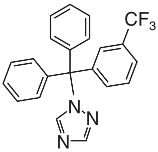
Propiconazole



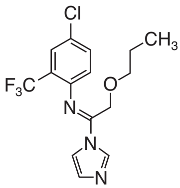
Prochloraz



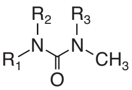
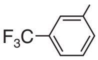
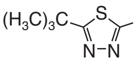
Fluotrimazole



Triflumizole



Pesticide structures: urea derivatives

Structure	Compound	R_1	R_2	R_3
	Fluometuron		H	CH_3
	Tebuthiuron		CH_3	H

Environmental pollutants

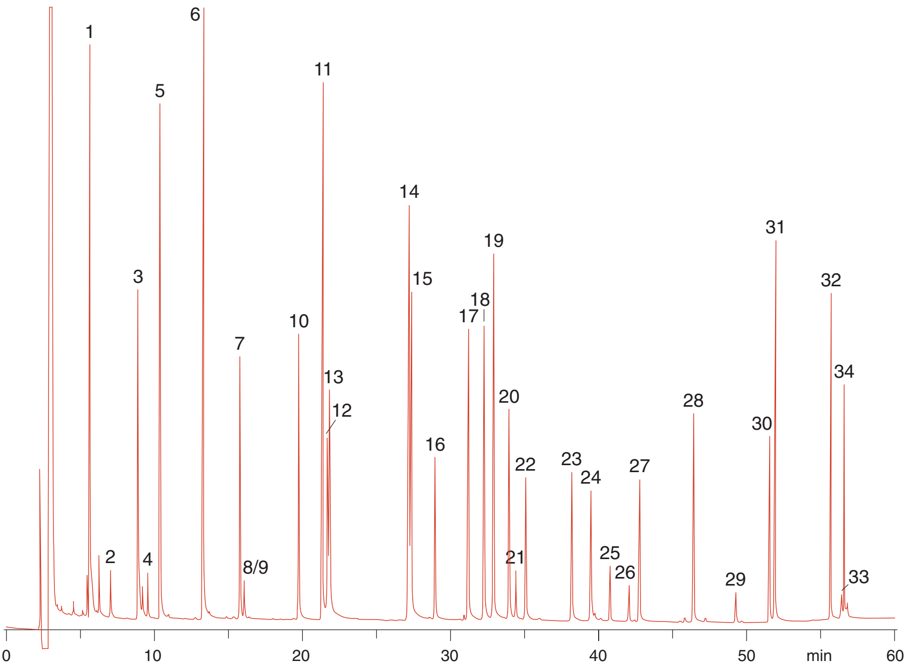
Analysis of a pesticide mixture

MN Appl. No. 210740

Column:	OPTIMA® δ-6, 50 m x 0.20 mm ID, 0.20 μm film, REF 726465.50, max. temperature 340/360 °C
Injection:	0.03 – 0.5 μg/ml depending on component, splitless, purge time 0.8 min, 270 °C
Carrier gas:	2.3 ml/min He
Temperature:	130 °C (1 min) → 25 °C/min → 180 °C (5 min) → 2 °C/min → 260 °C → 6 °C/min → 310 °C (4 min)
Detector:	PND 300 °C

Peaks:

1. Dichlorvos
2. Degradation product of ethion/ dioxathion
3. Mevinphos
4. Propham
5. Methacrifos
6. Heptenophos
7. Sulfotep/ degradation product of diazinon
8. Diphenylamine
9. Chlorpropham
10. Diazinon
11. Dioxathion
12. Dimethoate
13. Etrimfos
14. Fenchlorphos/pirimiphos
15. Tolclofos-methyl
16. Malathion
17. Fenthion
18. Bromophos-methyl
19. Chlorthion
20. Chlorfenvinphos
21. Penconazole
22. Quinalphos
23. Methidathion
24. Imazalil
25. Flusilazole
26. Myclobutanil
27. Ethion
28. Carbophenothion
29. Tebuconazole
30. Pyridaphenthion
31. Phenkapton
32. Azinphos-methyl
33. Bitertanol
34. Azinphos-ethyl



Courtesy of Mr. Grabher, CLUA, Sigmaringen, Germany

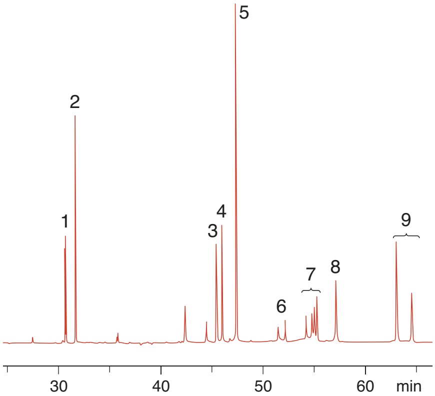
Analysis of pyrethroid insecticides

MN Appl. No. 210720

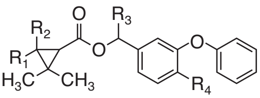
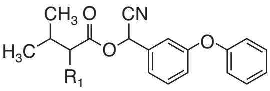
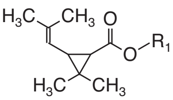
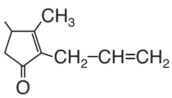
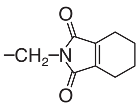
Column: OPTIMA® δ-6, 50 m x 0.20 mm ID, 0.20 μm film, REF 726465.50, max. temperature 340/360 °C
Injection: 0.03 – 0.5 μg/ml depending on component, splitless, purge time: 0.8 min, 270 °C
Carrier gas: 2.3 ml/min He
Temperature: 130 °C (1 min) $\xrightarrow{25\ °C/min}$ 180 °C (5 min) $\xrightarrow{2\ °C/min}$ 260 °C $\xrightarrow{6\ °C/min}$ 310 °C (14 min)
Detector: ECD 300 °C

Peaks:
1. Bioallethrin isomers
2. Chlorthion
3. Fenpropathrin + tetramethrin isomer 1
4. Tetramethrin isomer 2
5. Cyhalothrin
6. Permethrin isomers
7. Cyfluthrin isomers
8. Alphamethrin = α-Cypermethrin
9. Fenvalerate isomers

Courtesy of Mr. Grabher, CLUA, Sigmaringen, Germany



Pesticide structures: pyrethroids

Structure	Compound	R_1	R_2	R_3	R_4
	Cyfluthrin	$CH{=}CCl_2$	H	CN	F
	Cyhalothrin	$CH{=}CCl{-}CF_3$	H	CN	H
	α-Cypermethrin	$CH{=}CCl_2$	H	CN	H
	Fenpropathrin	CH_3	CH_3	CN	H
	Permethrin	$CH{=}CCl_2$	H	H	H
	Fenvalerate	4-Cl-phenyl	–	–	–
	Flucythrinate	4-CHF_2O-phenyl	–	–	–
	Fluvalinate	4-CF_3,2-Cl-phenyl–NH	–	–	–
	Bioallethrin		–	–	–
	Tetramethrin		–	–	–

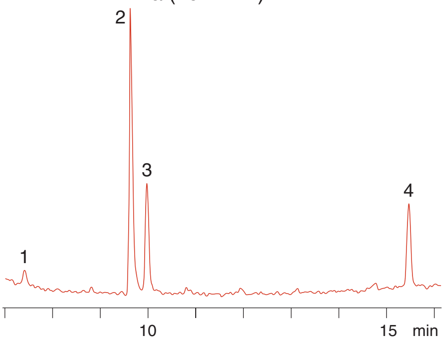
Environmental pollutants

Analysis of acaricides and fungicides for peel-treatment

MN Appl. No. 210210

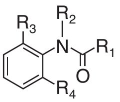
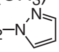
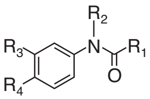
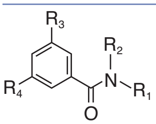
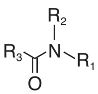
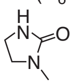
Column: OPTIMA® δ-3, 30 m x 0.25 mm ID, 0.25 μm film, REF 726420.30, max. temperature 340/360 °C
Injection: 1.0 μl, 250 °C, 1 min splitless, then 1:25
Carrier gas: He
Pressure: 26.5 kPa (1 min) $\xrightarrow{7\ kPa/min}$ 42.9 kPa $\xrightarrow{1.1\ kPa/min}$ 71 kPa (20.2 min)
Temperature: 80 °C (1 min) $\xrightarrow{30\ °C/min}$ 150 °C $\xrightarrow{4.8\ °C/min}$ 280 °C (20 min)
Detector: MSD

Peaks:
1. Mecarbam
2. Imazalil
3. Chlorfenson
4. Tetradifon



Courtesy of K. Friedrichs,
Chem. Untersuchungsamt, Bielefeld, Germany

Pesticide structures: carboxylic acid amides

Structure	Compound	R_1	R_2	R_3	R_4
	Acetochlor	CH_2Cl	CH_2–OC_2H_5	CH_3	C_2H_5
	Alachlor	CH_2Cl	CH_2–OCH_3	C_2H_5	C_2H_5
	Butachlor	CH_2Cl	CH_2–O–*n*-C_4H_9	C_2H_5	C_2H_5
	Fenfuram	*o*-methylfuranyl	H	H	H
	Metalaxyl	CH_2–OCH_3	$CH(CH_3)$–CO–OCH_3	CH_3	CH_3
	Metazachlor	CH_2Cl	CH_2– 	CH_3	CH_3
	Methfuroxam	trimethylfuranyl	H	H	H
	Metolachlor	CH_2Cl	$CH(CH_3)$–CH_2–OCH_3	CH_3	C_2H_5
	Ofurace	CH_2Cl	γ-butyrolactone	CH_3	CH_3
	Propachlor	CH_2Cl	$CH(CH_3)_2$	H	H
	Chlorpropham	O–*i*-C_3H_7	H	Cl	H
	Flamprop	C_6H_5	$CH(CH_3)$–COOH	Cl	F
	Pentanochlor	$CH(CH_3)$–*i*-C_3H_7	H	Cl	CH_3
	Propanil	C_2H_5	H	Cl	Cl
	Propham	O–*i*-C_3H_7	H	H	H
	Diethyltoluamide	C_2H_5	C_2H_5	CH_3	H
	Propyzamide	$C(CH_3)_2$–C≡CH	H	Cl	Cl
	Diphenamid	CH_3	CH_3	$CH(C_6H_5)_2$	
	Isocarbamid	CH_2– $CH(CH_3)_2$	H		
	Napropamide	C_2H_5	C_2H_5	$CH(CH_3)$–O–1-naphthyl	

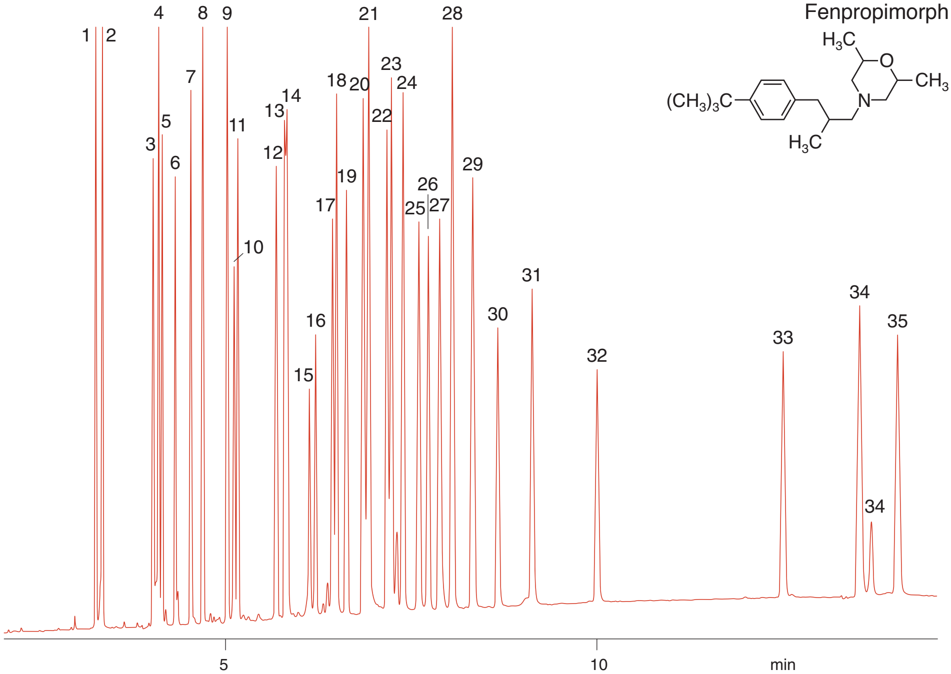
Analysis of fungicides

MN Appl. No. 200910

Column: OPTIMA® 1, 25 m x 0.32 mm ID, 0.25 µm film, REF 726302.25, max. temperature 340/360 °C
Injection: 1 µl on column
Carrier gas: 50 kPa H_2
Temperature: 80 °C $\xrightarrow{40\ °C/min}$ 200 °C $\xrightarrow{6\ °C/min}$ 280 °C
Detector: PND 300 °C

Peaks: [ng]

1. Etridiazole [2]
2. Prothiocarb [2.5]
3. Diphenylamine [2]
4. Azobenzene [2]
5. Cycloate [2.5]
6. Ethalfluralin [2]
7. Dicloran [2.5]
8. Ethoxyquin [5]
9. Benzo[h]quinoline [2]
10. Fenfuram [2.5]
11. Fluchloralin [2.5]
12. Vinclozolin [5]
13. Alachlor [5]
14. Metalaxyl [5]
15. Dichlofluanid [2]
16. Thiobencarb [2.5]
17. Methfuroxam [4]
18. Triadimefon [2]
19. Fenpropimorph [5]
20. Thiabendazole [2.5]
21. Penconazole [2]
22. Triadimenol [2.5]
23. Quinomethionate [2.5]
24. Triflumizole [2.5]
25. Flutriafol [2]
26. Flurodifen [5]
27. Hexaconazole [2]
28. Myclobutanil [2]
29. Diclobutrazol [2]
30. Thioquinox [2]
31. Ofurace [5]
32. Nuarimol [2]
33. Fenarimol [2.5]
34. Bitertanol [2.5]
35. Prochloraz [2]



Courtesy of Mr. Lembacher, Hipp-Nährmittel, Pfaffenhofen, Germany

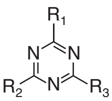
Analysis of herbicides

MN Appl. No. 200770

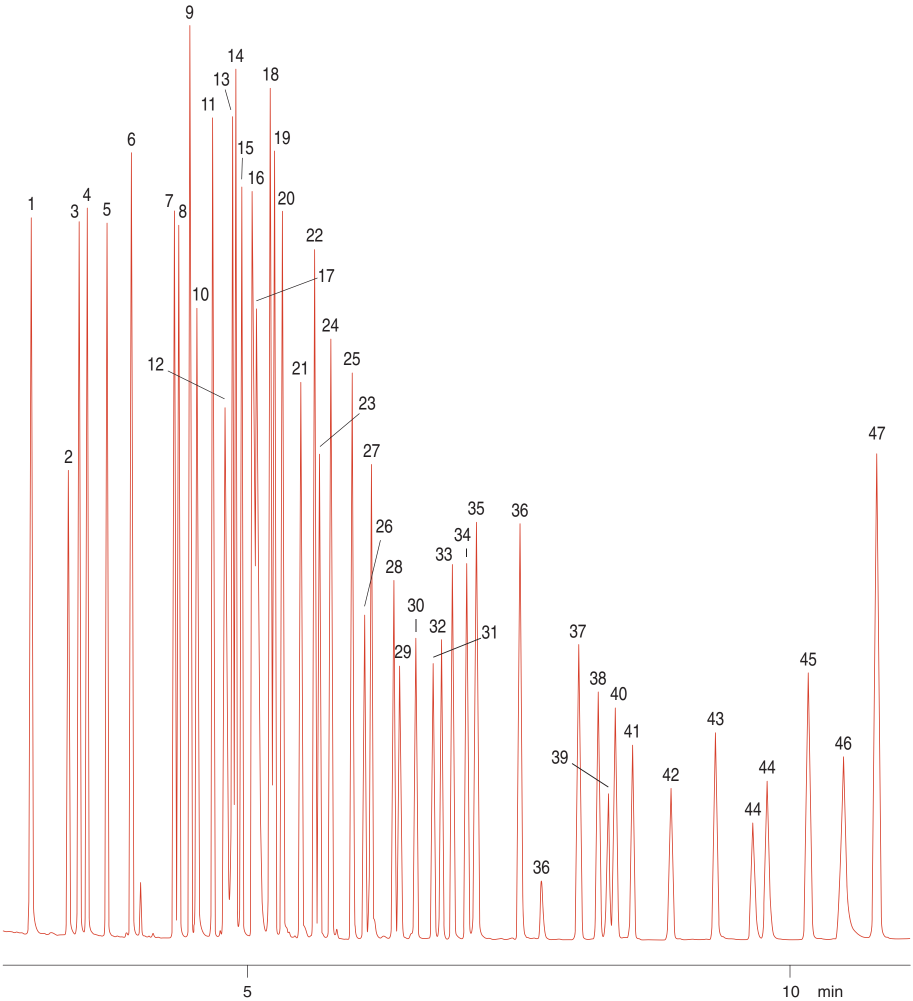
Column: OPTIMA® 1301, 25 m x 0.32 mm ID, 0.25 μm film, REF 726777.25, max. temperature 300/320 °C
Injection: 0.5 μl, splitless, 280 °C
Carrier gas: 50 kPa H_2
Temperature: 80 $\xrightarrow{30\ °C/min}$ 200 °C $\xrightarrow{4\ °C/min}$ 270 °C
Detector: PND 310 °C

Peaks: [ng]
1. EPTC [5]
2. Butylate [5]
3. Vernolate [5]
4. Pebulate [5]
5. Propham [5]
6. Molinate [5]
7. Azobenzene [2.5]
8. Cycloate [5]
9. Diphenylamine [5]
10. Ethalfluralin [5]
11. Terbumeton desethyl [5]
12. Desethyldesisopropylatrazine [1.25]
13. Desisopropylatrazine [1.25]
14. Desethylatrazine [1.25]
15. Terbuthylazine desethyl [1.25]
16. Atraton [2.5]
17. Prometon [2.5]
18. Trietazine [1.25]
19. Atrazine [1.25])
20. Sebuthylazine desethyl [1.25]
21. Isocarbamid [2.5]
22. Fluchloralin [5]
23. Sebuthylazine [1.25]
24. Desmetryn [1.25]
25. Simetryn [1.25]
26. Metalaxyl [5]
27. Terbutryn [1.25]
28. Isomethiozin [1.25]
29. Metolachlor [5]
30. Propanil [5]
31. Pentanochlor [5]
32. Isopropalin [2.5]
33. Dimethametryn [1.25]
34. Metazachlor [2.5]
35. Bromacil [5]
36. Triadimenol [5]
37. Oxadiazon [5]
38. Methoprotryn [1.25]
39. Fluazifop-butyl [5]
40. Thioquinox [2.5]
41. Fluorodifen [5]
42. Flamprop-isopropyl [5]
43. Metamitron [2.5]
44. Propiconazole [5]
45. Fluotrimazole [5]
46. Lenacil [5]
47. Hexazinone [5]

Pesticide structures: triazines



Compound	R_1	R_2	R_3
Atrazine	Cl	NH–C_2H_5	NH–$CH(CH_3)_2$
Cyanazine	Cl	NH–C_2H_5	NH–$C(CH_3)_2$–CN
Propazine	Cl	NH–$CH(CH_3)_2$	NH–$CH(CH_3)_2$
Sebuthylazine	Cl	NH–C_2H_5	NH–$(CH_2)_3$–CH_3
Simazin	Cl	NH–C_2H_5	NH–C_2H_5
Terbuthylazine	Cl	NH–C_2H_5	NH–$C(CH_3)_3$
Trietazine	Cl	NH–C_2H_5	$N(C_2H_5)_2$
Anilanzine	Cl	Cl	NH–(*o*-Cl-C_6H_4)
Atratone	O–CH_3	NH–C_2H_5	NH–$CH(CH_3)_2$
Prometon	O–CH_3	NH–$CH(CH_3)_2$	NH–$CH(CH_3)_2$
Secbumeton	O–CH_3	NH–C_2H_5	NH–$CH(CH_3)$–C_2H_5
Terbumeton	O–CH_3	NH–C_2H_5	NH–$C(CH_3)_3$
Ametryn	S–CH_3	NH–C_2H_5	NH–$CH(CH_3)_2$
Desmetryn	S–CH_3	NH–CH_3	NH–$CH(CH_3)_2$
Dimethametryn	S–CH_3	NH–C_2H_5	NH–$CH(CH_3)$–$CH(CH_3)_2$
Methoprotryn	S–CH_3	NH–$CH(CH_3)_2$	NH–$(CH_2)_3$–OCH_3
Prometryn	S–CH_3	NH–$CH(CH_3)_2$	NH–$CH(CH_3)_2$
Simetryn	S–CH_3	NH–C_2H_5	NH–C_2H_5
Terbutryn	S–CH_3	NH–C_2H_5	NH–$C(CH_3)_3$



Courtesy of Mr. Lembacher, Hipp Nährmittel, Pfaffenhofen, Germany

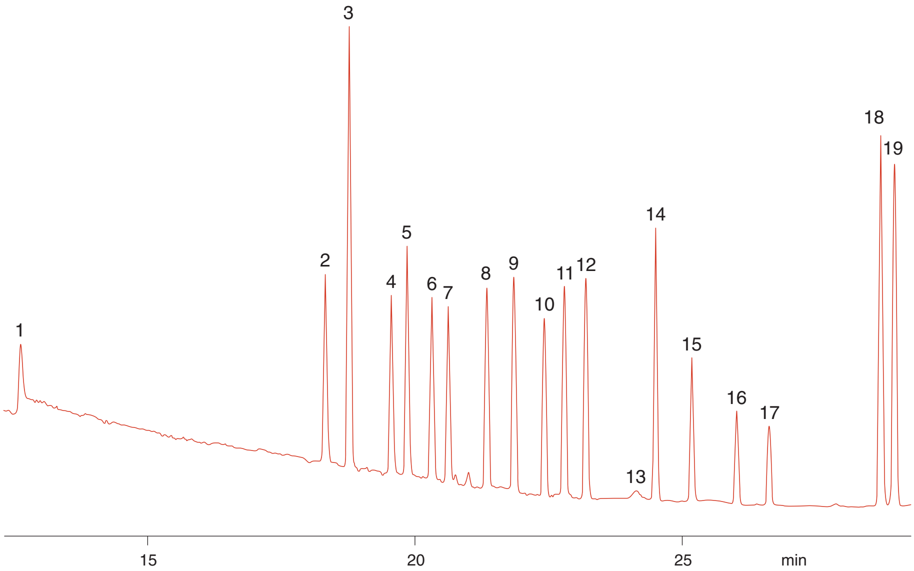
Analysis of triazine herbicides

MN Appl. No. 200820

Column: PERMABOND® FFAP, 25 m x 0.25 mm ID, 0.1 μm film, REF 723936.25, max. temperature 220/240 °C
Injection: 2.5 μl, 1 min splitless, then split 1:50
Carrier gas: 250 kPa He
Temperature: 100 °C $\xrightarrow{5\ °C/min}$ 240 °C
Detector: PND 250 °C

Peaks: [ng/ml]

1. Azobenzene [4768]
2. Prometon [716]
3. Terbumeton [1646]
4. Atraton [740]
5. Propazine [820]
6. Terbuthylazine [780]
7. Secbumeton [748]
8. Atrazine [828]
9. Prometryn [792]
10. Terbutryn [784]
11. Simazin [856]
12. Ametryn [764]
13. Cyanazine [728]
14. Simetryn [836]
15. Desethylatrazine [872]
16. Metribuzin [744]
17. Desisopropylatrazine [784]
18. Anilazine [3488]
19. Methoprotryn [1544]



Courtesy of J. Heering, Diplomarbeit FH Köln, Germany

Analysis of triazine herbicides

MN Appl. No. 210410

Column: OPTIMA® 5 Amine, 25 m x 0.20 mm ID, 0.35 µm film, REF 726355.25, max. temperature 300/320 °C

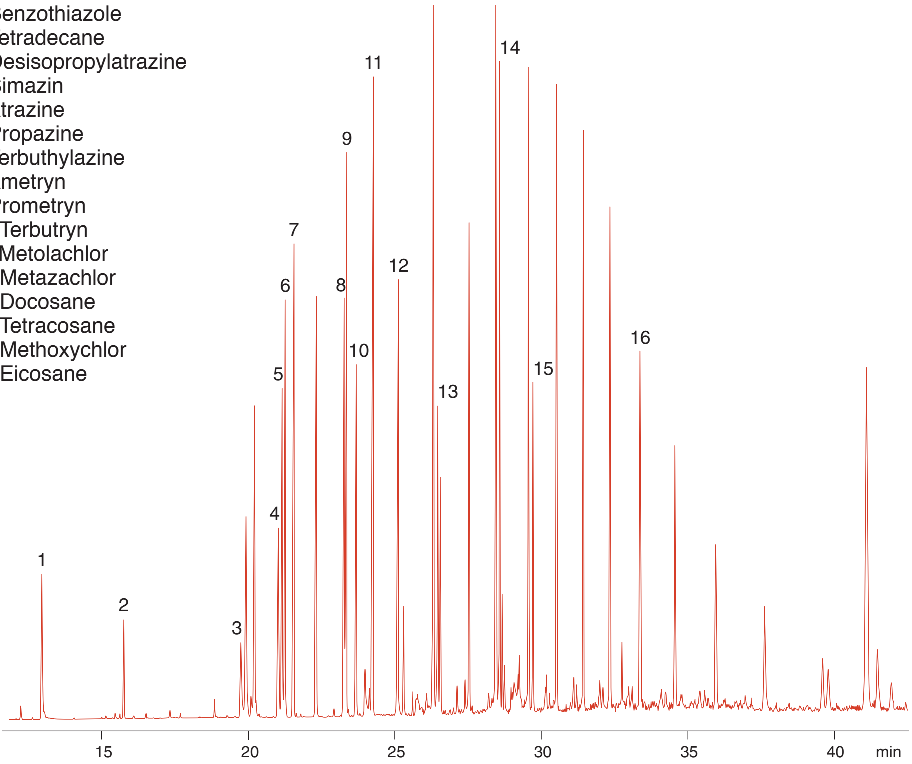
Carriergas: 24 cm/s He

Temperature: 70 °C (3 min) $\xrightarrow{8\ °C/min}$ 300 °C

Detector: MSD

Peaks:

1. Benzothiazole
2. Tetradecane
3. Desisopropylatrazine
4. Simazin
5. Atrazine
6. Propazine
7. Terbuthylazine
8. Ametryn
9. Prometryn
10. Terbutryn
11. Metolachlor
12. Metazachlor
13. Docosane
14. Tetracosane
15. Methoxychlor
16. Eicosane



Environmental pollutants

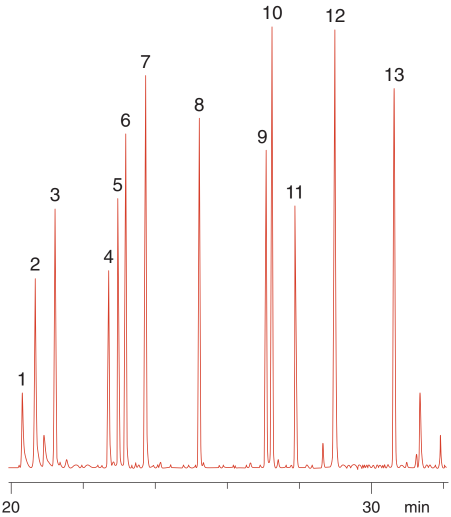
Analysis of triazines

MN App. No. 250210

Column:	OPTIMA® 5 MS, 50 m x 0.25 mm ID, 0.25 μm film, REF 726220.50, max. temperature 340/360 °C
Injection:	splitless
Carrier gas:	25 cm/s He
Temperature:	120 °C (1 min) —4 °C/min→ 280 °C
Detector:	MSD

Peaks: [ppm]

1. Desisopropylatrazine [10.0]
2. Desethylatrazine [11.4]
3. Desethylterbuthylazine [10.9]
4. Simazin [9.8]
5. Atrazine [10.2]
6. Propazine [10.8]
7. Terbuthylazine [12.2]
8. Sebuthylazine [12.1]
9. Ametryn [9.7]
10. Prometryn [12.1]
11. Terbutryn [9.3]
12. Metolachlor [14.8]
13. Metazachlor [12.6]



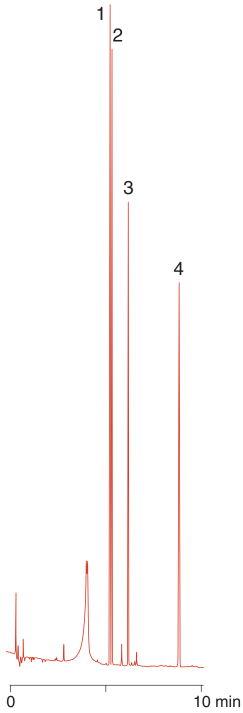
Analysis of dinitroanilline herbicides (EPA 627)

MN Appl. No. 200740

Column:	OPTIMA® 1301, 25 m x 0.32 mm ID, 0.25 μm film, REF 726777.25, max. temperature 300/320 °C
Injection:	0.5 μl on column, 100 pg each
Carrier gas:	50 kPa H_2
Temperature:	80 °C —30 °C/min→ 200 °C —4 °C/min→ 270 °C
Detector:	ECD 310 °C

Peaks:

1. Trifluralin
2. Ethalfluralin
3. Profluralin
4. Isopropalin



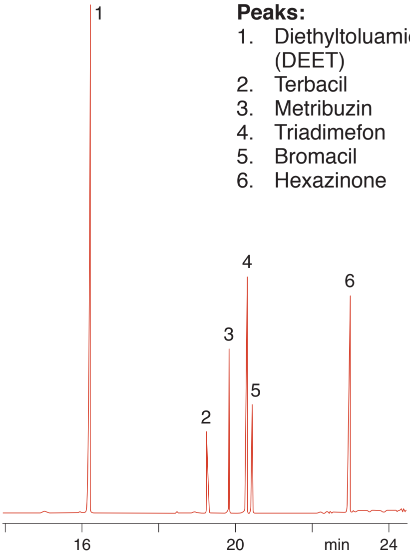
Courtesy of Mr. Lembacher, Hipp Nährmittel, Pfaffenhofen, Germany

Analysis of organo-nitrogen pesticides (EPA 633)

MN Appl. No. 250110

Column:	OPTIMA® δ-3, 50 m x 0.25 mm ID, 0.25 μm film, REF 726420.50, max. temperature 340/360 °C
Injection:	1.0 μl, 3 s splitless
Carrier gas:	1.3 bar He
Temperature:	50 °C $\xrightarrow{10\ °C/min}$ 220 °C $\xrightarrow{20\ °C/min}$ 320 °C
Detector:	MSD

Peaks:
1. Diethyltoluamide (DEET)
2. Terbacil
3. Metribuzin
4. Triadimefon
5. Bromacil
6. Hexazinone

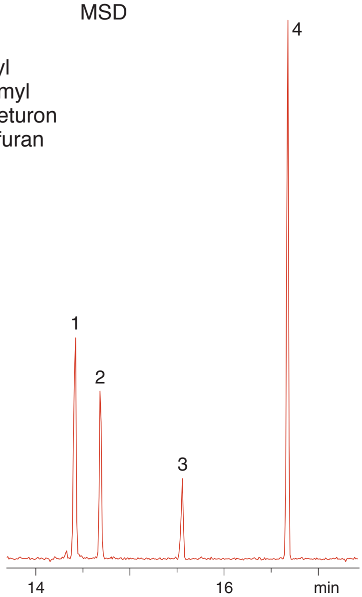


Analysis of carbamate/urea pesticides (EPA 632)

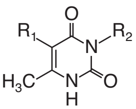
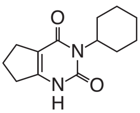
MN Appl. No. 200860

Column:	OPTIMA® 5, 25 m x 0.20 mm ID, 0.20 μm film, REF 726857.25, max. temperature 340/360 °C
Injection:	1.0 μl carbamate/urea pesticides (EPA 632), 10 μg/ml each in MeOH, 3 s splitless
Carrier gas:	25 cm/s He
Temperature:	50 °C (5 min) $\xrightarrow{10\ °C/min}$ 220 °C $\xrightarrow{20\ °C/min}$ 330 °C
Detector:	MSD

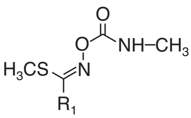
Peaks:
1. Oxamyl
2. Methomyl
3. Fluometuron
4. Carbofuran



Pesticide structures: uracil derivatives

Structure	Compound	R_1	R_2
	Bromacil	Br	$CH(CH_3)–C_2H_5$
	Terbacil	Cl	$C(CH_3)_3$
	Lenacil	–	–

Pesticide structures: oxime carbamates

Structure	Compound	R_1
	Methomyl	CH_3
	Oxamyl	$CO – N(CH_3)_2$

Analysis of phenoxycarboxylic acid herbicides

MN Appl. No. 201060

Column: OPTIMA® 1301, 25 m x 0.32 mm ID, 0.25 μm film, REF 726777.25, max. temperature 300/320 °C

Injection: 0.5 μl on column

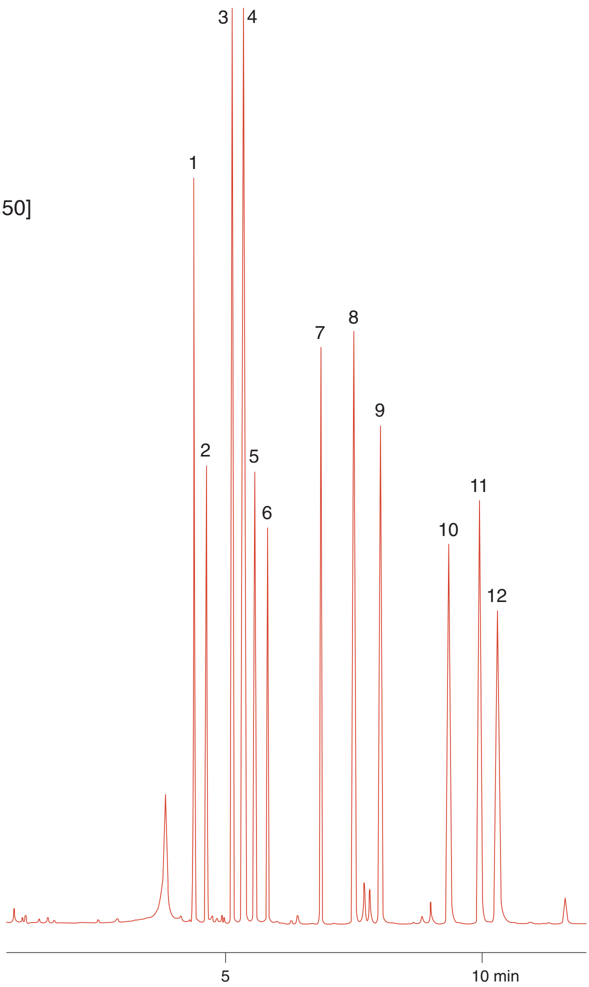
Carrier gas: 70 kPa H_2

Temperature: 80 $\xrightarrow{30\ °C/min}$ 220 °C $\xrightarrow{4\ °C/min}$ 270 °C

Detector: ECD 310 °C

Peaks: [ng]

1. Chlorfenprop-methyl [0.25]
2. 2,4-D methyl ester [0.25]
3. 2,4,5-TP methyl ester [0.125]
4. 2,4,5-T methyl ester [0.125]
5. 2,4-D isobutyl ester [0.25]
6. 2,4-D 1-butyl ester [0.25]
7. Alodan (int. std.)[0.05]
8. Dichlorprop 2-ethyl 1-hexyl ester [0.50]
9. 2,4-D isooctyl ester [0.50]
10. 2,4,5-T isooctyl ester [0.125]
11. Dichlorprop methyl ester [0.50]
12. 2,4,5-T octyl ester [0.50]



Courtesy of Mr. Lembacher, Hipp Nährmittel, Pfaffenhofen, Germany

Phenoxycarboxylic acid pesticides

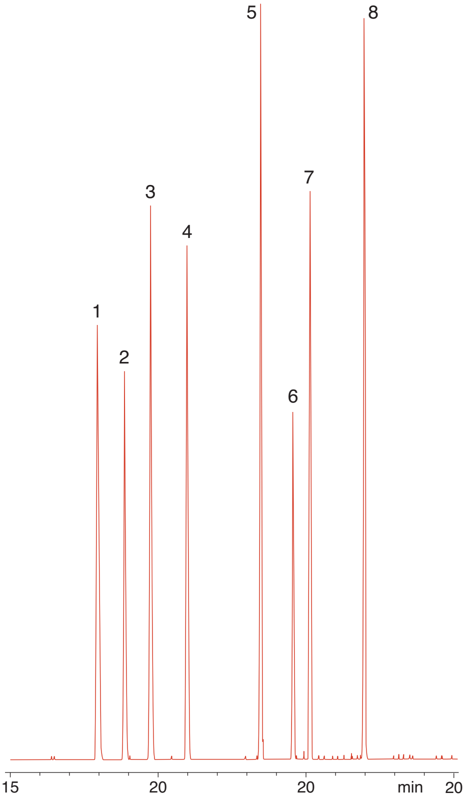
Analysis of phenoxycarboxylic acid herbicides (DIN 38407-14)

MN Appl. No. 213280

Column:	OPTIMA® 35 MS, 30 m x 0.25 mm ID, 0.25 µm film, REF 726154.30, max. temperature 360/370 °C
Injection:	2 µl, 280 °C, analytes derivatised with TMSH split 10 ml/min
Carrier gas:	1 bar He
Temperature:	145 °C $\xrightarrow{3\ °C/min}$ 220 °C
Detector:	MSD

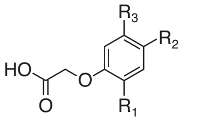
Peaks: methyl esters of

1. Mecoprop
2. MCPA
3. Dichlorprop
4. 2,4-D
5. Fenoprop
6. MCPB
7. 2,4,5-T
8. 2,4-DB



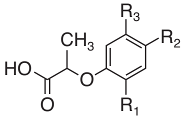
Pesticide structures: phenoxycarboxylic acids

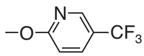
Compound	R_1	R_2	R_3
Phenoxyacetic acid derivatives			



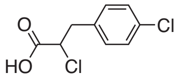
Compound	R_1	R_2	R_3
2,4-D	Cl	Cl	H
2,4,5-T	Cl	Cl	Cl
MCPA	CH_3	Cl	H

Phenoxypropionic acid derivatives

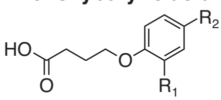


Compound	R_1	R_2	R_3
2,4-DP = Dichlorprop	Cl	Cl	H
2,4,5-TP = Fenoprop	Cl	Cl	Cl
MCPP = Mecoprop	CH_3	Cl	H
Fluazifop	H		H

Chlorfenprop



Phenoxybutyric acid derivatives



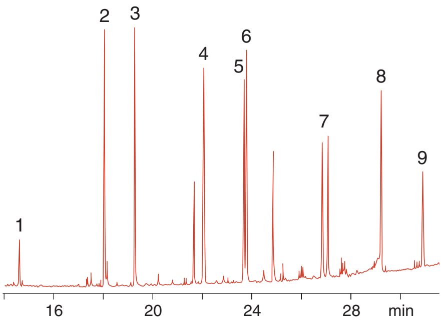
Compound	R_1	R_2	R_3
2,4-DB	Cl	Cl	–
MCPB	CH_3	Cl	–

Environmental pollutants

Analysis of a pesticide mixture
MN Appl. No. 210680

Column:	OPTIMA® δ-3, 50 m x 0.20 mm ID, 0.20 μm film, REF 726400.50, max. temperature 340/360 °C
Injection:	2 μl, 8 ng/μl, splitless, KAS 60 °C $\xrightarrow{12\ °C/s}$ 250 °C (2 min)
Carrier gas:	50 ml/min He, 35 psi
Temperature:	100 °C (12 min) $\xrightarrow{15\ °C/min}$ 220 °C (1 min) $\xrightarrow{5\ °C/min}$ 340 °C (10 min)
Detector:	MSD

Peaks:
1. Acephate
2. Pirimicarb
3. Metalaxyl
4. Metazachlor
5. α-Endosulfan
6. Profenofos
7. Propiconazole
8. Methoxychlor
9. Phosalone

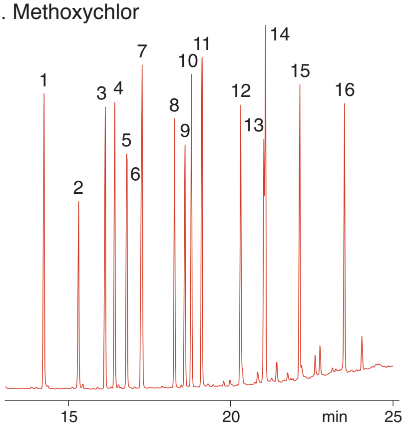


Courtesy of Mr. Heinzler, Staatl. Medizinal-, Lebensmittel- und Veterinär-Untersuchungsamt, Kassel, Germany

Analysis of organochlorine pesticides
MN Appl. No. 210840

Column:	OPTIMA® δ-6, 30 m x 0.25 mm ID, 0.25 μm film, REF 726470.30, max. temperature 340/360 °C
Injection:	10 μg/ml in acetone
Carrier gas:	H_2
Temperature:	60 °C (2 min) $\xrightarrow{30\ °C/min}$ 150 °C $\xrightarrow{8\ °C/min}$ 300 °C (6 min)
Detector:	MSD (ion trap)

Peaks:
1. α-BHC
2. Quintozene
3. β-BHC
4. Heptachlor
5. δ-BHC
6. Chlorothalonil
7. Aldrin
8. Isodrin
9. *cis*-Heptachlor epoxide
10. *trans*-Heptachlor epoxide
11. *p,p'*-DDE
12. Dieldrin
13. Endrin
14. *o,p'*-DDT
15. *p,p'*-DDT
16. Methoxychlor



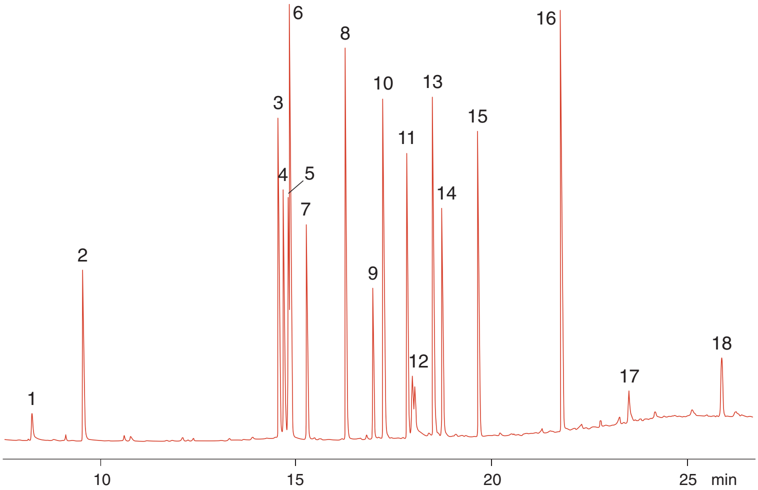
Courtesy of Mrs. Geilen, Berg. Wasser- u. Umweltlabor, Wuppertal Germany

Column and conditions as in application 210840

MN Appl. No. 210830

Plant-protective pesticides

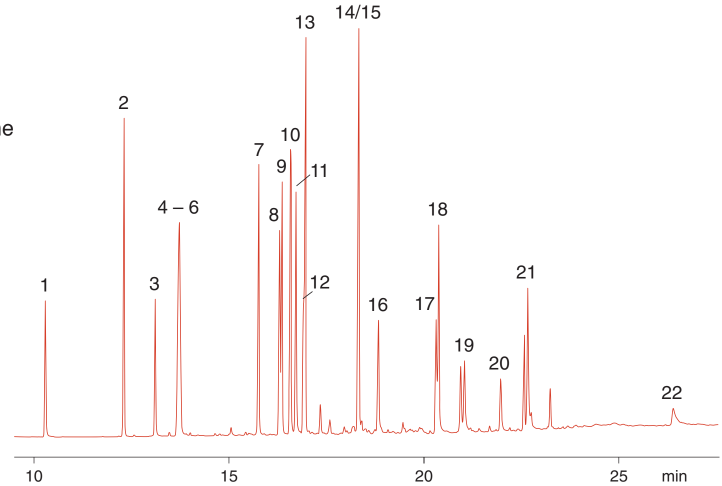
Peaks:
1. Carbofuran
2. Dichlobenil
3. Propazine
4. Atrazine
5. Simazin
6. Terbuthylazine
7. γ-BHC
8. Alachlor
9. Parathion-methyl
10. Metolachlor
11. Parathion-ethyl
12. Bromacil
13. Chlorfenvinphos
14. Metazachlor
15. α-Endosulfan
16. β-Endosulfan
17. Chloridazon
18. Azinphos-ethyl



MN Appl. No. 210850

Organonitrogen pesticides

Peaks:
1. Propham
2. Trifluralin
3. Chlorpropham
4. Desethylatrazine
5. Desethylterbuthylazine
6. Desisopropylatrazine
7. Sebuthylazine
8. Vinclozolin
9. Desmetryn
10. Prometryn
11. Ametryn
12. Metribuzin
13. Terbutryn
14. Cyanazine
15. Pendimethalin
16. Triadimenol
17. Flusilazole
18. Methoprotryn
19. Cyproconazole
20. Metamitron
21. Tebuconazole
22. Prochloraz



Courtesy of Mrs. Geilen, Berg. Wasser- u. Umweltlabor, Wuppertal Germany

Environmental pollutants

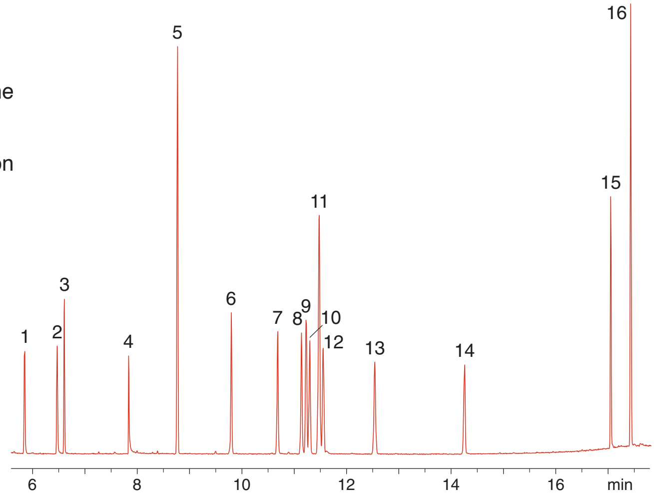
Separation of pesticides and aromatic hydrocarbons (EPA 526 mix)

MN Appl. No. 212820

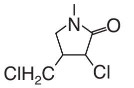
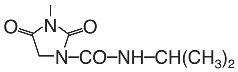
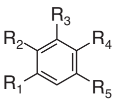
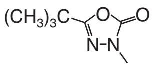
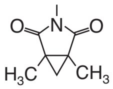
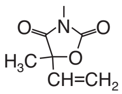
Column: OPTIMA® 5 MS Accent, 30 m x 0.25 mm ID, 0.25 µm film, REF 725820.30, max. temperature 340/360 °C
Sample: EPA method 526 mix, 10 ppm (20 ppm internal standard)
Injection: 1 µl splitless, hold 0.3 min, 300 °C
Carrier gas: 0.8 ml/min He
Temperature: 50 °C (1 min) —20 °C/min→ 200 °C (5 min) —30 °C/min→ 310 °C (3 min)
Detector: MSD 280 °C

Peaks:

1. Nitrobenzene
2. 2,4-Dichlorophenol
3. 1,3-Dimethyl-2-nitrobenzene
4. 2,4,6-Trichlorophenol
5. Acenaphthene-d_{10} (int. st.)
6. Azobenzene (decomposition product of 1,2-diphenyl-hydrazine)
7. Prometon
8. Terbufos
9. Diazinon
10. Fonofos
11. Phenanthrene-d_{10} (int. st.)
12. Disulfoton
13. Acetochlor
14. Cyanazine
15. Triphenyl phosphate
16. Chrysene-d_{12}



Pesticide structures: miscellaneous heterocyclic aromatic compounds

Structure	Compound	R_1	R_2	R_3	R_4	R_5
	Fluorochloridone		H	CF_3	H	H
	Iprodione		H	Cl	H	Cl
	Oxadiazon		Cl	H	Cl	$O\text{-}CH(CH_3)_2$
	Procymidone		H	Cl	H	Cl
	Vinclozolin		H	Cl	H	Cl

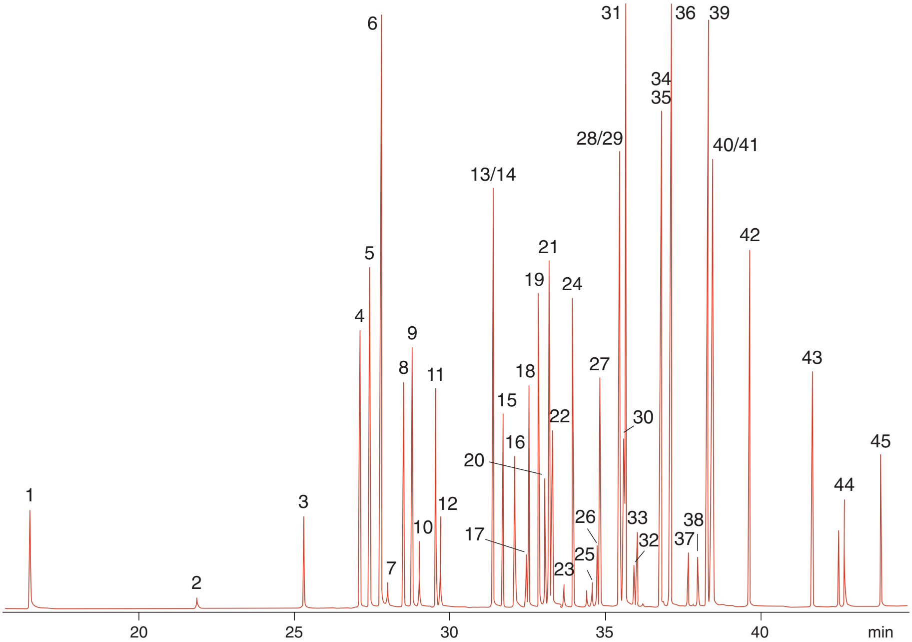
On-column analysis of a pesticide mixture

MN Appl. No. 210430

Column: OPTIMA® 5, 50 m x 0.25 mm ID, 0.25 μm film, REF 726056.50, max. temperature 340/360 °C
Retention gap: Me-Sil deactivated, 1.6 m x 0.25 mm ID, REF 723706.10 (10 m)
Injection: 2 μl on column
Flow: 0.8 bar → 2.0 bar, 0.025 bar/min
Temperature: 60 °C (1 min) $\xrightarrow{5\ °C/min}$ 270 °C $\xrightarrow{20\ °C/min}$ 310 °C (8 min)
Detector: MSD

Peaks:

1. Dichlorvos
2. Trichlorfon
3. Tecnazene
4. Sulfotep
5. α-BHC
6. HCB
7. Dimethoate
8. β-BHC
9. γ-BHC
10. Quintozene
11. Diazinon
12. Disulfoton
13. Chlorpyrifos-methyl
14. Parathion-methyl
15. Demeton-S-methylsulfon
16. Heptachlor
17. Fenitrothion
18. Pirimiphos-methyl
19. Malathion
20. Aldrin
21. Fenthion
22. Chlorpyrifos-ethyl
23. Chlorthion
24. Bromophos-methyl
25. *trans*-Heptachlor epoxide
26. *cis*-Heptachlor epoxide
27. Chlorfenvinphos
28. Methidathion
29. *trans*-Chlordane
30. Bromophos-ethyl
31. *o,p'*-DDE
32. α-Endosulfan
33. *cis*-Chlordane
34. *p,p'*-DDE
35. Dieldrin
36. *o,p'*-DDD
37. Endrin
38. β-Endosulfan
39. *p,p'*-DDD
40. *o,p'*-DDT
41. Ethion
42. *p,p'*-DDT
43. Methoxychlor
44. Azinphos-methyl
45. Azinphos-ethyl



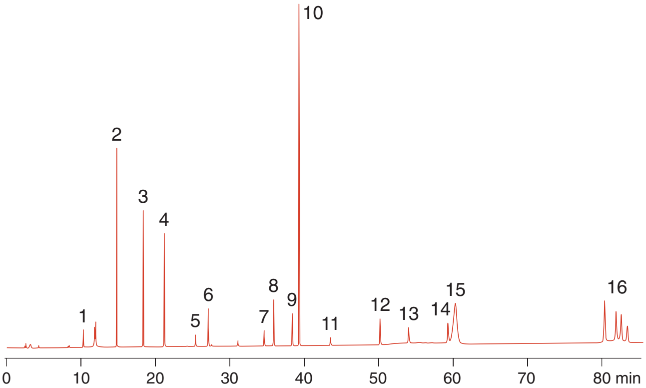
Environmental pollutants

Analysis of pesticide mixtures

Column: OPTIMA® 1301, 60 m x 0.25 mm ID, 0.25 µm film, REF 726771.60, max. temperature 300/320 °C
Injection: 3 µl, 0.1 ng/µl, 80 °C (1 min) → 250 °C (1 min), pulsed splitless
Carrier gas: 54 ml/min He
Temperature: 80 °C (2 min) $\xrightarrow{20\ °C/min}$ 190 °C (12 min) $\xrightarrow{2\ °C/min}$ 240 °C (23 min) $\xrightarrow{10\ °C/min}$ 260 °C (20 min)
Detector: ECD

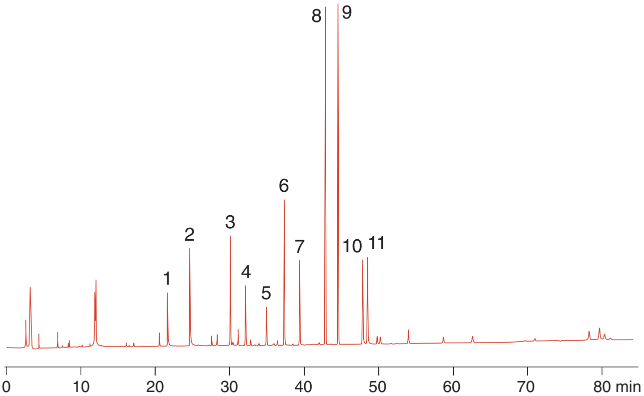
MN Appl. No. 210630

Peaks:
1. Phosphamidon
2. Tecnazene
3. α-BHC
4. Lindane
5. Chlorothalonil
6. Fenchlorphos
7. Metazachlor
8. Bromophos-ethyl
9. Prothiophos
10. Dieldrin + profenofos
11. o,p'-DDT
12. Nuarimol
13. Bromopropylate
14. Bifenox
15. Tetradifon
16. – 19. Cypermethrin, 4 stereoisomers



MN Appl. No. 210640

Peaks:
1. Dimethoate
2. Propyzamide
3. Demeton-S-methyl + chlorpyrifos-ethyl
4. Parathion-ethyl
5. Quinalphos + penconazole
6. Procymidone + methidathion
7. Dieldrin + profenofos
8. Myclobutanil
9. PCB-128 + β-endosulfan + ethion
10. PCB-153
11. Propiconazole



Courtesy of Mrs. Goda, Lebensmitteluntersuchungsamt, Braunschweig, Germany

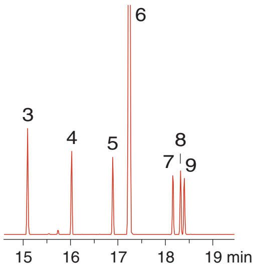
Analysis of a pesticide mixture

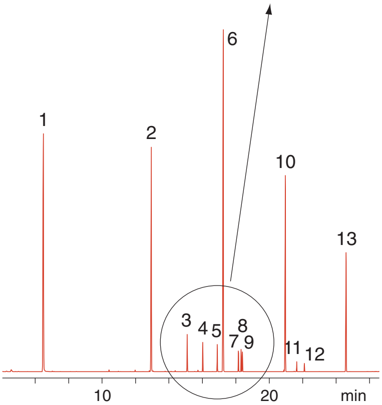
Sample:	pesticide standard of Kantonal Laboratory Schaffhausen (Switzerland) 0.1 mg/ml or 0.01 mg/ml each
Injection:	1.0 µl, 3 s splitless
Carrier gas:	25 cm/s He
Temperature:	100 °C (3 min) → 8 °C/min → 250 °C → 10 °C/min → 320 °C
Detector:	MSD

MN Appl. No. 200920

Column: OPTIMA® 5, 25 m x 0.20 mm ID, 0.20 µm film, REF 726857.25, max. temperature 340/360 °C

Peaks:
1. Dichlorvos
2. Naled
3. Chlorothalonil
4. Vinclozolin
5. Dichlofluanid
6. Chlorpyrifos
7. Captan
8. Folpet
9. Procymidone
10. Carbophenothion
11. Captafol
12. Iprodione
13. Coumaphos

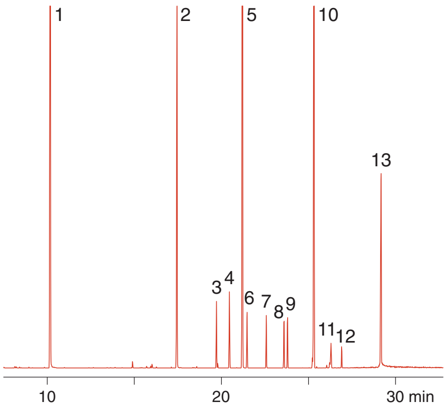




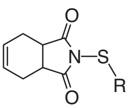
MN Appl. No. 200930

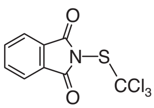
Column: OPTIMA® 17, 25 m x 0.20 mm ID, 0.20 µm film, REF 726065.25, max. temperature: 320/340 °C

Peaks:
1. Dichlorvos
2. Naled
3. Vinclozolin
4. Chlorothalonil
5. Chlorpyrifos
6. Dichlofluanid
7. Procymidone
8. Captan
9. Folpet
10. Carbophenothion
11. Iprodione
12. Captafol
13. Coumaphos



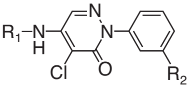
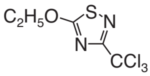
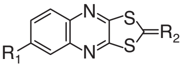
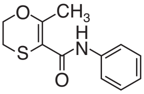
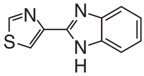
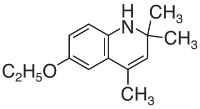
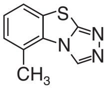
Pesticide structures: phthalimide derivatives

Structure	Compound	R
	Captan Captafol	CCl_3 $CCl_2–CCl_2H$

Structure	Compound
	Folpet

Environmental pollutants

Miscellaneous pesticide structures

Structure	Compound	R_1	R_2	Structure	Compound
	Chloridazon	H	H		Etridiazole
	Norflurazon	CH_3	CF_3		
	Quinomethionat	CH_3	O		Fluridone
	Thioquinox	H	S		
	Carboxin	–	–		Thiabendazole
	Ethoxyquin	–	–		Tricyclazole

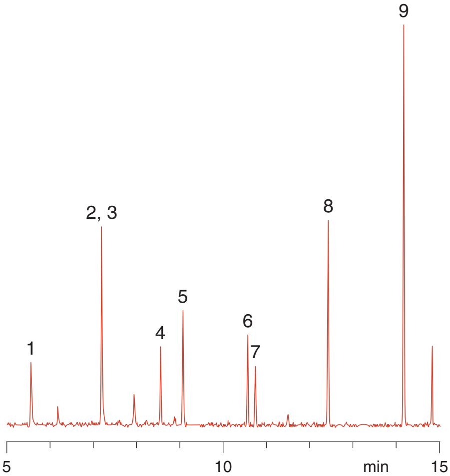
Analysis of halogenated acetic acids (EPA 552.2)

MN Appl. No. 213210

Column: OPTIMA® 35 MS, 30 m x 0.25 mm ID, 0.25 μm film, REF 726154.30, max. temperature 360/370 °C
Injection: 1 μl, split 1:20
Carrier gas: 1 ml/min He
Temperature: 50 °C (3 min) $\xrightarrow{10\ °C/min}$ 200 °C (10 min)
Detector: MSD

Peaks:

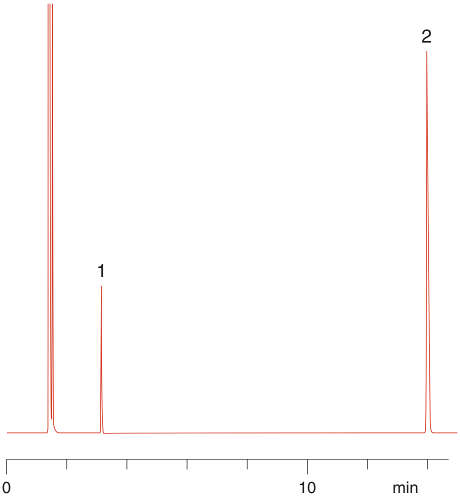
1. Chloroacetic acid methyl ester
2. Dichloroacetic acid methyl ester
3. Bromoacetic acid methyl ester
4. Trichloroacetic acid methyl ester
5. Bromochloroacetic acid methyl ester
6. Bromodichloroacetic acid methyl ester
7. Dibromoacetic acid methyl ester
8. Dibromochloroacetic acid methyl ester
9. Tribromoacetic acid methyl ester



Analysis of acetic acid and trifluoroacetic acid
MN Appl. No. 213250

Column: OPTIMA® FFAP, 25 m x 0.25 mm ID, 0.25 μm film, REF 726116.25, max. temperature 250/260 °C
Injection: 1 μl, split 1:40
Carrier gas: 0.95 bar He
Temperature: 40 °C (5 min) → 10 °C/min → 120 °C
Detector: FID 250 °C

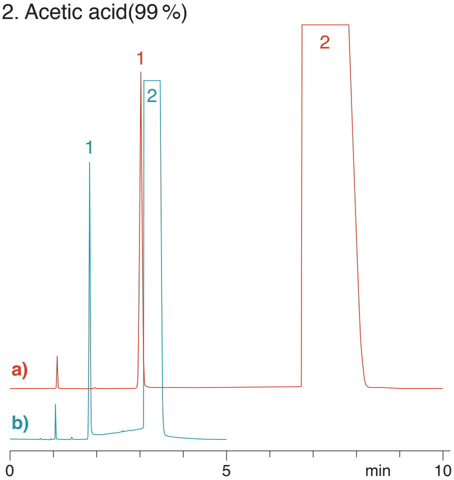
Peaks:
1. Trifluoroacetic acid (TFA)
2. Acetic acid



Analysis of acetic acid and acetic acid anhydride
MN Appl. No. 250620

Column: PERMABOND® FFAP, 25 m x 0.53 mm ID, 1.0 μm film, REF 723555.25, max. temperature 200/220 °C
Injection: 0.6 μl, split 1:100
Carrier gas: 0.4 bar He
Temperature: a) 100 °C, b) 130 °C
Detector: FID 200 °C

Peaks:
1. Acetic acid anhydride (1 %)
2. Acetic acid(99 %)



Although retention times are drastically decreased at higher temperatures, the title compounds are still perfectly separated at 130 °C with an even better peak shape.

Solvents
Chemicals

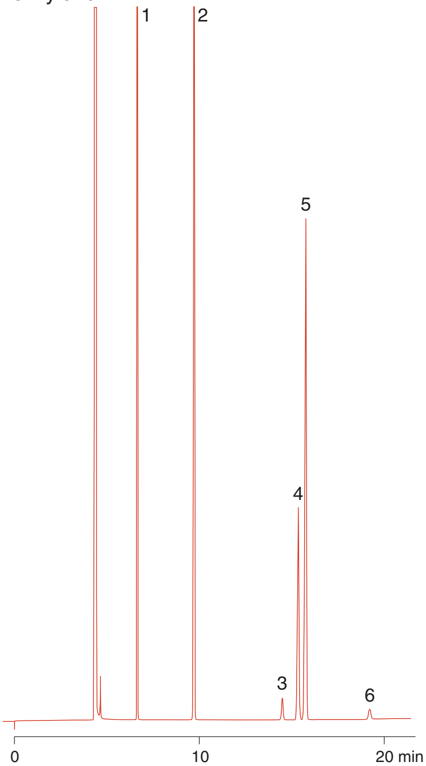
Analysis of aromatic hydrocarbons (BTX)

MN Appl. No. 200230

Column:	OPTIMA® 210, 50 m x 0.25 mm ID, 0.5 µm film, REF 726874.50, max. temperature 260/280 °C
Injection:	0.5 µl, split 105 ml/min
Carrier gas:	130 kPa N_2 (1.1 ml/min)
Temperature:	50 °C
Detector:	FID 250 °C

Peaks:

1. Benzene
2. Toluene
3. Ethylbenzene
4. *p*-Xylene
5. *m*-Xylene
6. *o*-Xylene



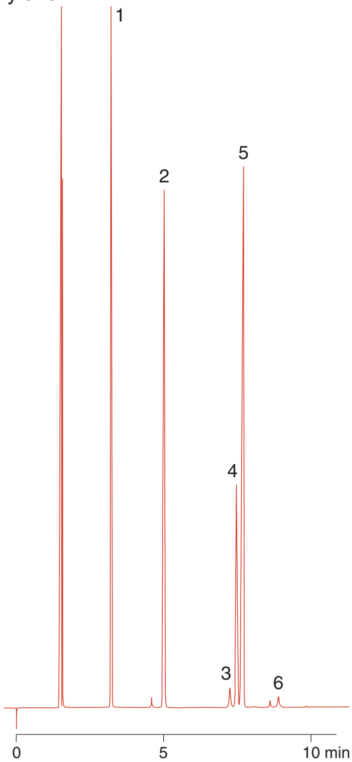
Analysis of aromatic hydrocarbons (BTX)

MN Appl. No. 200210

Column:	PERMABOND® CW 20 M, 25 m x 0.25 mm ID, 0.25 µm film, REF 723060.25, max. temperature 220/240 °C
Injection:	0.2 µl, split 1:50
Carrier gas:	0.8 bar N_2
Temperature:	40 °C (3 min) $\xrightarrow{5\ °C/min}$ 80 °C
Detector:	FID 260 °C

Peaks:

1. Benzene
2. Toluene
3. Ethylbenzene
4. *p*-Xylene
5. *m*-Xylene
6. *o*-Xylene



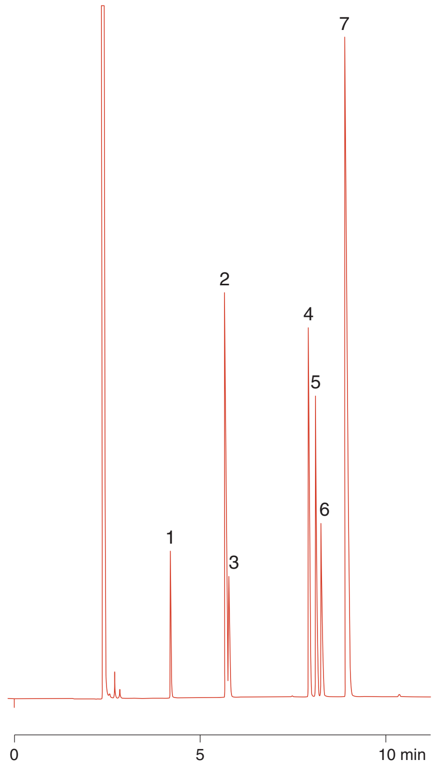
Analysis of aromatic hydrocarbons (BTX with toluene-d_8)

MN Appl. No. 200260

Column: FS-HYDRODEX β-PM, 50 m x 0.25 mm ID, REF 723370.50, max. temperature 230/250 °C
Split: 185 ml/min
Carrier gas: 120 kPa H_2 (2 ml/min)
Temperature: 60 °C $\xrightarrow{4\ °C/min}$ 100 °C
Detector: FID 250 °C

Peaks in *n*-hexane:

1. Benzene
2. Toluene-d_8
3. Toluene
4. *p*-Xylene
5. *m*-Xylene
6. Ethylbenzene
7. *o*-Xylene



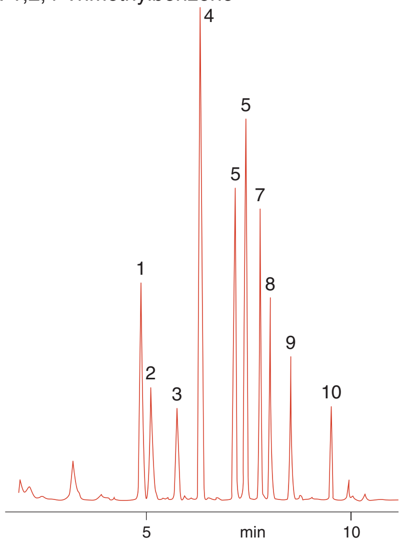
Analysis of aromatic hydrocarbons

MN Appl. No. 210590

Column: OPTIMA® δ-3, 30 m x 0.25 mm ID, 0.25 μm film, REF 726420.30, max. temperature 340/360 °C
Injection: 0.5 μl, 250 °C, split 1:10
Carrier gas: He
Temperature: 50 °C $\xrightarrow{12\ °C/min}$ 200 °C
Detector: MSD

Peaks:

1. Ethylbenzene
2. *p*-Xylene
3. *o*-Xylene
4. Cumene
5. *n*-Propylbenzene
6. 4-Ethyltoluene
7. 1,3,5-Trimethylbenzene
8. 2-Ethyltoluene
9. 1,2,3-Trimethylbenzene
10. 1,2,4-Trimethylbenzene

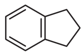
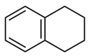


Courtesy of Mr. B. Sievers, Riedel-de Haen AG, Seelze, Germany

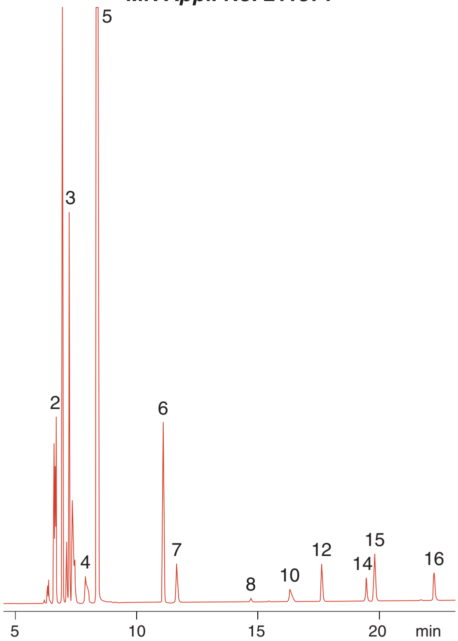
Analysis of aromatic solvents

Column: OPTIMA® 210, 50 m x 0.25 mm ID, 0.25 µm film, REF 726871.50, max. temperature 260/280 °C
Injection: 0.2 µl, split 89 ml/min
Carrier gas: 60 kPa N_2
Temperature: 50 °C (10 min) → 2 °C/min → 180 °C (20 min)
Detector: FID 260 °C

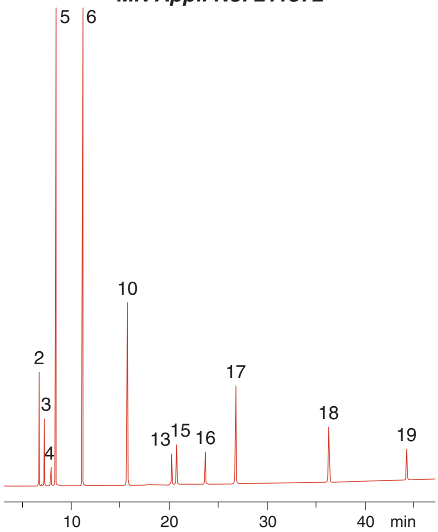
Peaks:

1. *n*-Butane
2. *n*-Hexane
3. Cyclohexane
4. Methylcyclohexane
5. Benzene
6. Toluene
7. *n*-Nonane
8. Ethylbenzene
9. *p*-Xylene
10. *m*-Xylene
11. *o*-Xylene
12. *i*-Propylbenzene
13. *n*-Propylbenzene
14. *p*-Ethyltoluene
15. *m*-Ethyltoluene
16. 1,2,4-Trimethylbenzene
17. Indane 
18. Tetralin 
19. Naphthalene

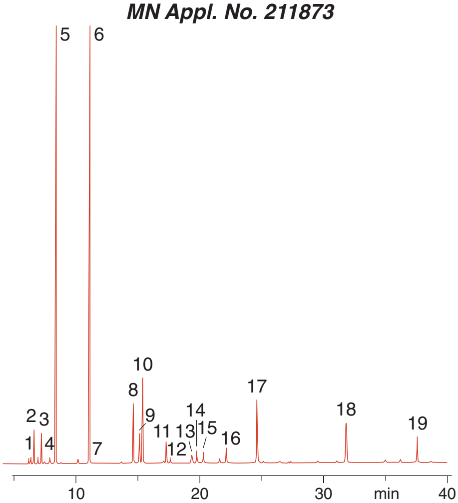
MN Appl. No. 211871



MN Appl. No. 211872



MN Appl. No. 211873



Courtesy of Aral Aromatics GmbH, Gelsenkirchen, Germany

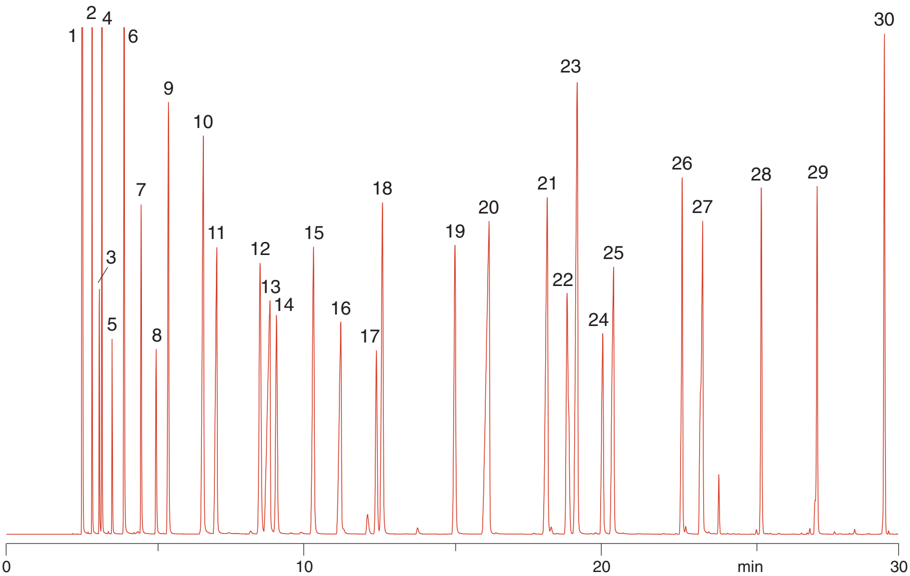
Analysis of solvents

MN Appl. No. 201390

Column: OPTIMA® 1, 60 m x 0.32 mm ID, 1.0 μm film, REF 726323.60, max. temperature 340/360 °C
Sample: solvent mixture, courtesy of J. Lutz, Alcan Rorschach, Switzerland
Injection: 0.4 μl, split 1:60
Carrier gas: 120 kPa H_2
Temperature: 50 °C (9 min) $\xrightarrow{4\ °C/min}$ 90 °C $\xrightarrow{14\ °C/min}$ 280 °C (2 min)
Detector: FID 300 °C

Peaks:

1. Methanol
2. Ethanol
3. Acetone
4. Propanol-2
5. Methyl acetate
6. Propanol-1
7. Methyl ethyl ketone
8. Ethyl acetate
9. Isobutanol
10. Butanol-1
11. 1-Methoxy-2-propanol
12. Isooctane
13. Ethylglycol
14. Isoheptane
15. Methyl isobutyl ketone
16. 1-Ethoxy-2-propanol
17. Toluene
18. *i*-Butyl acetate
19. *n*-Butyl acetate
20. 4-Hydroxy-4-methyl-2-pentanone
21. 1-Methoxy-2-propyl acetate
22. Xylene
23. Cyclohexanone
24. Ethyl glycol acetate
25. Butyl glycol
26. Heptanol
27. Ethyldiglycol
28. Butyldiglycol
29. Butyl glycol acetate
30. Butyldiglycol acetate

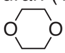


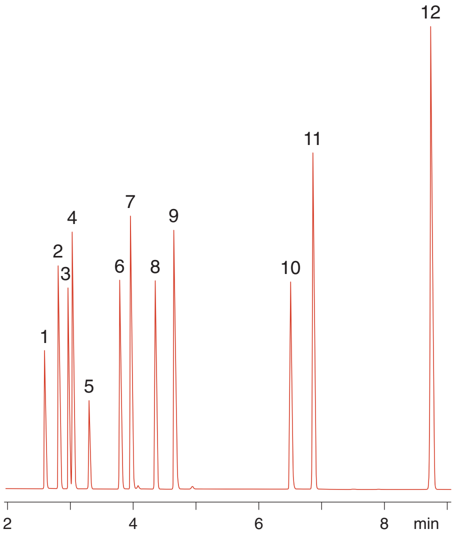
Analysis of solvents

MN Appl. No. 213150

Column:	OPTIMA® 1 MS Accent, 60 m x 0.32 mm ID, 0.5 µm film, REF 725807.60, max. temperature 340/360 °C
Injection:	1 µl, split 1:150
Carrier gas:	1 bar He
Temperature:	40 °C (5 min) $\xrightarrow{10\text{ °C/min}}$ 60 °C (2 min)
Detector:	FID 280 °C

Peaks:

1. Methanol
2. Ethanol
3. Acetone
4. Propanol-2
5. Dichloromethane
6. *t*-Butyl ethyl ether
7. Methyl ethyl ketone
8. Hexane
9. Tetrahydrofuran (THF) 
10. Dioxane 
11. Heptane
12. Toluene



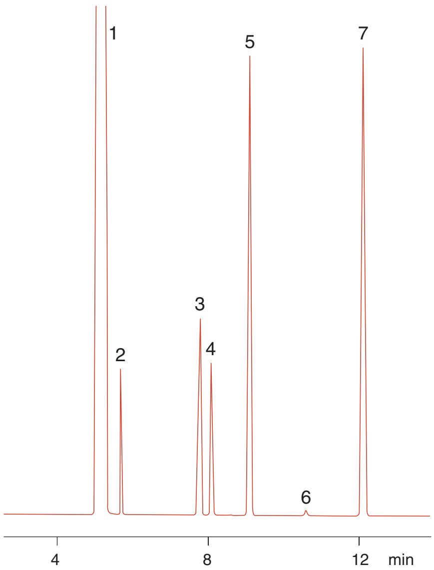
Analysis of volatile solvents

MN Appl. No. 210300

Column:	OPTIMA® δ-3, 60 m x 0.32 mm ID, 1 µm film, REF 726442.60, max. temperature 340/360 °C
Injection:	1 µl, split 1:75
Carrier gas:	1.2 bar He
Temperature:	34 °C (1 min) $\xrightarrow{4\text{ °C/min}}$ 50 °C $\xrightarrow{6\text{ °C/min}}$ 100 °C $\xrightarrow{8\text{ °C/min}}$ 200 °C (5 min)
Detector:	FID

Peaks:

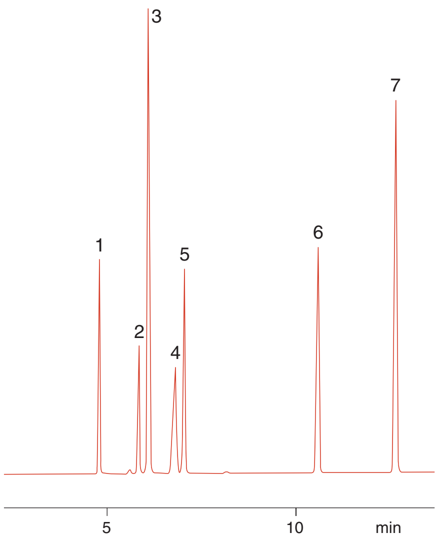
1. Methanol
2. Methyl formate
3. Methyl acetate
4. Acetonitrile
5. *n*-Hexane
6. Ethyl acetate
7. Cyclohexane



Analysis of solvents
MN Appl. No. 210260

Column: OPTIMA® δ-3, 60 m x 0.32 mm ID, 1 μm film, REF 726442.60, max. temperature 340/360 °C
Injection: 0.5 μl, split 1:100
Carrier gas: 1.2 bar He
Temperature: 60 °C (1 min) —6 °C/min→ 240 °C (5 min)
Detector: FID

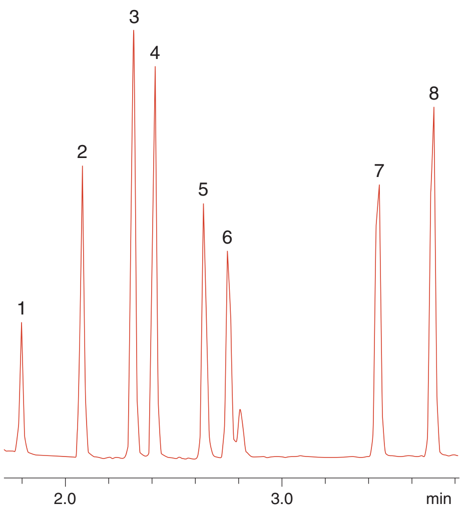
Peaks:
1. Methanol
2. Ethanol
3. Pentane
4. Propanol-2
5. Acetone
6. Ethyl acetate
7. Benzene



Analysis of solvents by headspace GC
MN Appl. No. 212960

Column: Optima® WAX, 30 m x 0.25 mm ID, 0.25 μm film, REF 726600.30, max. temperature 250/260 °C
Sample: headspace: heat 1 ml water + 20 μl of each solvent to 80 °C in a headspace vial for 15 min
Injection: 240 °C, split 3.64:1
Carrier gas: 7.35 psi He, 1 ml/min
Temperature: 45 °C (1 min) —10 °C/min→ 180 °C (2 min) —30 °C/min→ 240 °C (3 min)
Detector: MSD

Peaks:
1. Cyclohexane
2. Acetone
3. Tetrahydrofuran
4. Ethyl acetate
5. Dichloromethane
6. Propanol-2
7. Trichloromethane
8. Toluene



Courtesy of V. Cirimele, Laboratoire ChemTox, Illkirch Graffenstaden, France

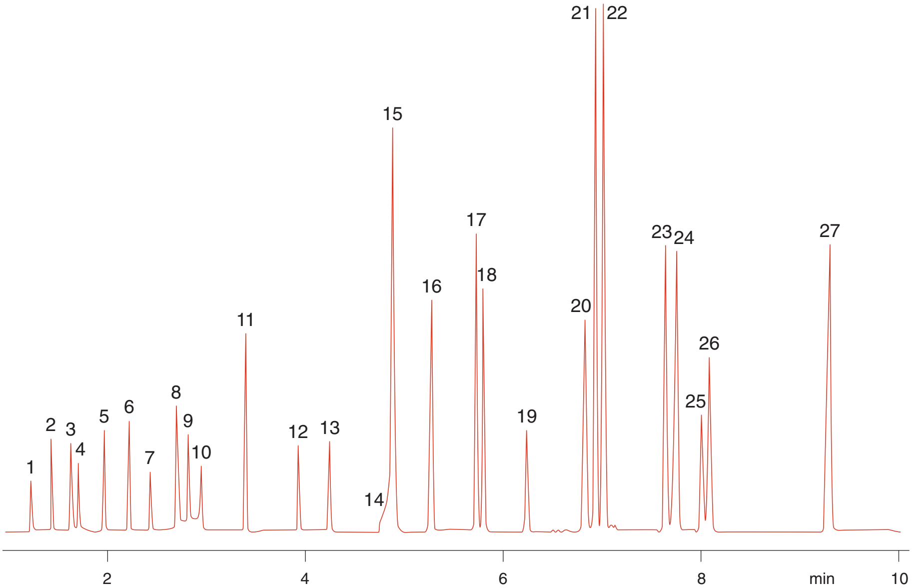
Rapid analysis of a complex solvent mixture

MN Appl. No. 250500

Column:	OPTIMA® δ-3, 30 m x 0.25 mm ID, 0.25 μm film, REF 726420.30, max. temperature 340/360 °C
Injection:	1.0 μl, split 1:80
Carrier gas:	100 kPa He
Temperature:	35 °C (1.8 min) $\xrightarrow{25\ °C/min}$ 50 °C $\xrightarrow{70\ °C/min}$ 200 °C (15 min)
Detector:	FID

Peaks:

1. Methanol
2. Ethanol
3. Propanol-2
4. Acetone
5. Dichloromethane
6. *n*-Hexane
7. Vinyl acetate
8. Butanol-2
9. Ethyl acetate
10. Trichloromethane
11. Benzene
12. Trichloroethene
13. 1,4-Dioxane
14. Propylene glycol
15. Toluene + pentenol
16. Heptanol-1
17. Limonene
18. Cineole
19. Linalool
20. 1-Vinylpyrrolidone
21. Menthofuran + menthone
22. Isomenthone + pulegone
23. Menthyl acetate
24. Carvone
25. Anethole
26. Anisaldehyde
27. Dodecanol-1



Courtesy of M. Bürkler, Solco Basel AG, Birsfelden, Switzerland

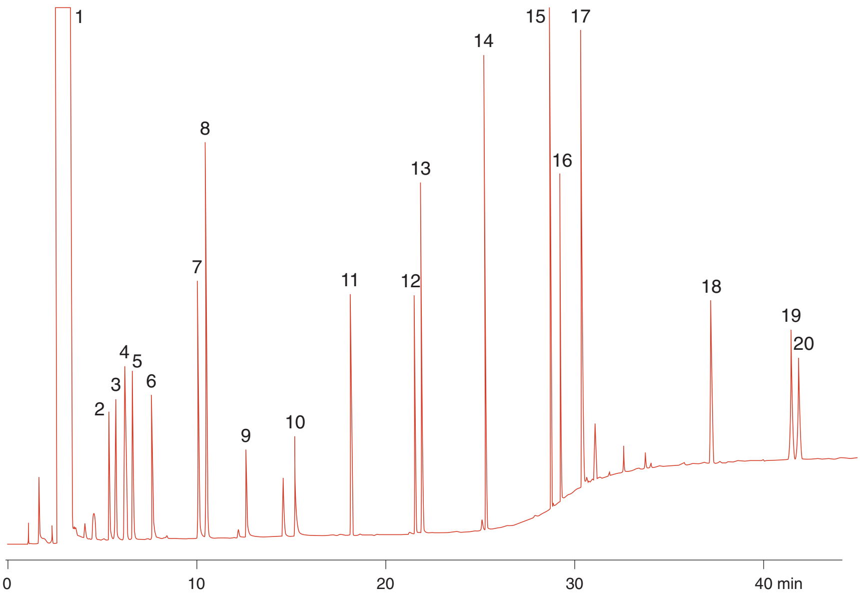
Analysis of solvents and semi-volatiles

MN Appl. No. 212520

Column:	OPTIMA® 624 LB, 30 m x 0.32 mm ID, 1.8 µm film, REF 726786.30 max. temperature 280/300 °C, retention gap Phe-Sil 0.5 m x 0.53 mm, REF 723711.10
Injection:	1 µl, cold on-column, 10 ppm per substance in acetone
Carrier gas:	1.1 bar He
Temperature:	45 °C (3 min) $\xrightarrow{6\ °C/min}$ 150 °C $\xrightarrow{18\ °C/min}$ 300 °C (20 min)
Detection:	FID 280 °C

Peaks:

1. Acetone
2. Ethyl acetate
3. Tetrahydrofuran
4. Cyclohexane
5. 2-Methylbutanol-2
6. Butanol-1
7. Pyridine
8. Toluene
9. Dimethylformamide
10. Dimethylsulfoxide
11. Decane
12. Octanol-1
13. Acetophenone
14. Butyrophenone
15. Heptanophenone
16. Methoxy-5-indole
17. Dibenzylamine
18. Methyl eicosanoate
19. Methyl *cis*-13-docosenoate
20. Methyl docosanoate



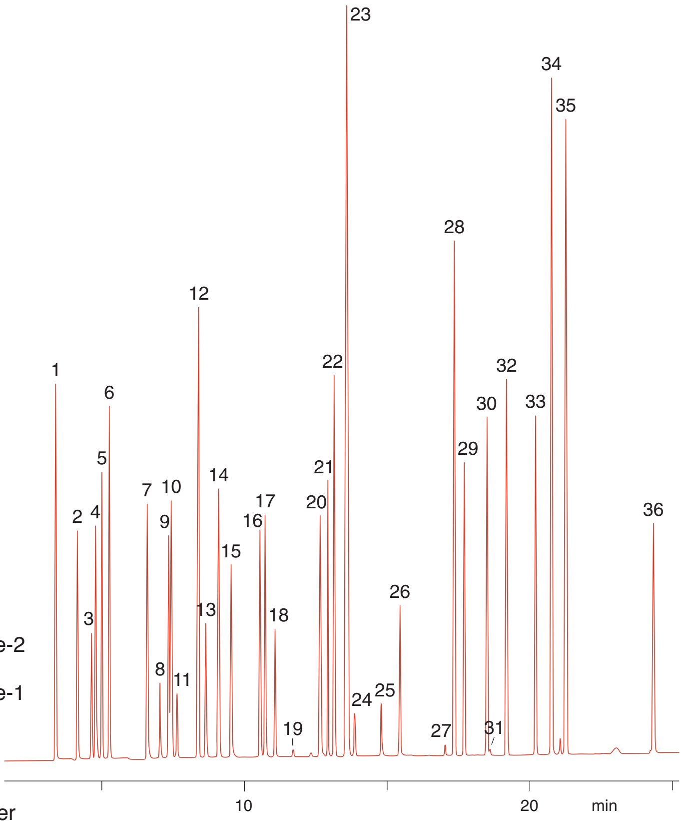
Analysis of solvents

MN Appl. No. 201410

Column: OPTIMA® 1701, 50 m x 0.32 mm ID, 1.0 μm film, REF 726929.50, max. temperature 300/320 °C
Injection: 0.1 μl, split 147 ml/min
Carrier gas: 150 kPa He (3 ml/min)
Temperature: 50 °C (5 min) $\xrightarrow{5\ °C/min}$ 160 °C
Detector: FID 240 °C

Peaks:

1. Methanol
2. Ethanol
3. Acetone
4. Propanol-2 + methyl acetate
5. Dichloromethane
6. *t*-Butanol
7. Propanol-1
8. Ethyl acetate
9. Butanone (MEK)
10. Trichloroethane
11. Trichloromethane
12. Benzene
13. *i*-Propyl acetate
14. *i*-Butanol
15. Methyl glycol
16. 1-Methoxypropanol-2
17. Butanol-1
18. *n*-Propyl acetate
19. Glycolic acid
20. Ethyl glycol
21. Toluene
22. *i*-Butyl methyl ketone
23. *i*-Butyl acetate
24. Tetrachloroethene
25. Ethoxypropanol
26. *n*-Butyl acetate
27. Ethylbenzene
28. *m*-Xylene + *p*-xylene
29. Methyl glycol acetate
30. 1-Methoxypropyl acetate-2
31. *o*-Xylene
32. 2-Methoxypropyl acetate-1
33. Ethyl glycol acetate
34. Butyl glycol + ethoxypropyl acetate
35. Cyclohexanone
36. Glycolic acid *n*-butyl ester



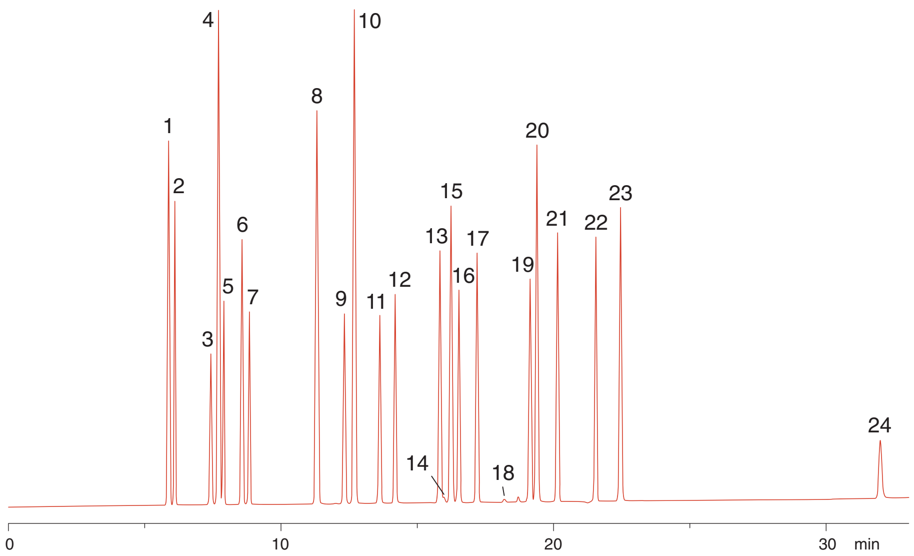
Analysis of solvents

MN Appl. No. 201420

Column: PERMABOND® CW 20 M, 50 m x 0.32 mm ID, 0.5 µm film, REF 723296.50, max. temperature 220/240 °C
Injection: 0.2 µl, split 90 ml/min
Carrier gas: 1 bar N_2
Temperature: 60 °C (5 min) $\xrightarrow{5\ °C/min}$ 210 °C
Detector: FID 250 °C

Peaks:

1. Acetone
2. Methyl acetate
3. Ethyl acetate
4. Methanol + isopropyl acetate
5. Butanone (MEK)
6. Propanol-2
7. Ethanol
8. Isobutyl methyl ketone
9. Propanol-1
10. Toluene
11. *n*-Butyl acetate
12. *i*-Butanol
13. 1-Methoxypropanol-2
14. Ethylbenzene
15. Butanol-1 + *p*-xylene
16. *m*-Xylene
17. Ethoxypropanol
18. *o*-Xylene
19. 1-Methoxypropyl acetate-2
20. Ethyl glycol
21. 2-Methoxypropyl acetate-1
22. Ethyl glycol acetate
23. Cyclohexanone
24. Ethylene glycol



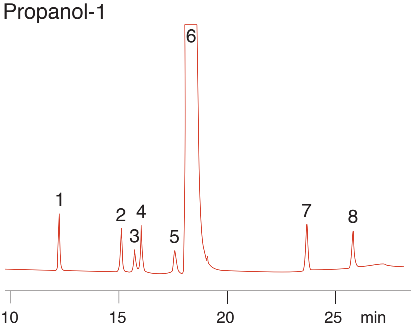
Analysis of solvent residues in ethanolic tinctures

MN Appl. No. 210880

Column: PERMABOND® CW 20 M, 60 m x 0.32 mm ID, 0.5 μm film, REF 723296.60, max. temperature 220/240 °C
Injection: 1 μl, split 50 ml/min
Carrier gas: 50 kPa N_2
Temperature: 60 °C (19 min) $\xrightarrow{5\ °C/min}$ 100 °C
Detector: FID 250 °C

Peaks:

1. Acetone
2. Ethyl acetate
3. Methanol
4. Methyl ethyl ketone
5. Propanol-2
6. Ethanol
7. Isobutyl methyl ketone
8. Propanol-1



Courtesy of Mr. Fischer, Pharmaz. Fabrik Evers & Co. GmbH, Hamburg, Germany

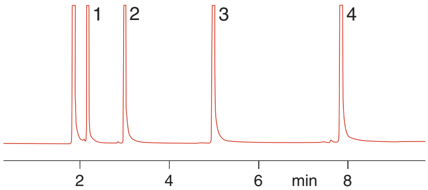
Analysis of glycols

MN Appl. No. 210950

Column: OPTIMA® δ-3, 30 m x 0.25 mm ID, 0.25 μm film, REF 726420.30, max. temperature 340/360 °C
Injection: 1 μl, split 100 ml/min
Carrier gas: 70 kPa He
Temperature: 150 °C (15 min) $\xrightarrow{10\ °C/min}$ 250 °C
Detector: FID

Peaks:

1. Diethylene glycol
2. Triethylene glycol
3. Tetraethylene glycol
4. Pentaethylene glycol

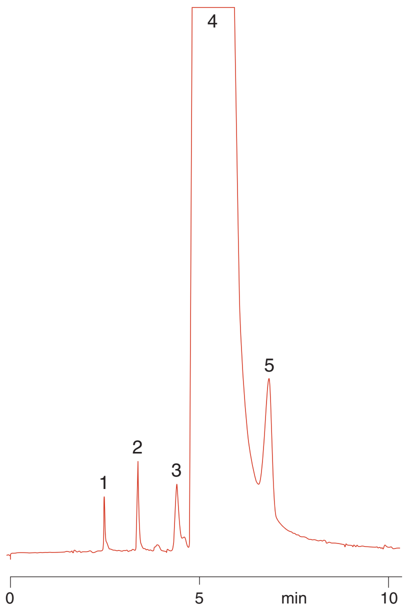


Analysis of alcohols in dichloromethane

MN Appl. No. 201460

Column: OPTIMA® 5, 25 m x 0.32 mm ID, 5.0 µm film, REF 726934.25, max. temperature 300/320 °C
Injection: 2 µl, split 30 ml/min
Carrier gas: 1 bar N_2
Temperature: 60 °C
Detector: FID 240 °C

Peaks:
1. Methanol
2. Ethanol
3. Propanol-2
4. Dichloromethane
5. Propanol-1

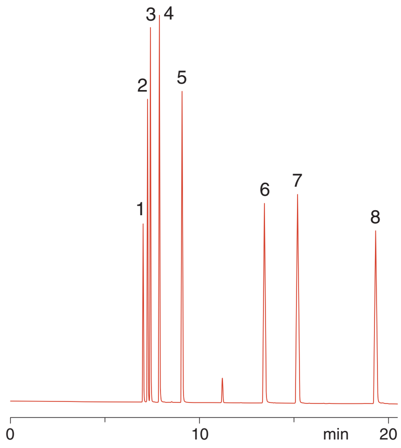


Analysis of alcohols

MN Appl. No. 201430

Column: OPTIMA® 17, 50 m x 0.32 mm ID, 0.5 µm film, REF 723744.50, max. temperature 320/340 °C
Injection: 1 µl, split 1:50
Carrier gas: 50 kPa N_2
Temperature: 50 °C $\xrightarrow{4\ °C/min}$ 200 °C
Detector: FID 250 °C

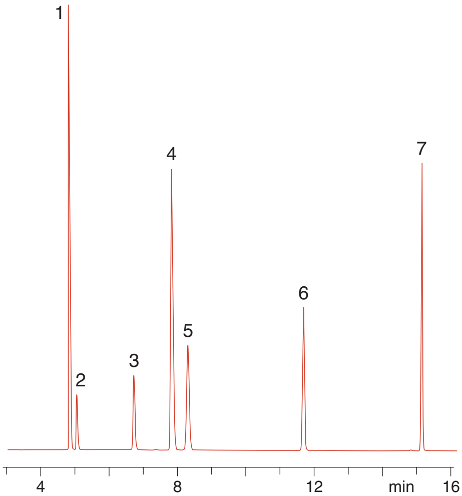
Peaks:
1. Methanol
2. Ethanol
3. Propanol-2
4. Propanol-1
5. Butanol-1
6. Hexanol-1
7. Cyclohexanol
8. Octanol-1



Headspace analysis of alcohols
MN Appl. No. 212630

Column:	OPTIMA® 624, 60 m x 0.32 mm ID, 1.80 µm film, REF 726787.60, max. temperature 280/300 °C
Injection:	headspace 200 °C, sample temperature 60 °C for 20 min, needle temperature 70 °C, transfer line 80 °C
Carrier gas:	130 kPa He
Temperature:	40 °C (5 min) → 20 °C/min → 200 °C
Detector:	FID 200 °C

Peaks:
1. Acetaldehyde
2. Methanol
3. Ethanol
4. Acetone
5. Propanol-2
6. Propanol-1
7. Butanol-1

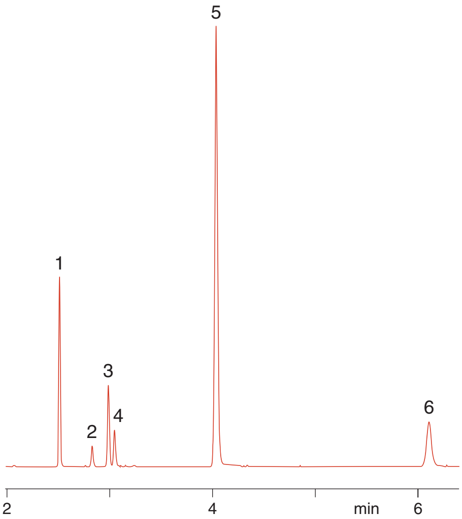


Courtesy of Mr. Kress, INSTAND e.V., Düssel-dorf, Germany

Headspace analysis of alcohols
MN Appl. No. 212940

Column:	OPTIMA® WAX, 30 m x 0.25 mm ID, 0.25 µm film, REF 726600.30, max. temperature 250/260 °C
Sample:	headspace: heat 1 ml water + 20 *µ*l of each alcohol to 80 °C in a headspace vial for 15 min
Injection:	250 °C, split 30:1
Carrier gas:	11.78 psi He, 1 ml/min
Temperature:	70 °C (10 min)
Detector:	MSD

Peaks:
1. Acetone
2. Methanol
3. Propanol-2
4. Ethanol
5. Propanol-1
6. Butanol-1



Courtesy of V. Cirimele, Laboratoire ChemTox, Illkirch Graffenstaden, France

Headspace analysis of alcohols

MN Appl. No. 212950

Column: OPTIMA® WAX, 30 m x 0.25 mm ID, 0.25 µm film, REF 726600.30, max. temperature 250/260 °C

Injection: headspace: heat 1 ml blood + 20 µl int. std. (50 mg/l propanol-1) to 80 °C in a headspace vial for 15 min; 240 °C, split 3.64:1

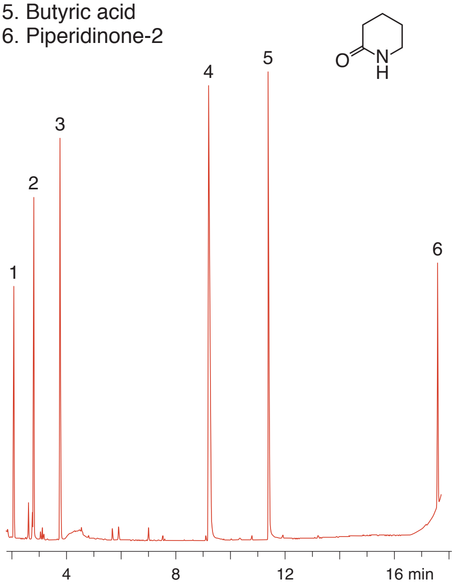
Carrier gas: 7.35 psi He, 1 ml/min

Temperature: 45 °C (1 min) $\xrightarrow{10\ °C/min}$ 180 °C (2 min) $\xrightarrow{30\ °C/min}$ 240 °C (3 min)

Detector: MSD

Peaks:

1. Acetone
2. Ethanol
3. Propanol-1
4. Acetic acid
5. Butyric acid
6. Piperidinone-2



Courtesy of V. Cirimele, Laboratoire ChemTox, Illkirch Graffenstaden, France

Analysis of a mixture of neutral and basic organic compounds

Sample: Base/Neutrals Mix 1, 200 µg/ml each in 2-propanol
Injection: 1.0 µl, split 1:150
Carrier gas: 25 cm/s He
Detector: MSD

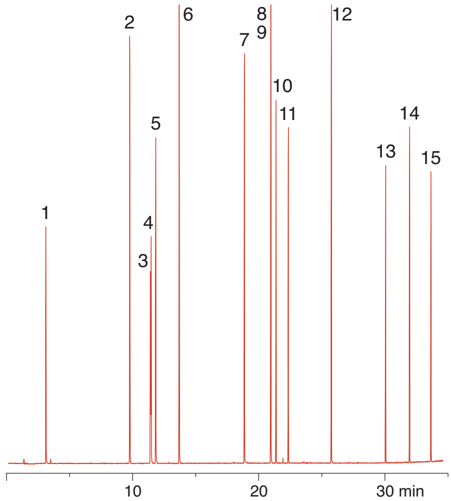
Peaks:

1. N-Nitrosodimethylamine
2. s-Dichloroethyl ether
3. Bis(1-chloroisopropyl) ether
4. Bis(2-chloroisopropyl) ether
5. N-Nitroso-di-*n*-propylamine
6. Bis(2-chloroethoxy)methane
7. Dimethyl phthalate
8. 4-Chlorophenoxybenzene
9. Diethyl phthalate
10. N-Nitrosodiphenylamine
11. 4-Bromophenoxybenzene
12. Dibutyl phthalate
13. Benzyl butyl phthalate
14. Bis(2-ethylhexyl) phthalate
15. Di-n-octyl phthalate

MN Appl. No. 201170

Column: OPTIMA® 5, 25 m x 0.20 mm ID, 0.20 µm film, REF 726857.25, max. temperature: 340/360 °C

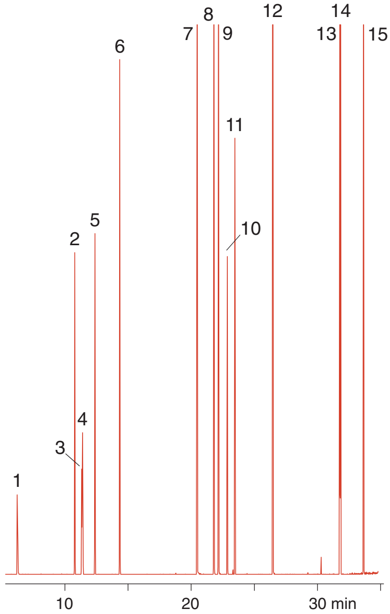
Temperature: 45 °C (5 min) $\xrightarrow{8\ °C/min}$ 330 °C



MN Appl. No. 201180

Column: OPTIMA® 17, 25 m x 0.20 mm ID, 0.20 µm film, REF 726065.25, max. temperature 320/340 °C

Temperature: 50 °C (3 min) $\xrightarrow{8\ °C/min}$ 320 °C

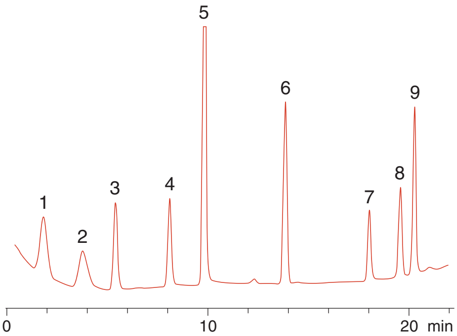


Analysis of organic pollutants from water-packaging materials

MN Appl. No. 212870

Column: OPTIMA® 17, 15 m x 0.53 mm ID, 1.0 μm film, REF 726747.15, max. temperature 300/320 °C
Injection: splitless, 270 °C
Carrier gas: 10 ml/min N_2
Temperature: 50 °C (1 min) $\xrightarrow{10\ °C/min}$ 270 °C (10 min)
Detector: FID 300 °C

Peaks:
1. Chlorobenzene
2. Isopentyl acetate
3. Styrene
4. Phenol
5. Benzyl alcohol
6. Cyclohexylbenzene
7. Benzophenone
8. Diazinon
9. Dibutyl phthalate



S. Guillot, M. T. Kelly, H. Fenet, M. Larroque, J. Chromatogr. A **1101** (2006) 46 – 52

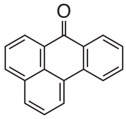
Analysis of 2,4-dinitrophenyl-hydrazones

MN Appl. No. 201250

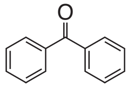
Column: OPTIMA® 1, 10 m x 0.53 mm ID, 0.50 μm film, REF 726519.10, max. temperature 320/340 °C
Injection: 1 μl, split 1:50
Carrier gas: 0.3 bar H_2
Temperature: 60 °C $\xrightarrow{30\ °C/min}$ 160 °C $\xrightarrow{8\ °C/min}$ 300 °C
Detector: FID 320 °C

Peaks: DNP hydrazones of

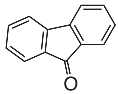
1. Benzanthrone

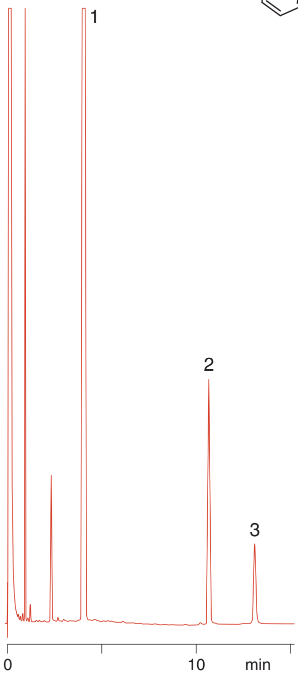


2. Benzophenone



3. Fluorenone





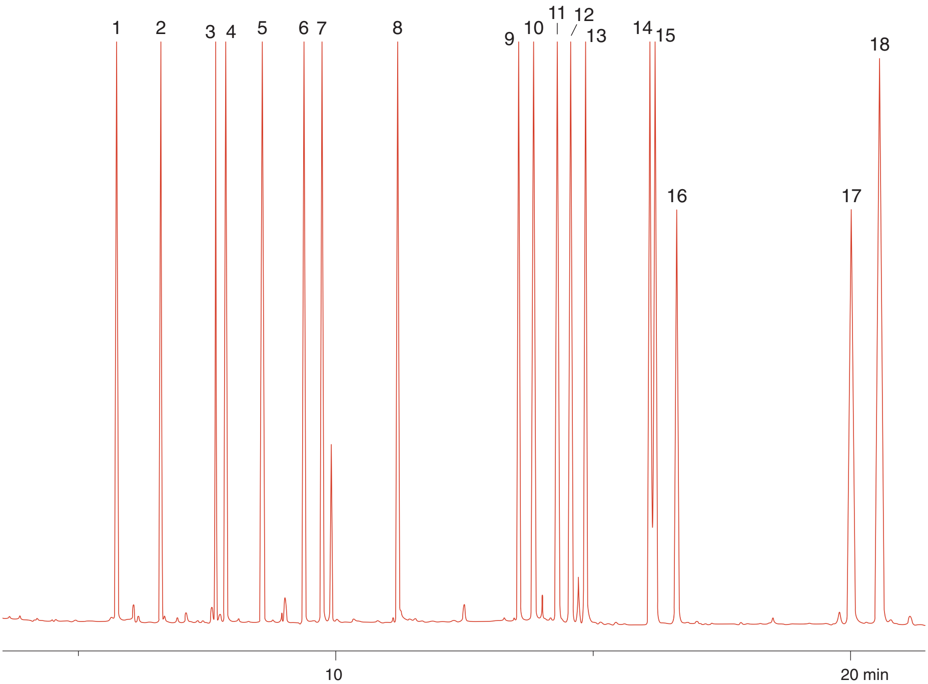
Analysis of plasticizers

MN Appl. No. 201200

Column:	OPTIMA® 5, 50 m x 0.25 mm ID, 0.25 µm film, REF 726056.50, max. temperature 340/360 °C
Injection:	1 µl on column, 20 ng each
Carrier gas:	140 kPa H_2
Temperature:	80 $\xrightarrow{40\ ^\circ C/min}$ 240 °C $\xrightarrow{6\ ^\circ C/min}$ 280 °C
Detector:	FID

Peaks:

1. Dimethyl phthalate
2. Diethyl phthalate
3. Diallyl phthalate
4. Dipropyl phthalate
5. Diisobutyl phthalate
6. Di-*n*-butyl phthalate
7. Methyl glycol phthalate
8. Dibutyl sebacate
9. Butyl benzyl phthalate
10. Di(2-ethylhexyl) adipate
11. Triphenyl phosphate
12. Diphenyl-(2-ethylhexyl) phosphate
13. Tri(2-ethylhexyl) phosphate
14. Dicyclohexyl phthalate
15. Di(2-ethylhexyl) phthalate
16. Diphenyl phthalate
17. Di-*n*-octyl phthalate
18. Tri-*p*-cresyl phosphate



Courtesy of Mr. Lembacher, Hipp Nährmittel, Pfaffenhofen, Germany

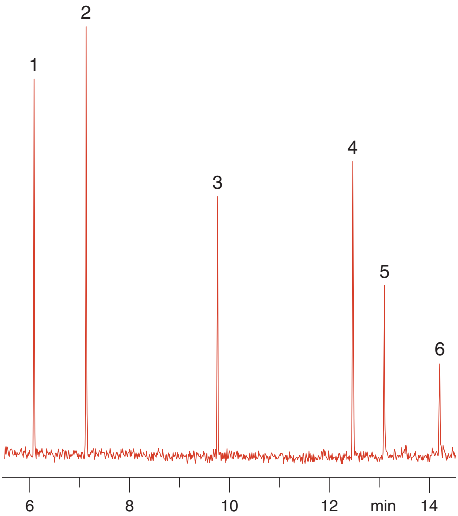
Analysis of phthalates (EPA 606)

MN Appl. No. 213160

Column: OPTIMA® δ-3, 30 m x 0.25 mm ID, 0.25 μm film, REF 726420.30, max. temperature 340/360 °C
Injection: 1 μl, split 1:10
Carrier gas: 1.4 ml/min H_2
Temperature: 100 °C $\xrightarrow{15\ °C/min}$ 320 °C
Detector: MSD

Peaks:

1. Dimethyl phthalate
2. Diethyl phthalate
3. Dibutyl phthalate
4. Butyl benzyl phthalate
5. Di(2-ethylhexyl) phthalate
6. Di-*n*-octyl phthalate



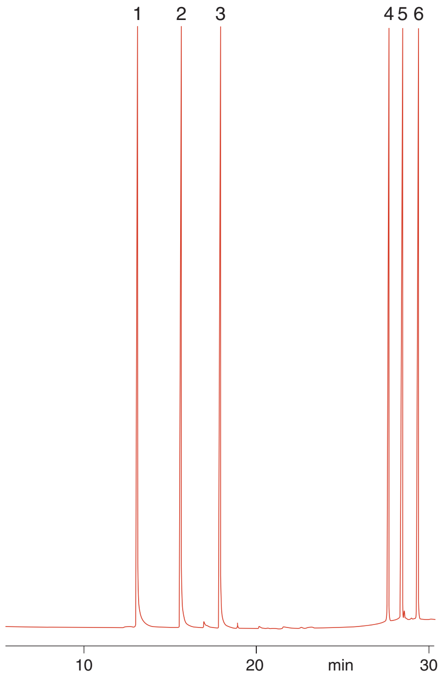
Analysis of phosphonic acid diethyl esters

MN Appl. No. 211860

Column: OPTIMA® δ-3, 30 m x 0.25 mm ID, 0.25 μm film, REF 726420.30, max. temperature 340/350 °C
Injection: 0.5 μl, 250 °C, split 40 ml/min
Carrier gas: 80 kPA He
Temperature: 60 °C $\xrightarrow{5\ °C/min}$ 150 °C $\xrightarrow{20\ °C/min}$ 300 °C
Detector: FID 300 °C

Peaks:

1. Diethyl methylphophonate
2. Diethyl ethylphosphonate
3. Diethyl allylphosphonate
4. Tetraethyl-ethylene-1,2-diphosphonate
5. Tetraethyl-propylene-1,3-diphosphonate
6. Tetraethyl-butylene-1,4-diphosphonate



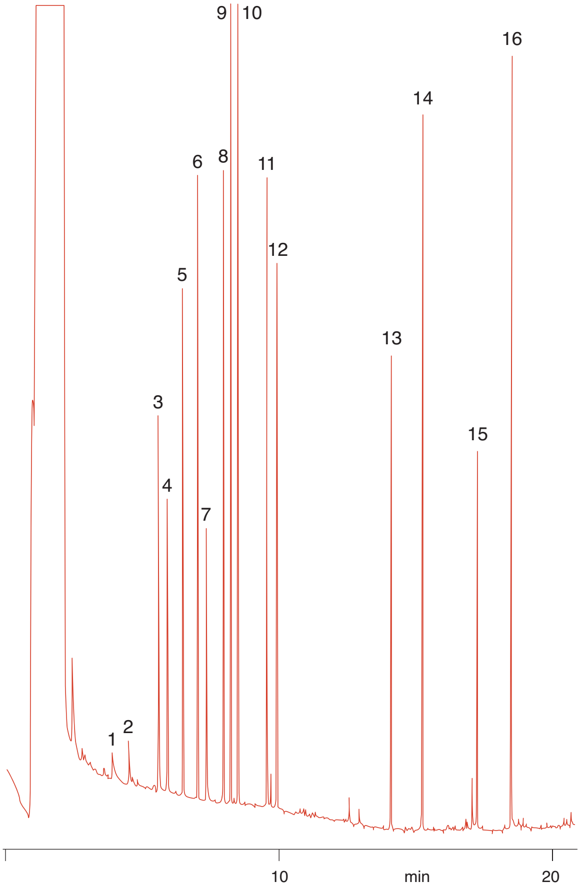
VeZerf Laborsynthesen GmbH, Idar-Oberstein, Germany

Analysis of halogeno- and phosphororganic compounds

MN Appl. No. 210340

Column: OPTIMA® 5, 30 m x 0.25 mm ID, 0.25 µm film, REF 726056.30, max. temperature 340/360 °C
Injection: 1.0 µl, splitless
Carrier gas: 1.5 bar H_2
Temperature: 39 °C (1 min) $\xrightarrow{10\ °C/min}$ 120 °C $\xrightarrow{12\ °C/min}$ 280 °C (10 min)
Detector: MSD

Peaks:
1. Dimethyl methylphosphonate
2. Trimethyl phosphate
3. 4-Fluorophenol
4. 1,2-Dichlorobenzene
5. 1-Octanol
6. 2,6-Dimethylphenol
7. Triethyl phosphate
8. 2,6-Dimethylbenzylamine
9. Naphthalene
10. *n*-Dodecane
11. 1-Dodecanol
12. 5-Chloro-2-methylbenzylamine
13. Tributyl phosphate
14. Dibenzothiophene
15. Malathion
16. Methyl octadecanoate



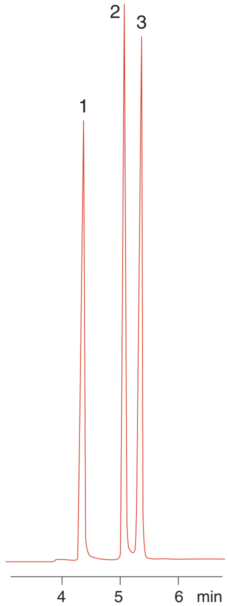
Courtesy of Mr. Kremer, Wehrwissenschaftl. Inst. für Schutztechnologien, Munster, Germany

Analysis of methylamines

MN Appl. No. 210490

Column: OPTIMA® 5, 50 m x 0.32 mm ID, 5.0 µm film, REF 726934.50, max. temperature 300/320 °C
Split: 108 ml/min
Carrier gas: 2.2 ml/min He
Temperature: 85 °C
Detector: FID

Peaks: 20 ng/peak
1. Methylamine
2. Dimethylamine
3. Trimethylamine

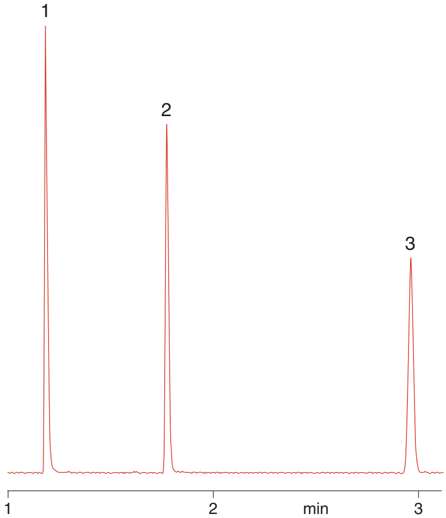


Analysis of ethylamines

MN Appl. No. 250050

Column: OPTIMA® 5 Amine, 30 m x 0.32 mm ID, 1.0 µm film, REF 726353.30, max. temperature 300/320 °C
Injection: 1 µl, split 1:70
Carrier gas: 0.5 bar H_2
Temperature: 40 °C $\xrightarrow{5\ °C/min}$ 100 °C
Detector: FID

Peaks:
1. Ethylamine
2. Diethylamine
3. Triethylamine



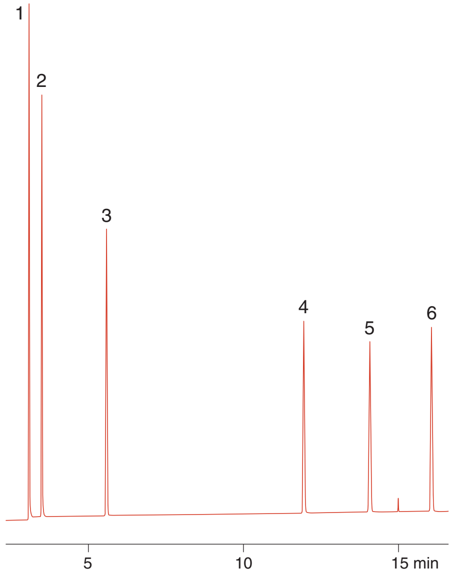
Analysis of amines

MN Appl. No. 201520

Column: FS-CW 20 M-AM, 25 m x 0.25 mm ID, 0.25 *µ*m film, REF 733110.25, max. temperature 220/240 °C
Injection: 0.2 *µ*l, split 1:100
Carrier gas: 0.45 bar N_2
Temperature: 80 °C (5 min) $\xrightarrow{8\ °C/min}$ 180 °C
Detector: FID 250 °C

Peaks:

1. Butylamine
2. Di-*i*-propylamine
3. Dibutylamine
4. Nonylamine
5. Decylamine
6. Undecylamine



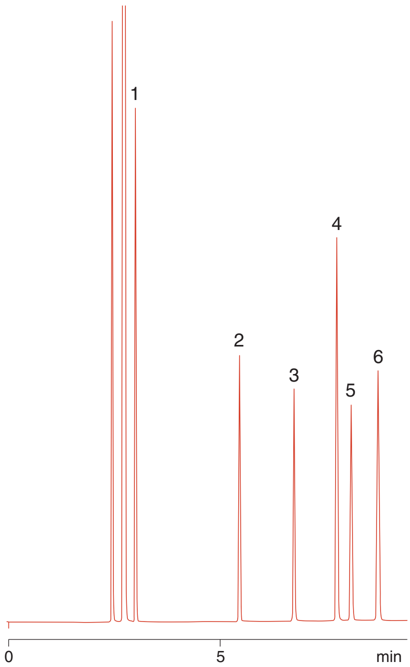
Analysis of amines

MN Appl. No. 201530

Column: FS-CW 20 M-AM, 25 m x 0.32 mm ID, 0.25 *µ*m film, REF 733299.25, max. temperature 220/240 °C
Injection: 0.5 *µ*l
Carrier gas: 0.5 bar N_2
Temperature: 80 °C $\xrightarrow{10\ °C/min}$ 190 °C
Detector: FID 240 °C

Peaks:

1. Dibutylamine
2. *n*-Nonylamine
3. *n*-Decylamine
4. Benzylamine
5. *n*-Undecylamine
6. Dicyclohexylamine



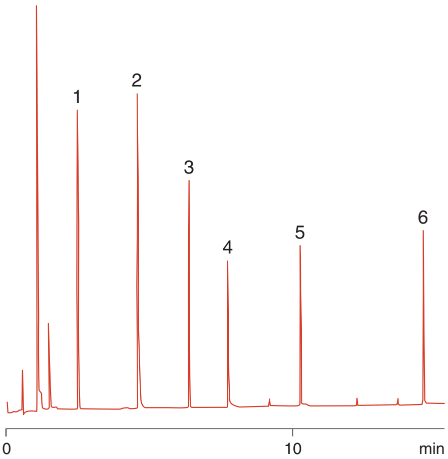
Separation of the OPTIMA® Amine test mixture (REF 722317)

MN Appl. No. 250020

Column:	OPTIMA® 5 Amine, 30 m x 0.32 mm ID, 1.0 μm film, REF 726353.30, max. temperature 300/320 °C
Injection:	1 μl, split 1:40
Carrier gas:	0.6 bar H_2
Temperature:	100 °C $\xrightarrow{10\ °C/min}$ 280 °C
Detector:	FID

Peaks:

1. Di-*i*-butylamine
2. Diethanolamine
3. 2,6-Dimethylaniline
4. *o*-Propanol-pyridine
5. Dicyclohexylamine
6. Dibenzylamine



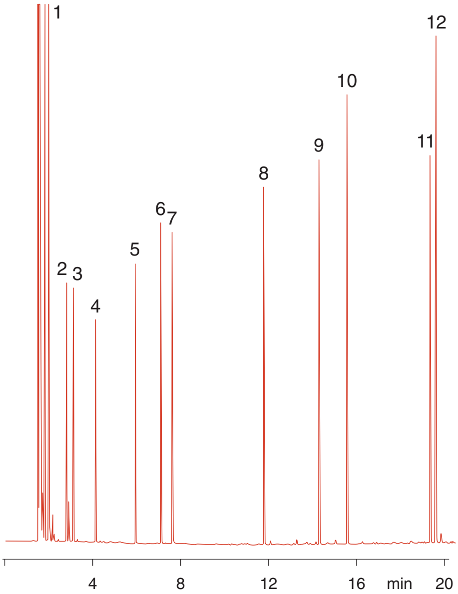
Analysis of secondary and tertiary amines

MN Appl. No. 210280

Column:	OPTIMA® 5 Amine, 30 m x 0.25 mm ID, 1.0 μm film, REF 726358.30, max. temperature 300/320 °C
Injection:	1.0 μl, 0.01 % in pentane split 1:100
Carrier gas:	0.55 bar H_2
Temperature:	50 °C (3 min) $\xrightarrow{10\ °C/min}$ 280 °C (10 min)
Detector:	FID 280 °C

Peaks:

1. Diethylamine
2. Di-*i*-propylamine
3. Triethylamine
4. Di-*n*-propylamine
5. Di-*n*-butylamine
6. Tri-*n*-propylamine
7. Di-*i*-butylamine
8. Tri-*n*-butylamine
9. Di-*i*-hexylamine
10. Dicyclohexylamine
11. Dibenzylamine
12. Tri-*n*-hexylamine



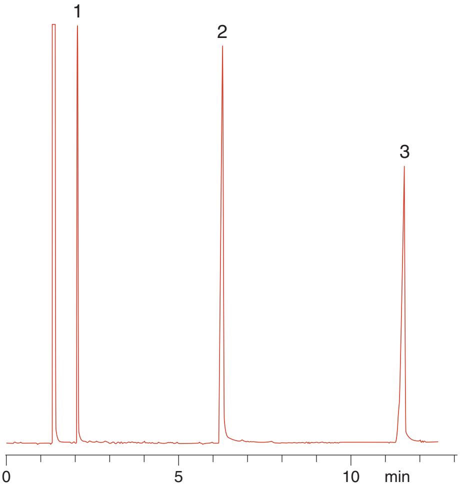
Analysis of ethanolamines

MN Appl. No. 250040

Column:	OPTIMA® 5 Amine, 30 m x 0.32 mm ID, 1.0 µm film, REF 726353.30, max. temperature 300/320 °C
Injection:	1 µl, 20 % in methanol split 1:30
Carrier gas:	0.6 bar H_2
Temperature:	80 °C $\xrightarrow{10\ °C/min}$ 200 °C
Detector:	FID

Peaks:

1. Ethanolamine
2. Diethanolamine
3. Triethanolamine



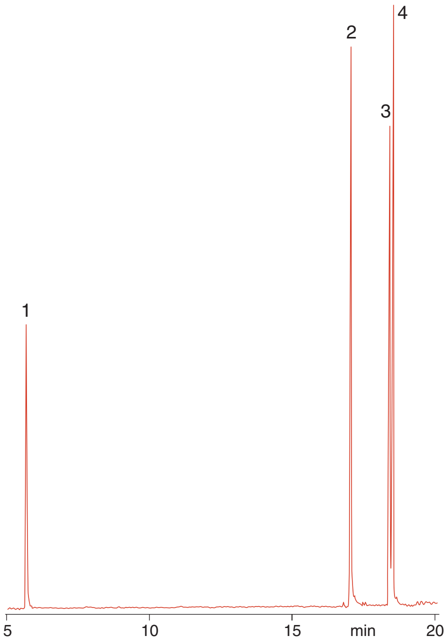
Analysis of pyridine compounds

MN Appl. No. 210360

Column:	OPTIMA® 5 Amine, 25 m x 0.20 mm ID, 0.35 µm film, REF 726355.25, max. temperature 300/320 °C
Injection:	310 °C
Carrier gas:	25 cm/s He
Temperature:	50 °C (3 min) $\xrightarrow{8\ °C/min}$ 290 °C
Detector:	MSD

Peaks:

1. Pyridine
2. *o*-Propanolpyridine
3. *m*-Propanolpyridine
4. *p*-Propanolpyridine

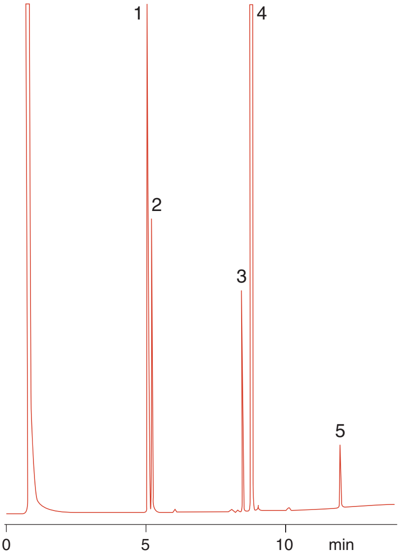


Analysis of an oxazole derivative of *N,N*-dimethylformamide

MN Appl. No. 210520

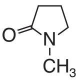
Column: OPTIMA® 240, 25 m x 0.25 mm ID, 0.25 µm film, REF 726089.25, max. temperature 260/280 °C
Injection: 0.5 µl, split 100 ml/min
Carrier gas: 0.8 bar He
Temperature: 50 °C → 7 °C/min → 200 °C
Detector: FID 280 °C

Peaks:
1. *N,N*-Dimethylformamide
2. 5-Cyano-4-methyloxazole
3. Methyl decanoate
4. *N*-Methylpyrrolidone
5. 4-Methyl-5-oxazole-carboxylic acid amide

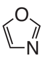


Courtesy of Hoffmann-La Roche AG, Basel, Switzerland

N-Methylpyrrolidone



Oxazole

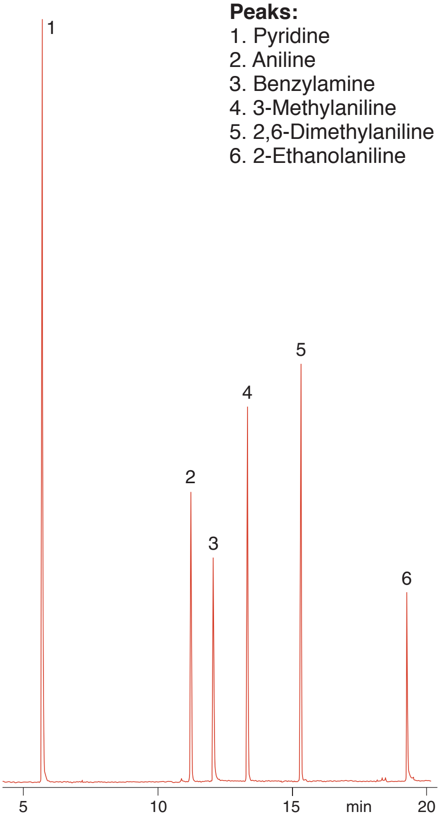


Analysis of aniline derivatives

MN Appl. No. 210380

Column: OPTIMA® 5 Amine, 25 m x 0.20 mm ID, 0.35 µm film, REF 726355.25, max. temperature 300/320 °C
Injection: 310 °C
Carriergas: 25 cm/s He
Temperature: 50 °C (3 min) → 8 °C/min → 290 °C
Detector: MSD

Peaks:
1. Pyridine
2. Aniline
3. Benzylamine
4. 3-Methylaniline
5. 2,6-Dimethylaniline
6. 2-Ethanolaniline



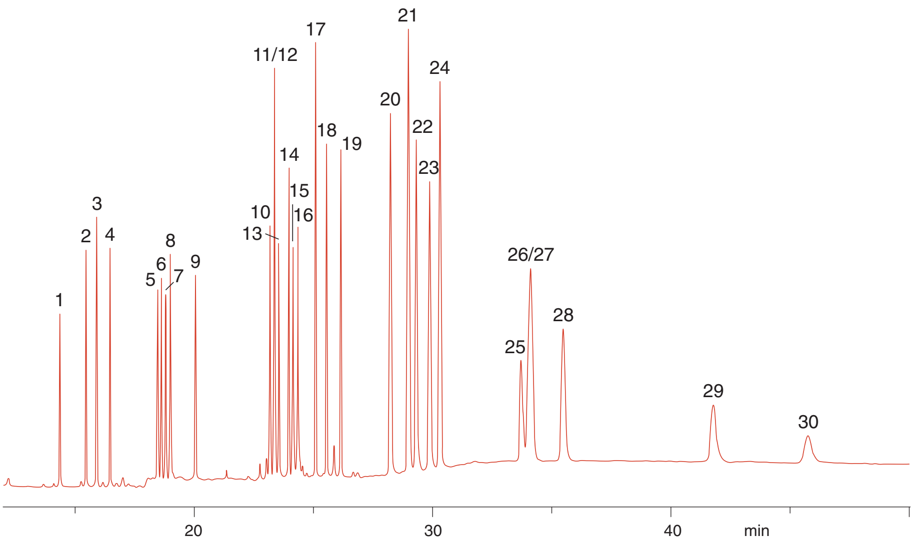
Analysis of substituted anilines

MN Appl. No. 201560

Column:	FS-CW 20 M-AM, 25 m x 0.25 mm ID, 0.25 μm film, REF 733110.25, max. temperature 220/240 °C
Injection:	2 μl, split 1:20
Carrier gas:	80 kPa He
Temperature:	80 °C (5 min) $\xrightarrow{5\ °C/min}$ 210 °C (10 min)
Detector:	MSD

Peaks:

1. Aniline
2. *o*-Toluidine
3. *p*-Toluidine
4. *m*-Toluidine
5. *o*-Chloroaniline
6. 2-Chloro-6-methylaniline
7. 2,6-Dichloroaniline
8. 4-i-Propylaniline (int. std.)
9. 2-Chloro-4-methylaniline
10. *p*-Chloroaniline
11. 2,4,6-Trichloroaniline
12. *m*-Chloroaniline
13. 3-Chloro-2-methylaniline
14. 4-Chloro-2-methylaniline
15. 5-Chloro-2-methylaniline
16. *m*-Phenetidine
17. 2,4-Dichloroaniline
18. 2,5-Dichloroaniline
19. 2,3-Dichloroaniline
20. 3,5-Dichloroaniline
21. 3,4-Dichloroaniline
22. 2,4,5-Trichloroaniline
23. 1-Naphthylamine (int. std.)
24. 2,3,4-Trichloroaniline
25. 5-Chloro-2-nitroaniline
26. 2-Chloro-5-nitroaniline
27. 4-Chloro-2-nitroaniline
28. 3,4,5-Trichloroaniline
29. 2-Chloro-4-nitroaniline
30. 4-Chloro-3-nitroaniline



B. Scholz, N. Palauschek, Z. Anal. Chem. **331** (1988) 282 – 289

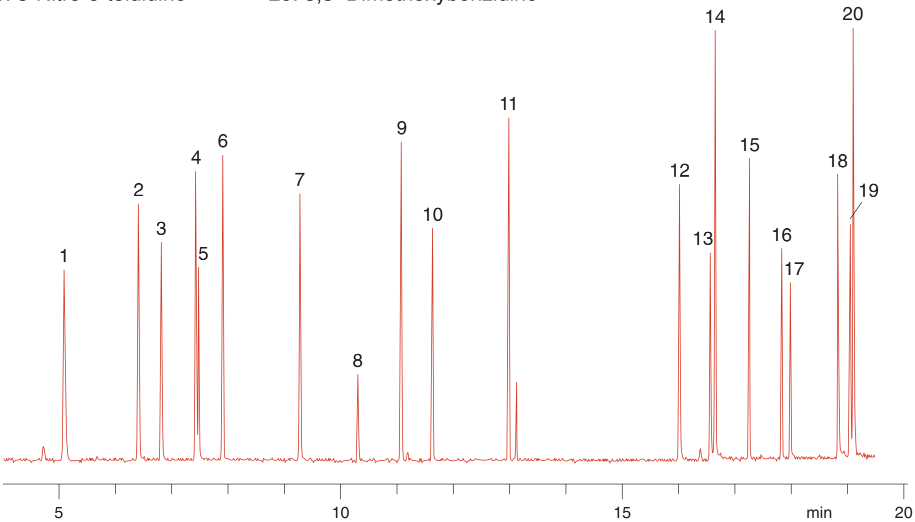
Analysis of aromatic amines

MN Appl. No. 213230

Column:	OPTIMA® 35 MS, 30 m x 0.25 mm ID, 0.25 μm film, REF 726154.30, max. temperature 360/370 °C
Injection:	1 μl, split 1:20
Carrier gas:	1.0 ml/min He
Temperature:	80 °C $\xrightarrow{10\ °C/min}$ 320 °C (10 min)
Detector:	MSD

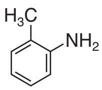
Peaks:

1. o-Toluidine
2. o-Anisidine
3. 4-Chloroaniline
4. p-Cresidine
5. 2,4,5-Trimethylaniline
6. 4-Chloro-o-toluidine
7. 2,4-Diaminotoluene
8. 2,4-Diaminoanisole
9. 2-Naphthylamine
10. 5-Nitro-o-toluidine
11. 4-Aminobiphenyl
12. 4-Aminoazobenzene
13. 4,4'-Oxydianiline
14. Benzidine + 4,4'-diaminodiphenylmethane
15. o-Aminoazotoluene + 3,3'-dimethyl-4,4'-diaminodiphenylmethane
16. 3,3'-Dimethylbenzidine
17. 4,4'-Thiodianiline
18. 3,3'-Dichlorobenzidine
19. 4,4'-Methylene-bis-(2-chloroaniline)
20. 3,3'-Dimethoxybenzidine

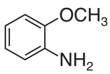


Structures of selected aromatic amines

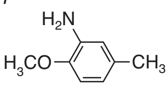
o-Toluidine



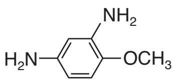
o-Anisidine



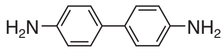
p-Cresidine



2,4-Diaminoanisole



Benzidine



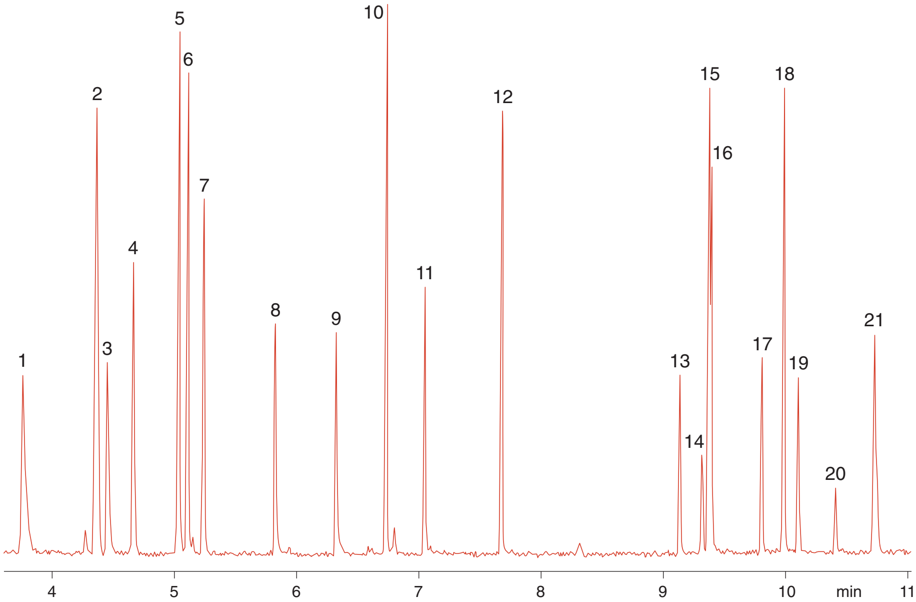
Analysis of azo-dyes and aromatic amines by fast GC

MN Appl. No. 210820

Column: OPTIMA® δ-3, 10 m x 0.1 mm ID, 0.1 μm film, REF 726410.10, max. temperature 340/360 °C
Injection: 1.0 μl, 250 °C
Carrier gas: 84 ml/min, splitless
Pressure: 580 kPa (1 min) $\xrightarrow{\text{42 kPa/min}}$ 966 kPa (5 min)
Temperature: 50 °C (1 min) $\xrightarrow{\text{25 °C/min}}$ 280 °C (5 min)
Detector: MSD 320 °C

Peaks:

1. *o*-Toluidine
2. 2,4- and 2,6-Dimethylaniline
3. *o*-Anisidine
4. 4-Chloroaniline
5. *p*-Cresidine
6. 2,4,5-Trimethylaniline
7. 4-Chloro-*o*-toluidine
8. 2,4-Diaminotoluene
9. 2,4-Diaminoanisole
10. 2-Naphthylamine
11. 5-Nitro-o-toluidine
12. 4-Aminobiphenyl
13. 4-Aminoazobenzene
14. 4,4'-Oxydianiline
15. 4,4'-Diaminodiphenylmethane
16. Benzidine
17. *o*-Aminoazotoluene
18. 3,3'-Dimethyl-4,4'-diaminodiphenylmethane
19. 3,3'-Dimethylbenzidine
20. 4,4'-Thiodianiline
21. 3,3'-Dimethoxybenzidine
 + 4,4'-methylene-bis-(2-chloroaniline)
 + 3,3'-dichlorobenzidine



Courtesy of Mrs. K. Friedrichs, Chem. Untersuchungsamt, Bielefeld, Germany

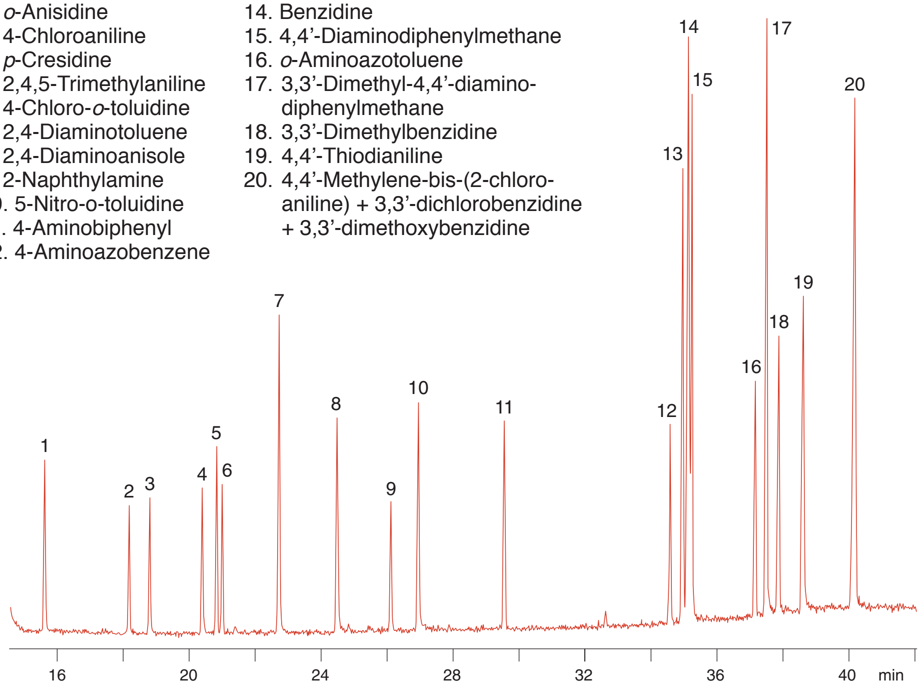
Analysis of azo-dyes and aromatic amines

MN Appl. No. 210170

Column: OPTIMA® 5 Amine, 30 m x 0.25 mm ID, 0.5 μm film, REF 726354.30, max. temperature 300/320 °C
Injection: 2.0 μl
Carrier gas: He
Temperature: 50 °C $\xrightarrow{7\ °C/min}$ 300 °C
Detector: MSD

Peaks:

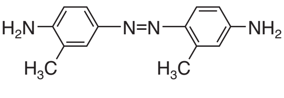
1. *o*-Toluidine
2. *o*-Anisidine
3. 4-Chloroaniline
4. *p*-Cresidine
5. 2,4,5-Trimethylaniline
6. 4-Chloro-*o*-toluidine
7. 2,4-Diaminotoluene
8. 2,4-Diaminoanisole
9. 2-Naphthylamine
10. 5-Nitro-o-toluidine
11. 4-Aminobiphenyl
12. 4-Aminoazobenzene
13. 4,4'-Oxydianiline
14. Benzidine
15. 4,4'-Diaminodiphenylmethane
16. *o*-Aminoazotoluene
17. 3,3'-Dimethyl-4,4'-diamino-diphenylmethane
18. 3,3'-Dimethylbenzidine
19. 4,4'-Thiodianiline
20. 4,4'-Methylene-bis-(2-chloro-aniline) + 3,3'-dichlorobenzidine + 3,3'-dimethoxybenzidine

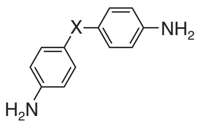


Courtesy of Mrs. Friedrichs, Chem. Untersuchungsamt Bielefeld, Germany

Structures of selected aromatic amines

o-Aminoazotoluene





4,4'-Oxydianiline X = O
4,4'-Thiodianiline X = S

Analysis of organotin compounds

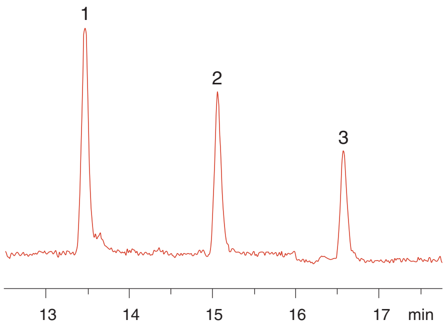
MN Appl. No. 210730

The sample is dissolved in *n*-hexane. After the Grignard reaction with pentylmagnesium bromide the residue is extracted with diethyl ether and dried with Na_2SO_4.

Column:	OPTIMA® 5 MS, 12 m x 0.20 mm ID, 0.35 µm film, REF 726215.12, max. temperature 340/360 °C
Septum purge:	4.5 ml/min
Injection:	1 µl, 250 °C, splitless
Carrier gas:	1 ml/min He (20 kPa)
Temperature:	90 °C $\xrightarrow{6\ °C/min}$ 280 °C (3 min)
Detector:	MSD 280 °C, EI, SIM

Peaks:

1. Tetrabutyl tin (internal standard)
2. Tributyl pentyl tin
3. Dibutyl dipentyl tin



Courtesy of Mr. Wohlfarth, Staatl. Med. Lebensm, Vet. UA, Wiesbaden, Germany

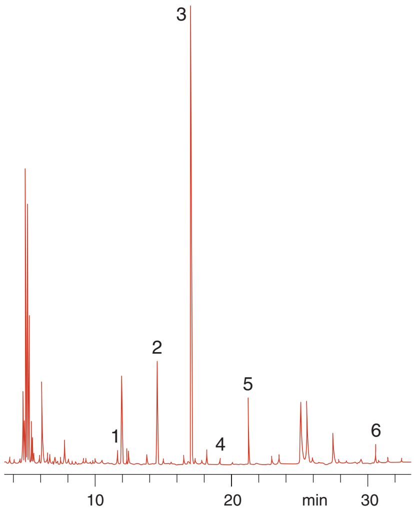
Qualitative determination of organotin compounds

MN Appl. No. 212140

Column:	OPTIMA® 1, 25 m x 0.2 mm ID, 0.35 µm film, REF 726837.25, max. temperature 340/360 °C
Injection:	1 µl, split 15 ml/min
Carrier gas:	He
Temperature:	50 °C $\xrightarrow{6\ °C/min}$ 300 °C
Detector:	MSD, transfer line 300 °C

Peaks:

1. $BuSnEt_3$
2. Bu_2SnEt_2
3. Bu_3SnEt
4. Bu_4Sn
5. *i*-$OcBu_2SnEt$
6. Oc_3SnEt



Solvents · Chemicals

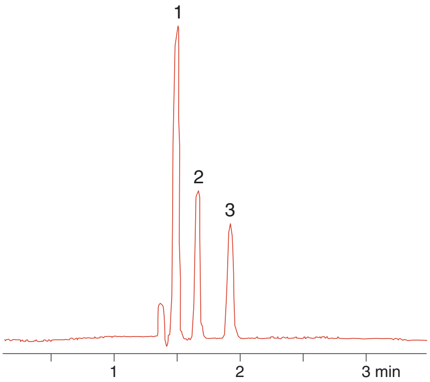
Analysis of methyl silanes

MN Appl. No. 200080

Column:	PERMABOND® Silane, 50 m x 0.32 mm ID, REF 723409.50, max. temperature 260/280 °C
Injection:	1 ml gas
Carrier gas:	60 kPa He
Temperature:	35 °C
Detector:	MSD

Peaks:

1. Methylsilane
2. Dimethylsilane
3. Trimethylsilane



Courtesy of Th. Goldschmidt AG, Essen, Germany

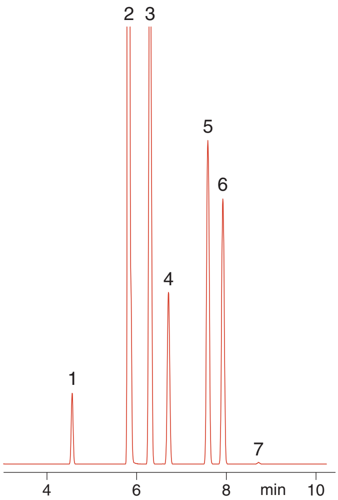
Analysis of chloromethyl silanes

MN Appl. No. 200090

Column:	PERMABOND® Silane, 50 m x 0.32 mm ID, REF 723409.50, max. temperature 260/280 °C
Injection:	0.5 μl, split 80 ml/min
Carrier gas:	1 ml/min He (constant flow)
Temperature:	50 °C (1 min) $\xrightarrow{5\ °C/min}$ 100 °C
Detector:	MSD

Peaks:

1. Tetramethylsilane
2. Dichloromethane
3. Tetrachlorosilane
4. Chlorotrimethylsilane
5. Methyltrichlorosilane
6. Dichlorodimethylsilane
7. Hexamethyldisiloxane



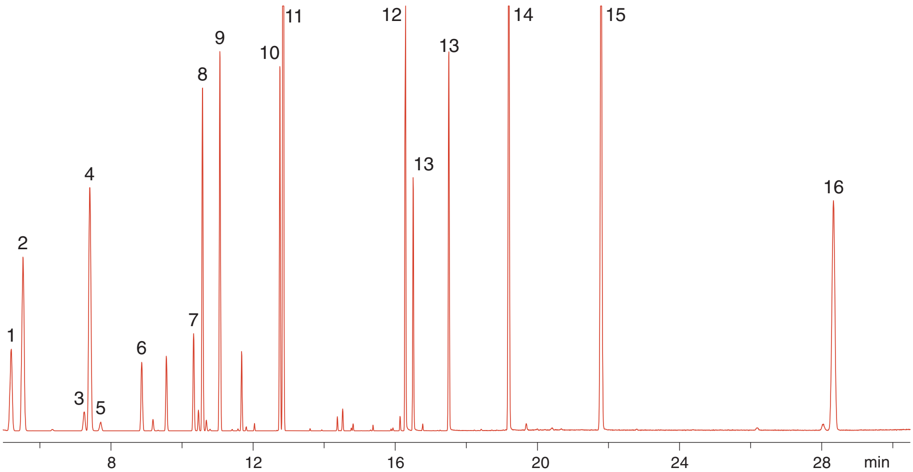
Analysis of silanes

MN Appl. No. 200100

Column: PERMABOND® Silane, 50 m x 0.32 mm ID, REF 723409.50, max. temperature 260/280 °C
Injection: 0.5 µl, split 80 ml/min
Carrier gas: 1.5 ml/min He (constant flow)
Temperature: 60 °C (6 min) $\xrightarrow{20\ °C/min}$ 250 °C (15 min)
Detector: MSD

Peaks:

1. Trimethylmethoxysilane
2. Methylhydrodimethoxysilane
3. Vinyldimethylmethoxysilane
4. Dimethyldimethoxysilane
5. Hexamethyldisiloxane
6. 1,1,3,3-Tetramethyldisiloxane
7. Hexamethyldisilazane (HMDS)
8. Vinyltrimethoxysilane
9. 1,3-Divinyltetramethyldisiloxane
10. 1,3-Divinyltetramethyldisilazane
11. Octamethylcyclotetrasiloxane (D_4)
12. (Cyanopropyl)methyldimethoxysilane
13. (Phenylpropyl)methyldimethoxysilane
14. Diphenyldimethoxysilane
15. 1,3-Diphenyltetramethyldisilazane
16. 1,3-Dicyanopropyltetramethyldisiloxane



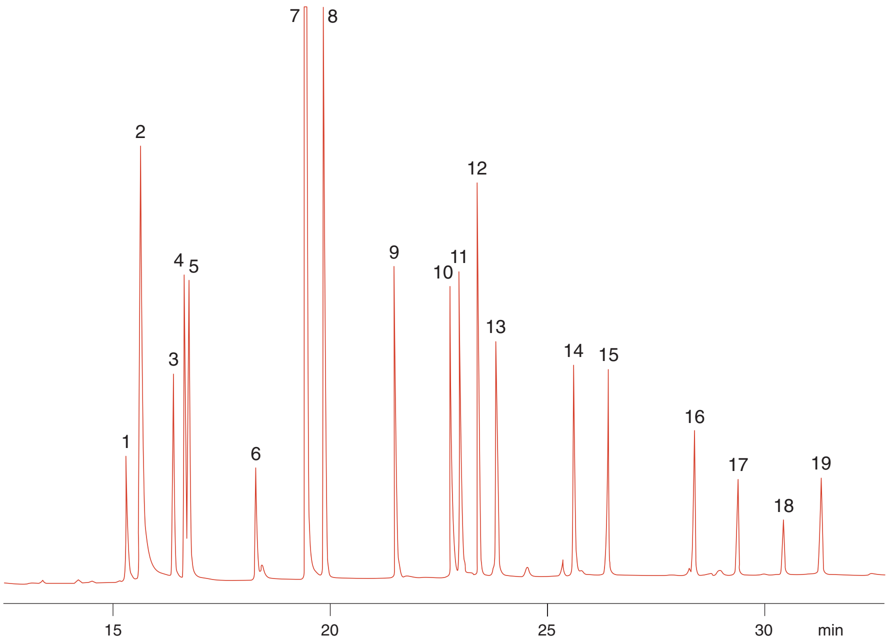
Analysis of bifunctional alkyl nitrates

MN Appl. No. 210290

Column:	OPTIMA® 1701, 50 m x 0.32 mm ID, 0.25 *μ*m film, REF 726318.50, max. temperature 300/320 °C
Carrier gas:	H_2
Temperature:	40 °C (3 min) $\xrightarrow{5\ °C/min}$ 200 °C (10 min)
Detector:	ECD 260 °C

Peaks:

1. 1-Nitrooxypropanol-2
2. 2-Nitrooxyethanol
3. *RR/SS*-3-Nitrooxybutanol-2
4. 2-Nitrooxypropanol-1
5. *RS/SR*-3-Nitrooxybutanol-2
6. 1-Nitrooxybutanol-2
7. 1,2-Ethanediol dinitrate / 1,2-Propanediol dinitrate / 2-Nitrooxybutanol-1
8. 2,3-Butanediol dinitrate
9. 1,2-Butanediol dinitrate
10. 1-Hydroxy-2-nitrooxycyclopentane
11. 1,3-Propanediol dinitrate
12. 1,3-Butanediol dinitrate
13. 1,2-Pentanediol dinitrate
14. 1-Hydroxy-2-nitrooxycyclohexane
15. 1,2-Hexanediol dinitrate
16. *trans*-1,2-Cyclohexanediol dinitrate
17. *cis*-1,2-Cyclohexanediol dinitrate
18. *cis-/trans*-1,3-Cyclohexanediol dinitrate
19. *trans*-1,2-Cycloheptanediol dinitrate / *cis-/trans*-1,3-Cyclohexanediol dinitrate



J. Kastler, K. Ballschmiter, Fresenius J Anal Chem **360** (1998) 812 – 816

Comparison of a separation on a 50 m standard capillary with separation on a 10 m fast GC column

MN Appl. No. 211260

A) Fast GC column

Column: OPTIMA® 5, 10 m x 0.1 mm ID,
0.1 μm film, REF 726846.10,
max. temperature 340/360 °C
injection 1 μl, split 1:40,
carrier gas 0.75 bar He

B) standard GC column

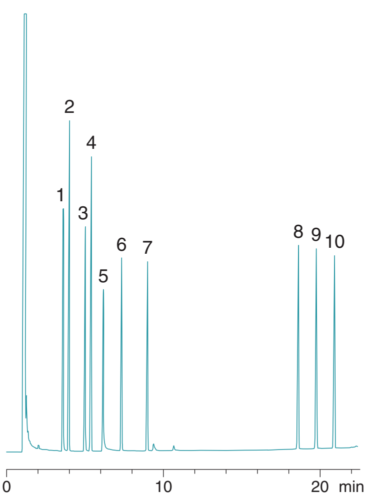
Column: OPTIMA® 5, 50 x 0.25 mm ID,
0.25 μm film, REF 726056.50,
max. temperature 340/360 °C
injection 1 μl, split 1:35,
carrier gas 1.5 bar He

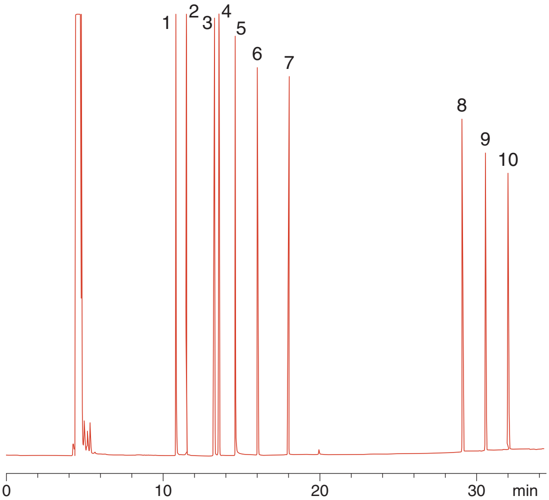
both separations: temperature: 80 °C $\xrightarrow{8\ °C/min}$ 320 °C (10 min), detector: FID

While maintaining the temperature programme and halving the pressure a time saving of 30 % results with identical separation efficiency.

Peaks:

1. Octanol
2. Undecane
3. Dimethylaniline
4. Dodecane
5. Decylamine
6. Methyl decanoate
7. Methyl undecanoate
8. Henicosane
9. Docosane
10. Tricosane





Food and Cosmetic Components

Fragrances

FAMEs

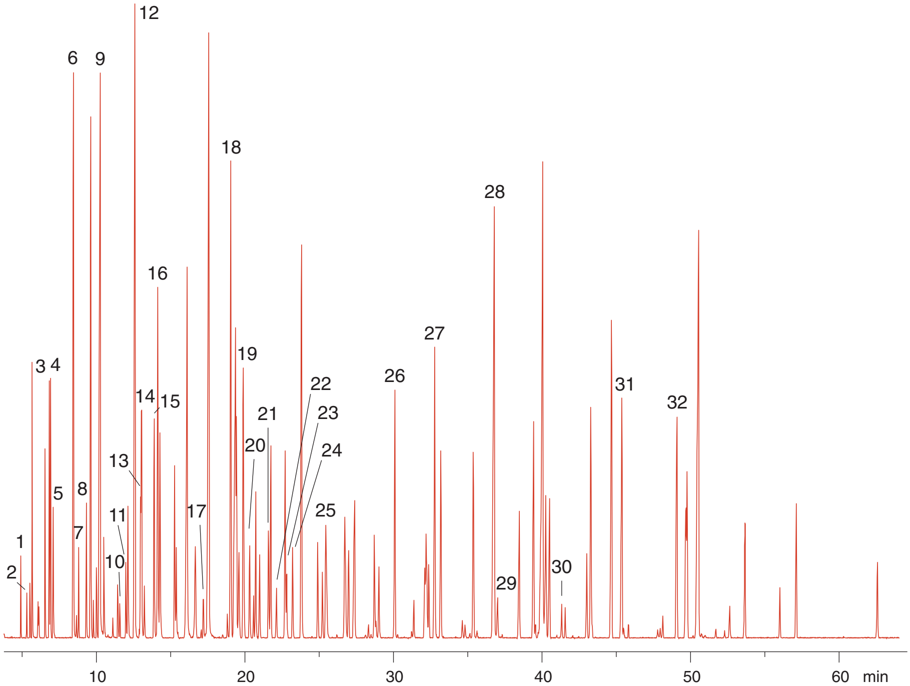
Analysis of a perfume standard

MN Appl. No. 201350

Column: OPTIMA® 5, 25 m x 0.20 mm ID, 0.20 µm film, REF 726857.25, max. temperature 340/360 °C
Injection: 1.0 µl of a standard of perfume ingredients, 1:100 in EtOH, split 1:100 sample courtesy of Mr. Vogel, Luzi AG, Dietlikon, Switzerland
Carrier gas: 25 cm/s He
Temperature: 70 °C (3 min) $\xrightarrow{2\ °C/min}$ 320 °C
Detector: MSD

Peaks:

1. Benzaldehyde
2. β-Pinene
3. Limonene
4. Eucalyptol (Cineole)
5. Benzyl alcohol
6. 2,6-Dimethyl-7-octen-2-ol
7. Hexanoic acid 2-propenyl ester
8. Benzoic acid methyl ester
9. Phenylethanol
10. *p*-Menth-1(7)-en-9-ol
11. 3,7-Dimethyl-6-octenal
12. Phenylacetic acid methyl ester
13. Menthol
14. Acetic acid isononyl ester
15. Linalyl propanoate
16. α-Methylbenzyl acetate
17. 4-Methoxybenzaldehyde
18. Bornyl acetate
19. Nonanoic acid ethyl ester
20. 3-Phenyl-2-propen-1-ol
21. Piperonal
22. 2-Aminobenzoic acid methyl ester
23. 2-Carene
24. Eugenol
25. Diphenyl ether
26. α-Isomethyl ionone
27. Lilial
28. Diethyl phthalate
29. 2-Naphthyl methyl ketone
30. Methyl dihydrojasmonate
31. Benzyl benzoate
32. Isopropyl myristate



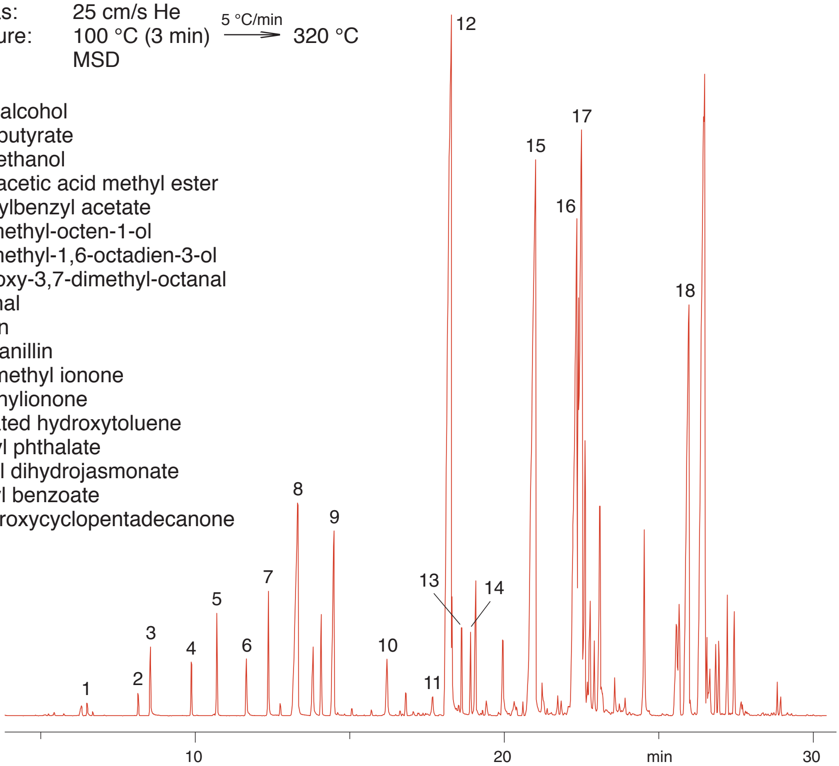
Food and cosmetic components

Analysis of commercial perfume

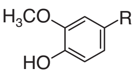
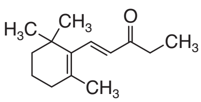
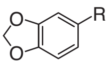
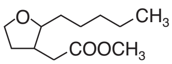
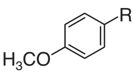
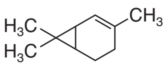
MN Appl. No. 201360

Column: OPTIMA® 5, 25 m x 0.20 mm ID, 0.20 µm film, REF 726857.25, max. temperature 340/360 °C
Injection: 1.0 µl perfume sample, 1:100 in EtOH, 3 s splitless
Carrier gas: 25 cm/s He
Temperature: 100 °C (3 min) $\xrightarrow{5\ °C/min}$ 320 °C
Detector: MSD

Peaks:
1. Benzyl alcohol
2. Linalyl butyrate
3. Phenylethanol
4. Phenylacetic acid methyl ester
5. α-Methylbenzyl acetate
6. 3,7-Dimethyl-octen-1-ol
7. 3,7-Dimethyl-1,6-octadien-3-ol
8. 7-Hydroxy-3,7-dimethyl-octanal
9. Piperonal
10. Vanillin
11. Ethylvanillin
12. α-Isomethyl ionone
13. β-Methylionone
14. Butylated hydroxytoluene
15. Diethyl phthalate
16. Methyl dihydrojasmonate
17. Benzyl benzoate
18. 2-Hydroxycyclopentadecanone



Structures of selected perfume ingredients

Structure	Compound	R	Structure	Compound
	Vanillin Vinylguaiacol Eugenol	CHO $CH{=}CH_2$ $CH_2{-}CH{=}CH_2$		β-Methylionone
	Piperonal Safrole	CHO $CH_2{-}CH{=}CH_2$		Methyl dihydrojasmonate
	Anisaldehyde Anethole	CHO $CH{=}CH{-}CH_3$		2-Carene

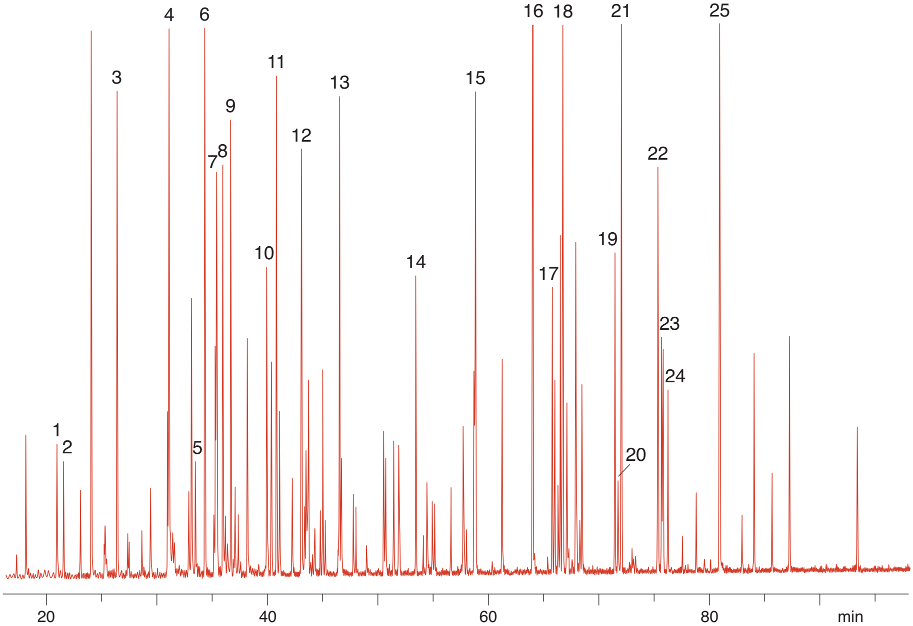
Analysis of a perfume standard

MN Appl. No. 250530

Column:	OPTIMA® δ-6, 50 m x 0.20 mm ID, 0.20 μm film, REF 726465.50, max. temperature 340/360 °C
Injection:	1.0 μl of a standard of perfume ingredients, 1:30 in EtOH, split 1:40 sample courtesy of Mr. Vogel, Luzi AG, Dietlikon, Switzerland
Carrier gas:	1.8 bar He
Temperature:	60 °C $\xrightarrow{2\ °C/min}$ 280 °C (5 min)
Detector:	MSD

Peaks:

1. Limonene
2. Cineole
3. Linalool
4. 2-Phenylethanol
5. Menthol
6. Benzyl acetate
7. Styralyl acetate (1-phenylethyl acetate)
8. 3,7-Dimethyl-6-octen-1-ol
9. Linalyl anthranilate
10. Ethyl nonanoate
11. Bornyl acetate
12. Hydroxycitronellal
13. 4-*t*-Butylcyclohexyl acetate
14. α-Isomethyl ionone
15. Lilial
16. Diethyl phthalate
17. 3,5-Di-*t*-butylphenol
18. Methyl dihydrojasmonate
19. Isopropyl myristate
20. Methyl atratate (methyl 2,4-dihydroxy-3,6-dimethylbenzoate)
21. Hexylcinnamic aldehyde
22. Benzyl benzoate
23. AETT (acetylethyltetramethyltetralin)
24. Oxacyclohexadecan-2-one
25. Benzyl salicylate



Food and cosmetic components

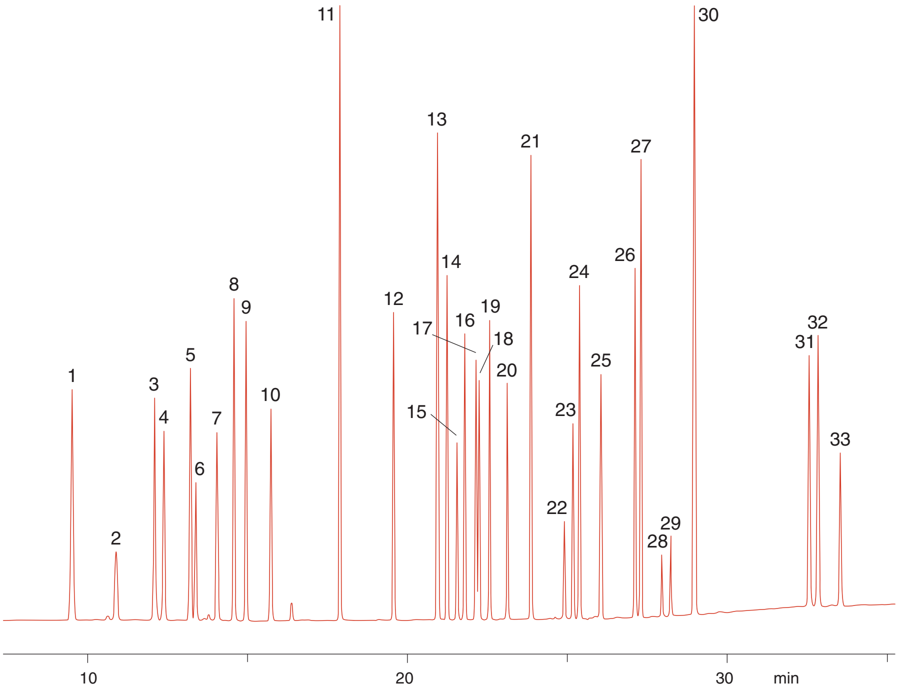
Analysis of essential oils

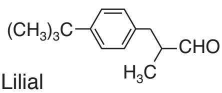
MN Appl. No. 201340

Column:	PERMABOND® CW 20 M, 50 m x 0.32 mm ID, 0.5 μm film, REF 723296.50, max. temperature 220/240 °C
Injection:	1 μl
Carrier gas:	1.5 bar He
Temperature:	60 °C (5 min) —8 °C/min→ 250 °C (10 min)
Detector:	FID 250 °C

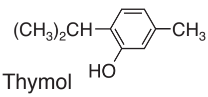
Peaks:

1. α-Pinene
2. Camphene
3. β-Pinene
4. Sabinene
5. Carene
6. Myrcene
7. α-Terpinene
8. Limonene
9. Cineole
10. γ-Terpinene
11. Hexanol-1
12. Fenchone
13. L-Menthone
14. Menthofuran
15. Isomenthone
16. Linalool
17. Camphor
18. Linalyl acetate
19. Menthyl acetate
20. Bornyl acetate
21. Menthol
22. α-Terpineol
23. Borneol
24. Menthyl valerianate
25. Carvone
26. Geraniol
27. Anethole
28. Benzyl alcohol
29. Safrole
30. Dodecanol
31. Thymol
32. Eugenol
33. α-Bisabolol

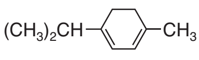




Lilial

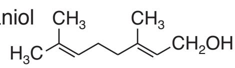


Thymol

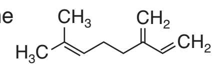


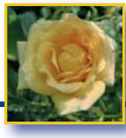
α-Terpinene

Geraniol



Myrcene



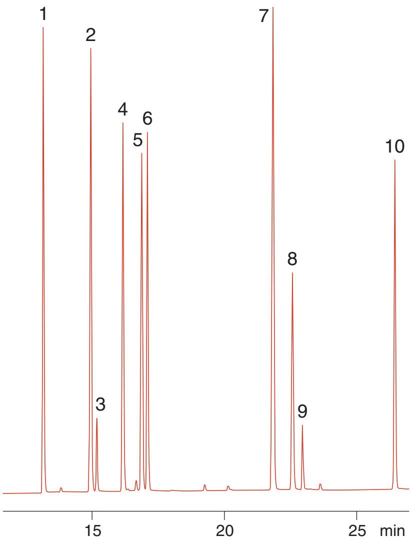


Analysis of essential oils

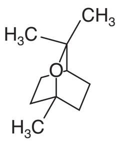
MN Appl. No. 201330

Column: OPTIMA® 5, 50 m x 0.25 mm ID, 0.35 µm film, REF 726623.50, max. temperature: 340/360 °C
Injection: 0.5 µl, split 1:50
Carrier gas: 1 bar N_2
Temperature: 95 °C (10 min) $\xrightarrow{6\ °C/min}$ 200 °C
Detector: FID 280 °C

Peaks:
1. α-Pinene
2. β-Pinene
3. Int. std.
4. Δ^3-Carene
5. Limonene
6. 1,8-Cineole
7. Camphor
8. Menthol
9. Int. std.
10. Bornyl acetate



1,8-Cineole

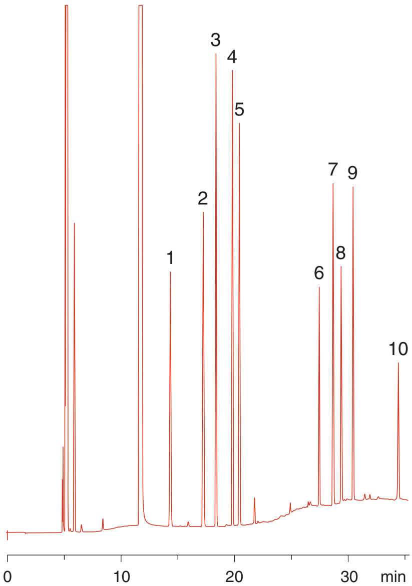


Analysis of essential oils

MN Appl. No. 201370

Column: PERMABOND® FFAP, 50 m x 0.32 mm ID, 0.5 µm film, REF 723344.50, max. temperature 220/240 °C
Injection: 0.5 µl, split 1:50
Carrier gas: 0.7 bar N_2
Temperature: 60 °C (6 min) $\xrightarrow{8\ °C/min}$ 200 °C (20 min)
Detector: FID 250 °C

Peaks:
1. α-Pinene
2. β-Pinene
3. Δ^3-Carene
4. Limonene
5. Eucalyptol (Cineole)
6. Camphor
7. Linalool
8. Bornyl acetate
9. Menthol
10. Carvone



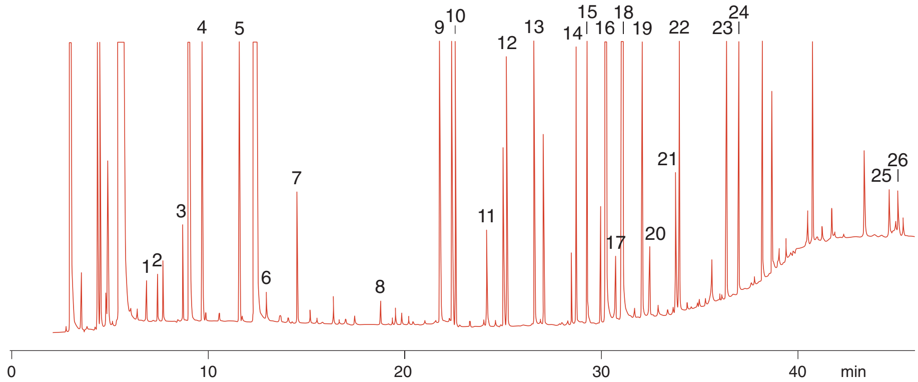
Key odorants in beer

MN Appl. No. 211880

Column:	PERMABOND® FFAP, 60 m x 0.25 mm ID, 0.25 μm film, REF 723116.60, max. temperature 220/240 °C
Injection:	1 μl, splitless (split open at 1.0 min)
Carrier gas:	H_2 (5.0)
Temperature:	40 °C (2 min) → 5 °C/min → 230 °C (40 min)
Detector:	FID

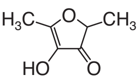
Peaks:

1. 2-Methylpropyl acetate
2: Ethyl butanoate
3. Methyl pentanoate
4. 3-Methylbutyl acetate
5. Methyl hexanoate
6. Ethyl hexanoate
7. Methyl heptanoate
8. Ethyl octanoate
9. 2-Methylthioethanol
10. 2-Methylpropionic acid
11. Butyric acid
12. 3-Methylbutyric acid
13. 3-Methylthiopropanol
14. 2-Phenylethyl acetate
15. Hexanoic acid
16. Benzyl alcohol
17. 3-Ethyl-2-hydroxy-2-cyclopenten-1-one
18. 2-Phenylethanol
19. (E)-2-Hexenoic acid
20. Maltol
21. Furaneol
22. Octanoic acid
23. Eugenol
24. 4-Vinylguaiacol
25. Phenylacetic acid
26. Vanillin

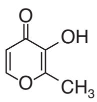


B. Thum, W. Back, EBC Congress 1999

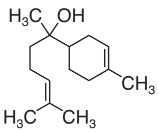
Furaneol

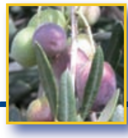


Maltol



Bisabolol





Analysis of a plum brandy

MN Appl. No. 210930

Column: PERMABOND® CW 20 M, 25 m x 0.32 mm ID, 0.5 µm film, REF 723296.25, max. temperature 220/240 °C

Injection: 1 ml, 150 °C, split 1:20

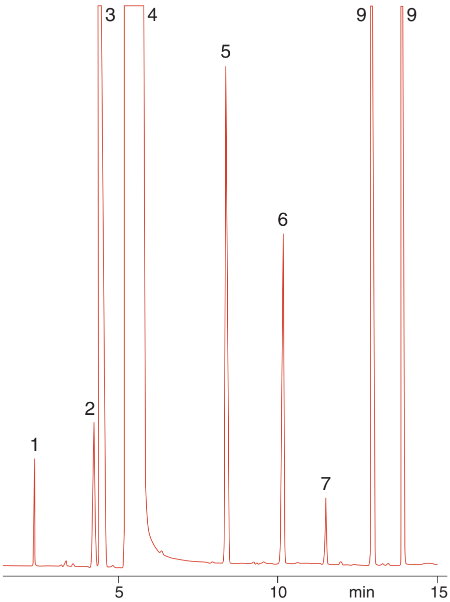
Carrier gas: N_2, 40 Kpa (1 – 2 ml/min)

Temperature: 50 °C (2 min) $\xrightarrow{2\ °C/min}$ 60 °C (5 min) $\xrightarrow{10\ °C/min}$ 150 °C (9 min) $\xrightarrow{10\ °C/min}$ 170 °C (5 min)

Detector: FID 180 °C

Peaks:

1. Acetaldehyde
2. Ethyl acetate
3. Methanol
4. Ethanol
5. Propanol-1
6. 2-Methylpropanol-1
7. Butanol-1
8. Isoamyl alcohol
9. Pentanol-1



Courtesy of Dr. Nilles, Wein- u. Bodenlabor, Volkach, Germany

Analysis of brandy made from wine

MN Appl. No. 201480

Column: OPTIMA® 5, 50 m x 0.32 mm ID, 1.0 µm film, REF 726325.50, max. temperature 340/360 °C

Injection: 0.5 µl, split 30 ml/min

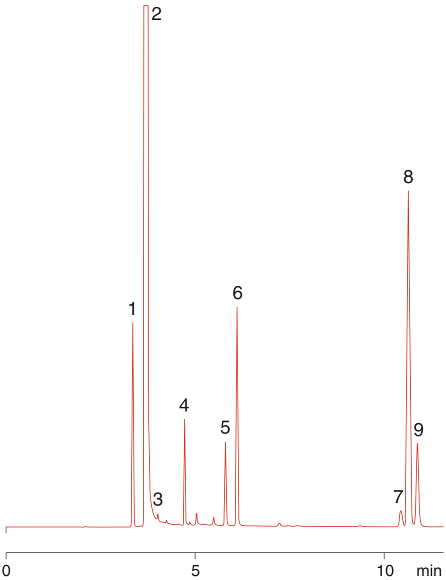
Carrier gas: 1 bar N_2

Temperature: 60 °C (10 min) $\xrightarrow{4\ °C/min}$ 80 °C

Detector: FID 250 °C

Peaks:

1. Acetaldehyde/methanol
2. Ethanol
3. Acetone
4. Propanol-1
5. Ethyl acetate
6. *i*-Butanol
7. Diethyl acetal
8. 3-Methyl-1-butanol
9. 2-Methyl-1-butanol



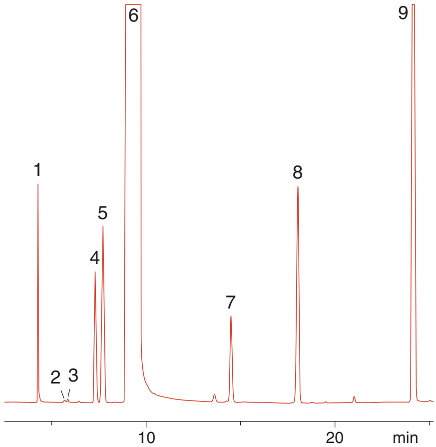
Food and cosmetic components

Analysis of brandy made from wine

MN Appl. No. 201490

Column: PERMABOND® CW 20 M, 50 m x 0.32 mm ID, 0.5 μm film, REF 723296.50, max. temperature 220/240 °C
Injection: 1 μl, split 20 ml/min
Carrier gas: 1 bar N_2
Temperature: 60 °C (10 min) → 4 °C/min → 140 °C
Detector: FID 250 °C

Peaks:
1. Acetaldehyde
2. Acetone
3. Methyl acetate
4. Ethyl acetate
5. Methanol
6. Ethanol
7. Propanol-1
8. *i*-Butanol
9. 2-Methyl-1-butanol/3-methyl-1-butanol

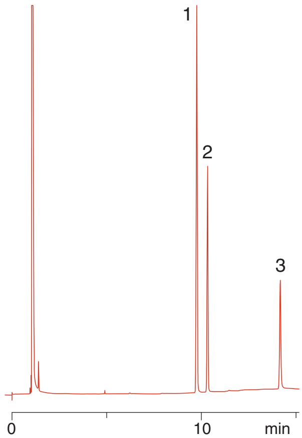


Analysis of DEG standard (5 g/l ethanol) for wine analysis

MN Appl. No. 201500

Column: PERMABOND® CW 20 M-DEG 25 m x 0.25 mm ID, 0.25 μm film, REF 723063.25, max. temperature 220/240 °C
Injection: 0.5 μl, split 1:40
Carrier gas: 1.2 bar N_2
Temperature: 80 °C → 10 °C/min → 200 °C
Detector: FID 260 °C

Peaks: DEG standard
1. 1,4-Butanediol
2. Diethylene glycol (DEG)
3. Glycerol



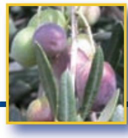
Summary of important saturated fatty acids

Code	Common name	Systematic name
C2:0	acetic acid	ethanoic acid
C3:0	propionic acid	propanoic acid
C4:0	butyric acid	butanoic acid
C4:0 iso	isobutyric acid	2-methylpropanoic acid
C5:0	valeric acid	pentanoic acid
C5:0 iso	isovaleric acid	3-methylbutanoic acid
C6:0	caproic acid	hexanoic acid
C6:0 iso	isocaproic acid	4-methylvaleric acid
C7:0	enanthic acid	heptanoic acid
C8:0	caprylic acid	octanoic acid
C9:0	pelargonic acid	nonanoic acid
C10:0	capric acid	decanoic acid
C12:0	lauric acid	dodecanoic acid
C14:0	myristic acid	tetradecanoic acid
C14:0 iso	isomyristic acid	12-methyltridecanoic acid
C15:0		pentadecanoic acid
C15:0 iso	13-methylmyristic acid	13-methyltetradecanoic acid
C15:0 anteiso	12-methylmyristic acid	12-methyltetradecanoic acid
C16:0	palmitic acid	hexadecanoic acid
C16:0 iso	isopalmitic acid	14-methylpentadecanoic acid
C17:0	margaric acid	heptadecanoic acid
C17:0 iso	isomargaric acid 15-methylpalmitic acid	15-methylhexadecanoic acid
C17:0 anteiso	anteisomargaric acid 14-methylpalmitic acid	14-methylhexadecanoic acid
C18:0	stearic acid	octadecanoic acid
C19:0 cyclo	methylene stearic acid	methylene octadecanoic acid
C20:0	arachidic acid	eicosanoic acid
C22:0	behenic acid	docosanoic acid
C23:0	trocosanoic acid	tricosanoic acid
C24:0	lignoceric acid	tetracosanoic acid
C26:0	cerotic acid	hexacosanoic acid

Food and cosmetic components

Summary of important unsaturated fatty acids

Code	Systematic name	ω reference system	Common name	ω-3 acid	ω-6 acid
C3:1	propenoic acid		acrylic acid		
C6:2	2,4-hexadienoic acid	C6:2n2	sorbic acid		
C14:1	*cis*-9-tetradecenoic acid	C14:1n5c	myristoleic acid		
	trans-9-tetradecenoic acid	C14:1n5t	myristelaidic acid		
C15:1	*cis*-10-pentadecenoic acid	C15:1n5			
C16:1	*cis*-9-hexadecenoic acid	C16:1n7c	palmitoleic acid		
	trans-9-hexadecenoic acid	C16:1n7t	palmitelaidic acid		
C17:1	*cis*-10-heptadecenoic acid	C17:1n7			
C18:1	*cis*-9-octadecenoic acid	C18:1n9c	oleic acid		
	trans-9-octadecenoic acid	C18:1n9t	elaidic acid		
	cis-11-octadecenoic acid	C18:1n7	vaccenic acid		
C18:2	*cis*-9,12-octadecadienoic acid	C18:2n6c	linoleic acid		x
	trans-9,12-octadecadienoic acid	C18:2n6t	linolelaidic acid		x
C18:3	*cis*-9,12,15-octadecatrienoic acid	C18:3n3	α -linolenic acid	x	
	cis-6,9,12-octadecatrienoic acid	C18:3n6	γ-linolenic acid		x
C18:4	*cis*-6,9,12,15-octadecatetraenoic acid	C18:4n3	stearidonic acid	x	
C20:1	*cis*-11-eicosenoic acid	C20:1n9	gondoic acid		
C20:2	*cis*-11,14-eicosadienoic acid	C20:2n6			x
C20:3	*cis*-5,8,11-eicosatrienoic acid	C20:3n9	mead acid		
	cis-8,11,14-eicosatrienoic acid	C20:3n6			x
	cis-11,14,17-eicosatrienoic acid	C20:3n3		x	
C20:4	*cis*-5,8,11,14-eicosatetraenoic acid	C20:4n6	arachidonic acid		x
	cis-8,11,14,17-eicosatetraenoic acid	C20:4n3		x	
C20:5	*cis*-5,8,11,14,17-eicosapentaenoic acid	C20:5n3		x	
C22:1	*cis*-13-docosenoic acid	C22:1n9	erucic acid		
C22:2	*cis*-13,16-docosadienoic acid	C22:2n6			x
C22:3	*cis*-13,16,19-docosatrienoic acid	C22:3n3		x	
C22:4	*cis*-7,10,13,16-docosatetraenoic acid	C22:4n6	adrenic acid		x
C22:5	*cis*-7,10,13,16,19-docosapentaenoic a.	C22:5n3	clupanodonic acid	x	
C22:6	*cis*-4,7,10,13,16,19-docosahexaenoic a.	C22:6n3		x	
C24:1	*cis*-15-tetracosenoic acid	C24:1n9	nervonic acid		



Determination of butyric acid content in edible fats

MN Appl. No. 210130

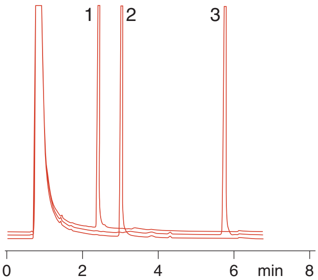
In so-called mixed spreads unsaturated vegetable oils and fats replace a certain percentage of milk fat (MF). The proportion of MF in the product has to be labelled to protect the consumer from fraudulent malpractise, since the price of MF is higher than that of other relevant raw materials. In order to check correct labelling of mixed spreads, food inspection authorities need a reliable analytical method to determine the percentage of MF in the spread. The most distinctive feature of MF, i.e. the unique occurence of butyric acid, is most often determined by chromatography and used as an indicator for calculating the MF content in foodstuffs.

MF (100 mg) is weighed in a 10 ml HS vial, 1 ml sodium methoxide (0.5 % metallic sodium in methanol), 1 ml internal standard solution (isobutyric acid, valeric acid) are added, and the vial is sealed with a PTFE-lined crimp cap.

Column:	OPTIMA® 5, 25 m x 0.32 mm ID, 1.0 µm film, REF 726325.25, max. temperature 340/360 °C
Injection:	head space, split 1:34, 150 °C
Carrier gas:	3 ml/min H_2, 50 kPa head-pressure
Temperature:	50 °C (7 min) $\xrightarrow{4\ °C/min}$ 60 °C
Detector:	FID 250 °C

Peaks:

1. C4 iso
2. C4
3. C5



F. Ulberth, Z. Lebensm. Unters. Forsch. A, **206** (1998) 305 – 307

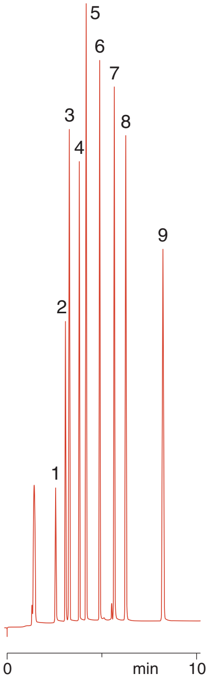
Analysis of free carboxylic acids C2 – C7

MN Appl. No. 201570

Column:	PERMABOND® FFAP, 10 m x 0.25 mm ID, 0.25 µm film, REF 723116.10, max. temperature 220/240 °C
Injection:	0.5 µl, split 1:50
Carrier gas:	0.3 bar N_2
Temperature:	120 °C $\xrightarrow{6\ °C/min}$ 150 °C (10 min)
Detector:	FID 260 °C

Peaks:

1. C2
2. C3
3. C4 iso
4. C4
5. C5 iso
6. C5
7. C6 iso
8. C6
9. C7



Food and cosmetic components

Separation of C18 FAMEs

MN Appl. No. 212640

Column: OPTIMA® δ-6, 50 m x 0.20 mm ID, 0.2 μm film, REF 726465.50, max. temperature 340/360 °C

Injection: 1 μl, 0.1 % FAME in hexane split 20 ml/min

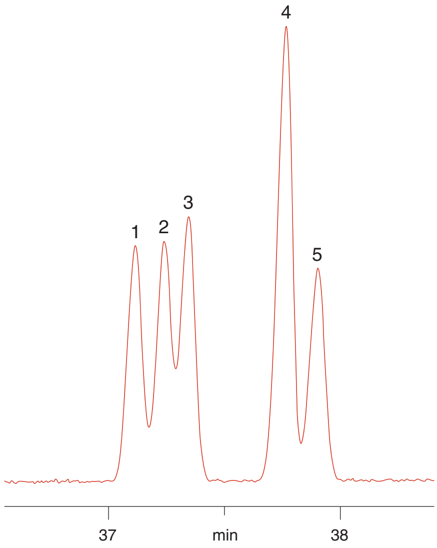
Carrier gas: 2.2 bar He

Temperature: 120 °C $\xrightarrow{6\ °C/min}$ 180 °C $\xrightarrow{2\ °C/min}$ 300 °C (5 min)

Detector: MSD 280 °C

Peaks:

1. C18:1n9c
2. C18:2n6c
3. C18:1n9t
4. C18:0
5. C18:3n3



Analysis of FAMEs C10:0 – C18:2

MN Appl. No. 201700

Column: PERMABOND® FFAP, 25 m x 0.25 mm ID, 0.25 μm film, REF 723116.25, max. temperature 220/240 °C

Injection: 0.5 μl, split 1:50

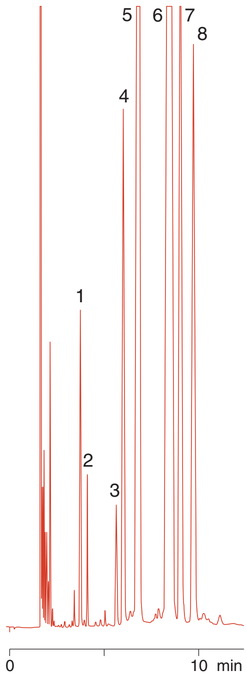
Carrier gas: 1 bar N_2

Temperature: 200 °C

Detector: FID 260 °C

Peaks:

1. C10:0
2. C16:0
3. C18:0
4. C18:1n9c
5. C18:2n6c
6. C18:2 (*cis, cis,* 9, 11)
7. C18:2 (*cis, trans,* 9, 11)
8. C18:2 (*trans, trans,* 9, 11)



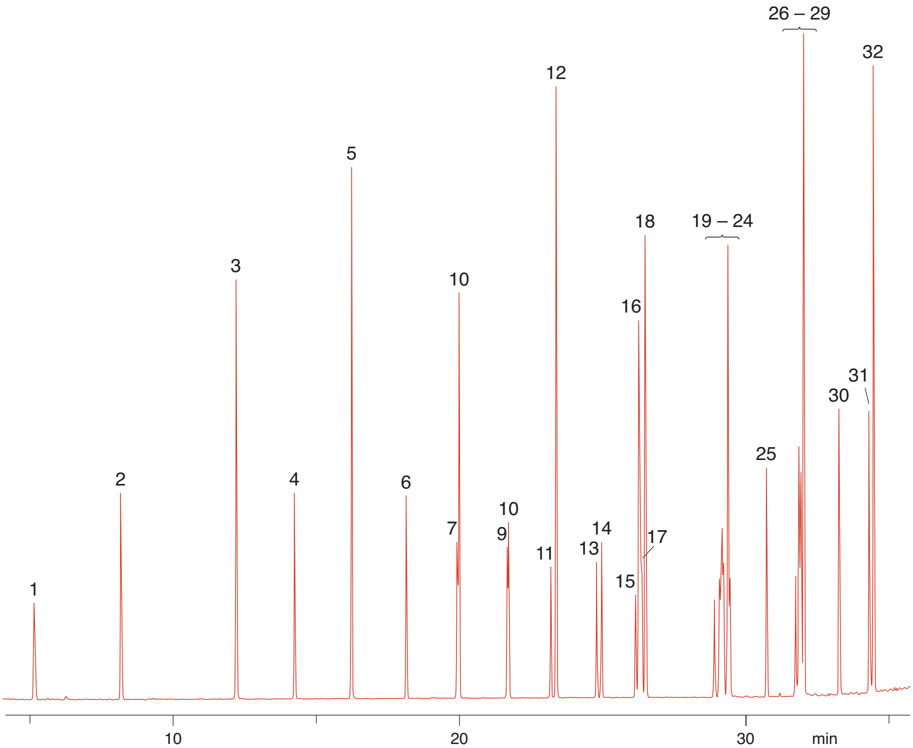
Analysis of FAMEs

MN Appl. No. 250120

Column: OPTIMA® δ-3, 25 m x 0.20 mm ID, 0.20 μm film, REF 726400.25, max. temperature 340/360 °C
Injection: 1 μl, split 1:40
Carrier gas: 1.1 bar He
Temperature: 100 °C (1 min) $\xrightarrow{6\ °C/min}$ 300 °C (5 min)
Detector: MSD

Peaks:

1. C6:0	9. C15:1	17. C18:0	25. C21:0
2. C8:0	10. C15:0	18. C18:2	26. C20:5
3. C10:0	11. C16:1	19. C20:4	27. C22:1
4. C11:0	12. C16:0	20. C20:3	28. C22:2
5. C12:0	13. C17:1	21. C20:1	29. C22:0
6. C13:0	14. C17:0	22. C20:2	30. C23:0
7. C14:1	15. C18:3	23. C20:0	31. C24:1
8. C14:0	16. C18:1	24. C20:3	32. C24:0



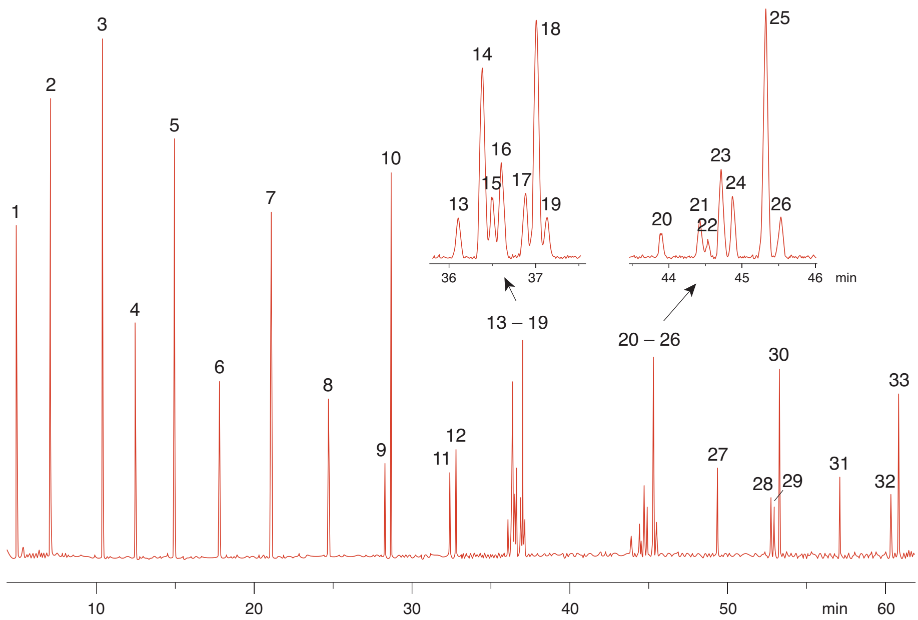
Analysis of FAMEs

MN Appl. No. 250470

Column: OPTIMA® δ-6, 50 m x 0.20 mm ID, 0.20 µm film, REF 726465.50, max. temperature 340/360 °C
Injection: 1 µl, 10 mg FAME mix per ml in CH_2Cl_2, split 1:50
Carrier gas: 2.2 bar He
Temperature: 120 °C $\xrightarrow{6\ °C/min}$ 180 °C $\xrightarrow{2\ °C/min}$ 300 °C (5 min)
Detector: MSD

Peaks:

1. C6:0
2. C8:0
3. C10:0
4. C11:0
5. C12:0
6. C13:0
7. C14:0 + C14:1n5c
8. C15:0 + C15:1n5c
9. C16:1n7c
10. C16:0
11. C17:1n7
12. C17:0
13. C18:3n6
14. C18:1n9c
15. C18:2n6c
16. C18:1n9t
17. C18:2n6t
18. C18:0
19. C18:3n3
20. C20:4n6
21. C20:3n6
22. C20:5n3
23. C20:1n9
24. C20:2n6
25. C20:0
26. C20:3n3
27. C21:0
28. C22:1n9
29. C22:2n6
30. C22:0
31. C23:0
32. C24:1n9
33. C24:0



Analysis of FAMEs in porcine fat

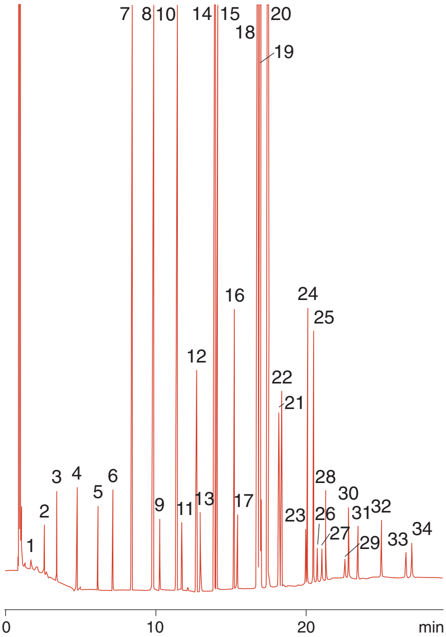
MN Appl. No. 210060

Column:	OPTIMA® 225, 25 m x 0.32 mm ID, 0.25 μm film, REF 726352.25, max. temperature 260/280 °C
Injection:	1 μl, split 1:40
Carrier gas:	60 kPa H_2
Temperature:	50 °C (2 min) $\xrightarrow{30\ °C/min}$ 125 °C $\xrightarrow{5\ °C/min}$ 160 °C $\xrightarrow{20\ °C/min}$ 180 °C $\xrightarrow{3\ °C/min}$ 200 °C $\xrightarrow{20\ °C/min}$ 220 °C (10 min)
Detector:	FID 260 °C

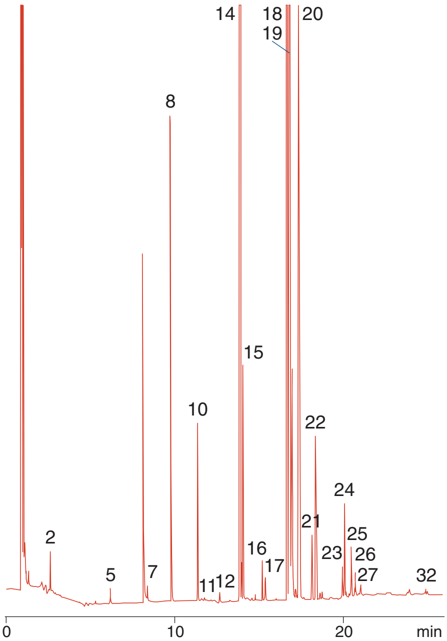
Peaks:

1. C4:0	6. C11:0	11. C14:1n5c	16. C17:0	21. C18:3	26. C20:4n6	31. C22:2
2. C5:0	7. C12:0	12. C15:0	17. C17:1	22. C19:0	27. C20:3	32. C22:6
3. C6:0	8. C13:0	13. C15:1	18. C18:0	23. C20:0	28. C20:5	33. C24:0
4. C8:0	9. C13:1	14. C16:0	19. C18:1n9c	24. C20:1	29. C22:0	34. C24:1n9
5. C10:0	10. C14:0	15. C16:1n7c	20. C18:2n6c	25. C20:2	30. C22:1	

FAME standard



FAMEs in porcine fat



Courtesy of Dr. Bantleon, Mr. Leusche, Mr. Hagemann, VFG-Labor, Versmold, Germany

Food and cosmetic components

Analysis of FAMEs from pork and salmon

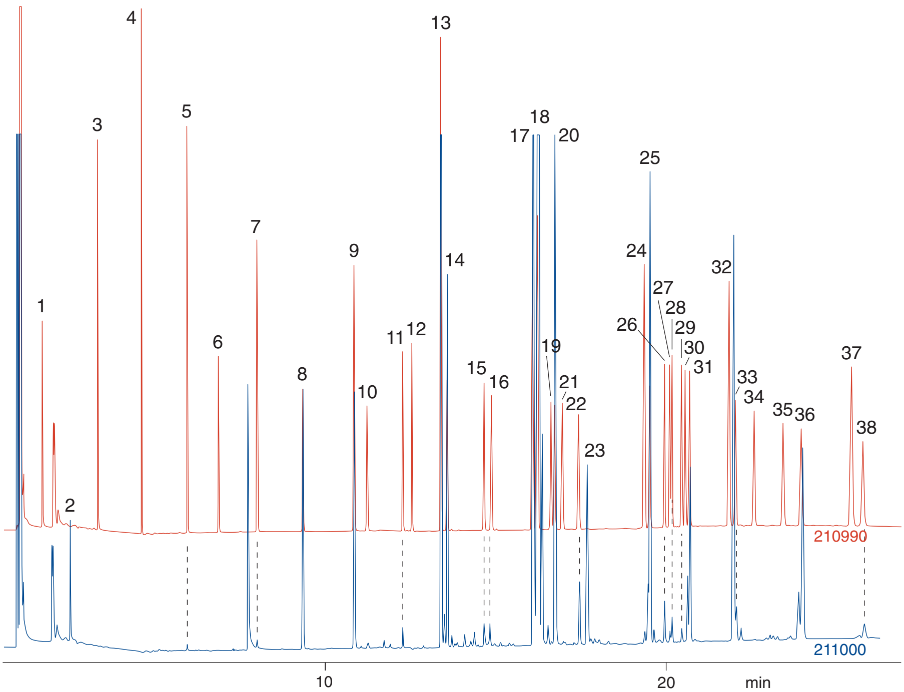
MN Appl. No. 210990 / 211000

Column: OPTIMA® 225, 25 m x 0.32 mm ID, 0.25 µm film, REF 726352.25, max. temperature 260/280 °C
Injection: 1 µl, split 1:40
Carrier gas: 60 kPa H_2
Temperature: 50 °C (2 min) $\xrightarrow{30\ °C/min}$ 125 °C $\xrightarrow{5\ °C/min}$ 160 °C $\xrightarrow{20\ °C/min}$ 180 °C $\xrightarrow{3\ °C/min}$ 200 °C $\xrightarrow{20\ °C/min}$ 220 °C (10 min)
Detector: FID 260 °C

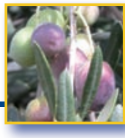
Application 210990: FAME mixture · Application 211000: FAMEs from pork and salmon

Peaks:

1. C4:0	9. C14:0	17. C18:0	25. C20:1n9	33. C22:1n9
2. C5:0	10. C14:1n5	18. C18:1n9c+t	26. C20:2n6	34. C22:2n6
3. C6:0	11. C15:0	19. C18:2n6t	27. C20:3n6	35. C23:0
4. C8:0	12. C15:1n5	20. C18:2n6c	28. C20:4n6	36. C22:6n3
5. C10:0	13. C16:0	21. C18:3n6	29. C20:3n3	37. C24:0
6. C11:0	14. C16:1n7	22. C18:3n3	30. C21:0	38. C24:1n9
7. C12:0	15. C17:0	23. C19:0	31. C20:5n3	
8. C13:0	16. C17:1n7	24. C20:0	32. C22:0	



Courtesy of Dr. Bantleon, Mr. Leusche, Mr. Hagemann, VFG-Labor, Versmold, Germany



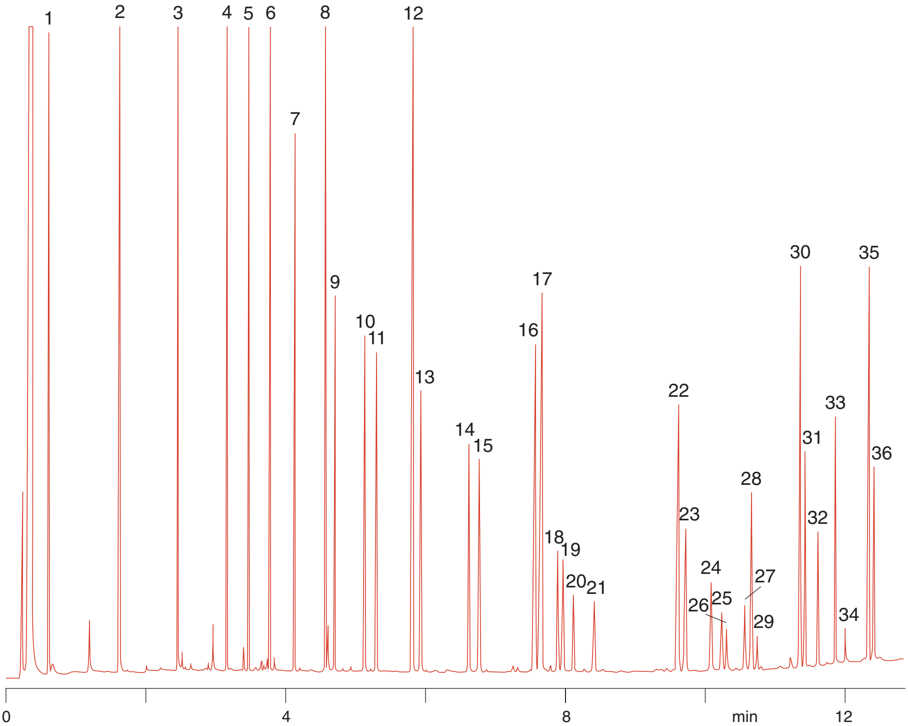
Fast analysis of a FAME mixture

MN Appl. No. 211820

Column: OPTIMA® 225, 10 m x 0.1 mm ID, 0.1 µm film, REF 726080.10, max. temperature 260/280 °C
Injection: 1 µl, split 1:250
Carrier gas: 280 kPa H_2
Temperature: 50 °C (1 min) $\xrightarrow{40\ °C/min}$ 160 °C $\xrightarrow{6\ °C/min}$ 200 °C $\xrightarrow{25\ °C/min}$ 240 °C (2 min)
Detector: FID 260 °C

Peaks:

1. C4:0
2. C6:0
3. C8:0
4. C10:0
5. C11:0
6. C12:0
7. C13:0
8. C14:0
9. C14:1
10. C15:0
11. C15:1n5
12. C16:0
13. C16:1
14. C17:0
15. C17:1n7
16. C18:0
17. C18:1n9c+t
18. C18:2n6t
19. C18:2n6c
20. C18:3n6
21. C18:3n3
22. C20:0
23. C20:1n9
24. C20:2n6
25. C20:3n6
26. C20:4n6
27. C20:3n3
28. C21:0
29. C20:5n3
30. C22:0
31. C22:1n9
32. C22:2n6
33. C23:0
34. C22:6n3
35. C24:0
36. C24:1



Food and cosmetic components

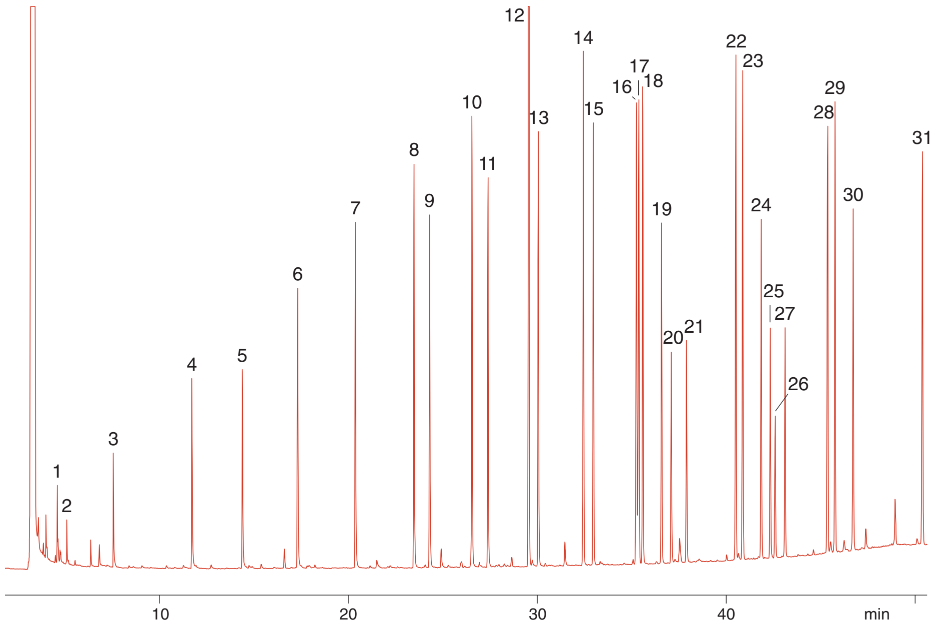
Analysis of FAMEs incl. *cis/trans* C18:1

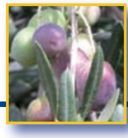
MN Appl. No. 201620

Column: OPTIMA® 240, 60 m x 0.25 mm ID, 0.25 µm film, REF 726089.60, max. temperature 260/280 °C
Injection: 1.0 µl of a FAME mixture, split 1:25
Carrier gas: 150 kPa H_2
Temperature: 80 °C $\xrightarrow{20\ °C/min}$ 120 °C $\xrightarrow{3\ °C/min}$ 260 °C (10 min)
Detector: FID 280 °C

Peaks:

1. C4:0	9. C14:1	17. C18:1n9t	25. C20:3
2. C5:0	10. C15:0	18. C18:1n9c	26. C20:4
3. C8:0	11. C15:1	19. C18:2	27. C20:3
4. C10:0	12. C16:0	20. C18:3	28. C22:0
5. C11:0	13. C16:1	21. C18:3	29. C22:1
6. C12:0	14. C17:0	22. C20:0	30. C22:3
7. C13:0	15. C17:1	23. C20:1	31. C24:1
8. C14:0	16. C18:0	24. C20:2	





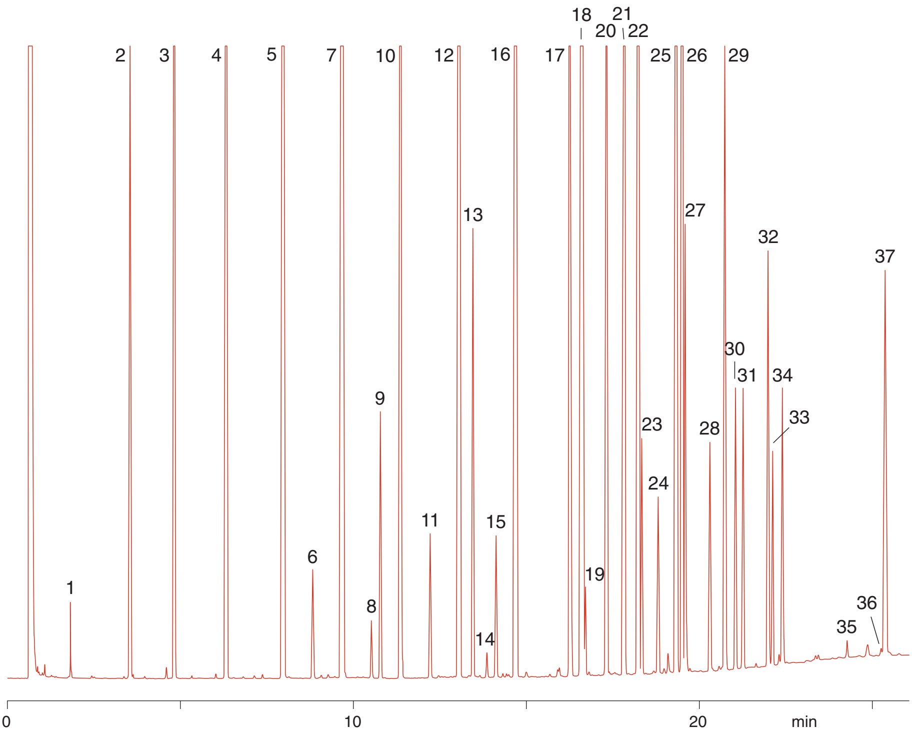
Analysis of FAMEs

MN Appl. No. 201660

Column: PERMABOND® FFAP, 25 m x 0.25 mm ID, 0.1 μm film, REF 723936.25, max. temperature 220/240 °C
Injection: 0.5 μl, split 120 ml/min
Carrier gas: 0.75 bar H_2
Temperature: 100 °C $\xrightarrow{6\ °C/min}$ 240 °C (5 min)
Detector: FID 250 °C

Peaks:

1. C8:0
2. C10:0
3. C11:0
4. C12:0
5. C13:0
6. C14:0 iso
7. C14:0
8. C15:0 iso
9. C15:0 anteiso
10. C15:0
11. C16:0 iso
12. C16:0
13. C16:1
14. C17:0 iso
15. C17:0 anteiso
16. C17:0
17. C18:0
18. C18:1n9c
19. C18:1n9t
20. C18:2
21. C19:0 + C18:3n6
22. C19:0 cyclo
23. C18:3n3
24. C18:4
25. C20:0
26. C20:1
27. C20:1
28. C20:2
29. C21:0
30. C20:4
31. C20:3n3
32. C20:5
33. C22:0
34. C22:1
35. C24:0
36. C24:1
37. C22:6

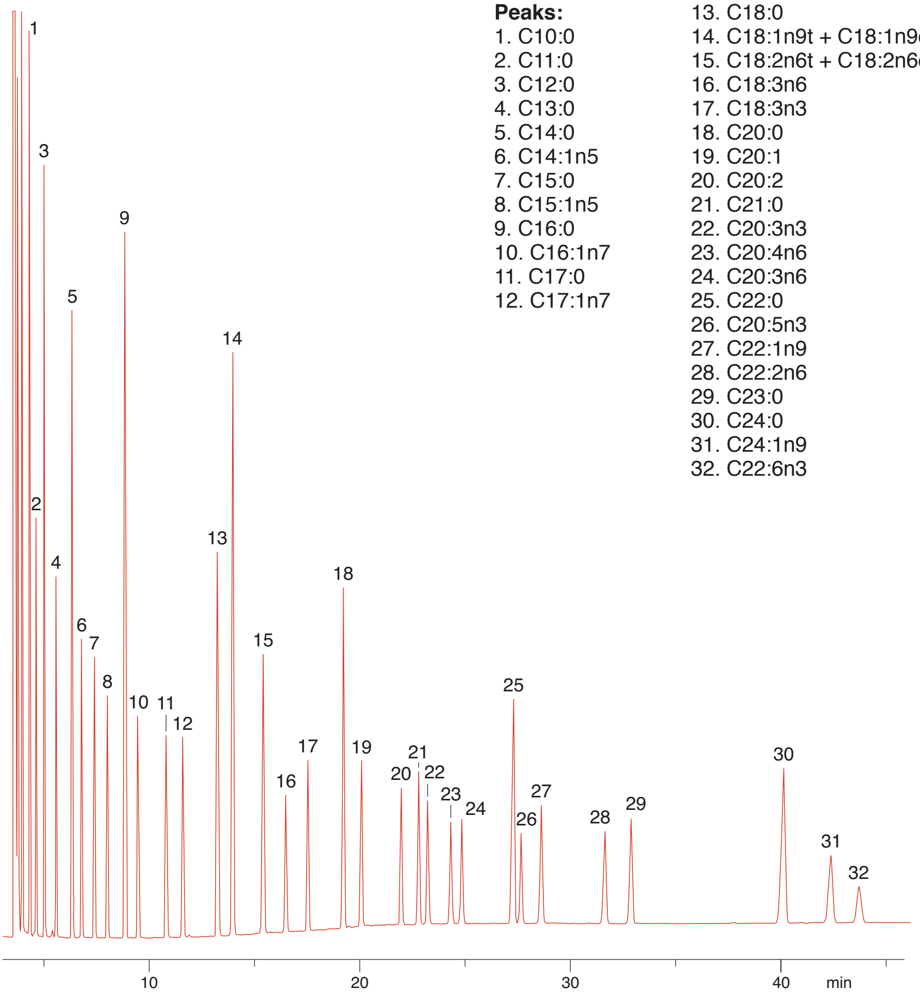


Food and cosmetic components

Analysis of a FAME standard

MN Appl. No. 212750

Column: PERMABOND® FFAP, 50 m x 0.25 mm ID, 0.25 μm film, REF 723116.50, max. temperature 220/240 °C
Injection: 1.0 μl, FAME standard, 250 °C
Carrier gas: 80 kPa H_2
Temperature: 200 °C (10 min) $\xrightarrow{2\ °C/min}$ 220 °C
Detector: FID 250 °C



Peaks:
1. C10:0
2. C11:0
3. C12:0
4. C13:0
5. C14:0
6. C14:1n5
7. C15:0
8. C15:1n5
9. C16:0
10. C16:1n7
11. C17:0
12. C17:1n7
13. C18:0
14. C18:1n9t + C18:1n9c
15. C18:2n6t + C18:2n6c
16. C18:3n6
17. C18:3n3
18. C20:0
19. C20:1
20. C20:2
21. C21:0
22. C20:3n3
23. C20:4n6
24. C20:3n6
25. C22:0
26. C20:5n3
27. C22:1n9
28. C22:2n6
29. C23:0
30. C24:0
31. C24:1n9
32. C22:6n3

Courtesy of Dr. E. Most, Institut für Tierernährung und Ernährungsphysiolgie, Justus-Liebig-Universität, Gießen, Germany

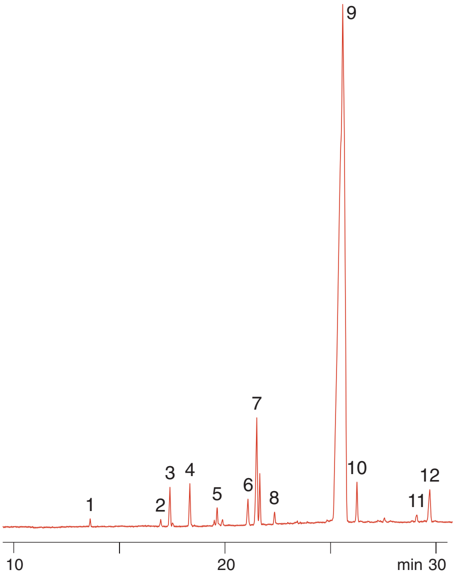
Analysis of FAMEs in rapeseed oil by fast GC

MN Appl. No. 212010

Column: PERMABOND® FFAP, 20 m x 0.10 mm ID, 0.1 µm film, REF 723180.20, max. temperature 220/240 °C
Injection: 0.5 µl
Carrier gas: 170 kPa
Temperature: 60 °C $\xrightarrow{15\ °C/min}$ 120 °C $\xrightarrow{10\ °C/min}$ 210 °C (5 min) $\xrightarrow{15\ °C/min}$ 240 °C (30 min)
Detector: FID 300 °C

Peaks:

1. C16:0	7. C20:1
2. C18:0	8. C20:2
3. C18:1n9c	9. C22:0 + C22:1n9
4. C18:2	10. C22:2
5. C18:3	11. C24:0
6. C20:0	12. C24:1



Analysis of FAMEs in rapeseed oil by fast GC

MN Appl. No. 212150

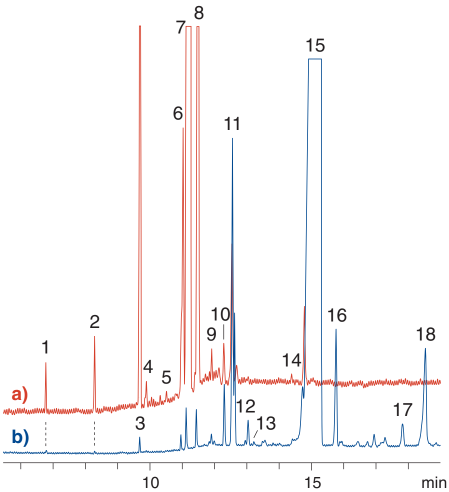
Column: PERMABOND® FFAP, 10 m x 0.10 mm ID, 0.25 µm film, REF 723181.10, max. temperature 220/240 °C
Injection: 1.0 µl, 250 °C
Carrier gas: He
Temperature: 60 °C $\xrightarrow{15\ °C/min}$ 230 °C (13.67 min)
Detector: FID 300 °C

Peaks:

a) fraction rich in oleic acid

b) fraction of rapeseed oil rich in erucic acid

1. C12:0	7. C18:1n9c	13. C21:0
2. C14:0	8. C18:2	14. C22:0
3. C16:0	9. C18:3	15. C22:1n9
4. C16:1	10. C20:0	16. C22:2
5. C17:0	11. C20:1	17. C24
6. C18:0	12. C20:2	18. C24:1



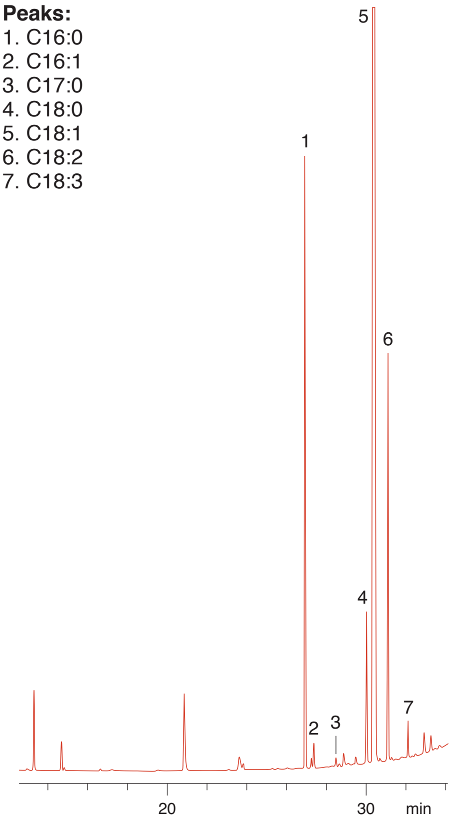
Food and cosmetic components

Analysis of FAMEs from olive oil

MN Appl. No. 210550

Column: PERMABOND® FFAP, 25 m x 0.32 mm ID, 0.25 µm film, REF 723341.25, max. temperature 220/240 °C
Injection: 1 µl, split 110 ml/min
Carrier gas: 3.3 ml/min H_2
Temperature: 50 °C (4 min) $\xrightarrow{6\ °C/min}$ 240 °C
Detector: FID 260 °C

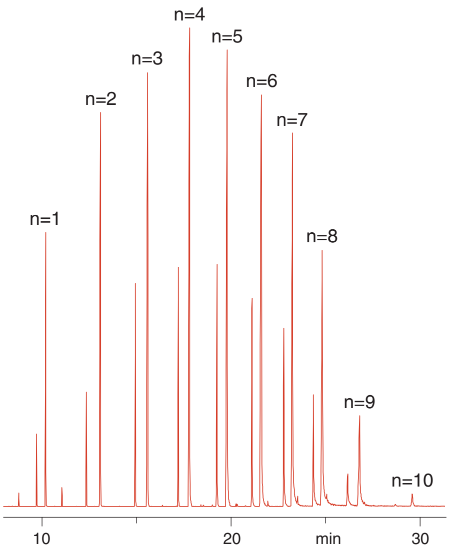
Peaks:
1. C16:0
2. C16:1
3. C17:0
4. C18:0
5. C18:1
6. C18:2
7. C18:3



Analysis of ethoxylated fatty alcohols C12 and C14 (TMS)

MN Appl. No. 201760

Column: OPTIMA® 5, 25 m x 0.20 mm ID, 0.2 µm film, REF 726857.25, max. temperature 340/360 °C
Sample: ethoxylated fatty alcohols R – (O – CH_2 – CH_2)$_n$ – O – TMS, silylated with BSTFA, R = C12 and C14
Injection: 0.5 µl, 300 °C, split 1:150
Carrier gas: 25 cm/s He
Temperature: 120 °C (3 min) $\xrightarrow{10\ °C/min}$ 330 °C
Detector: MSD
n = degree of ethoxylation

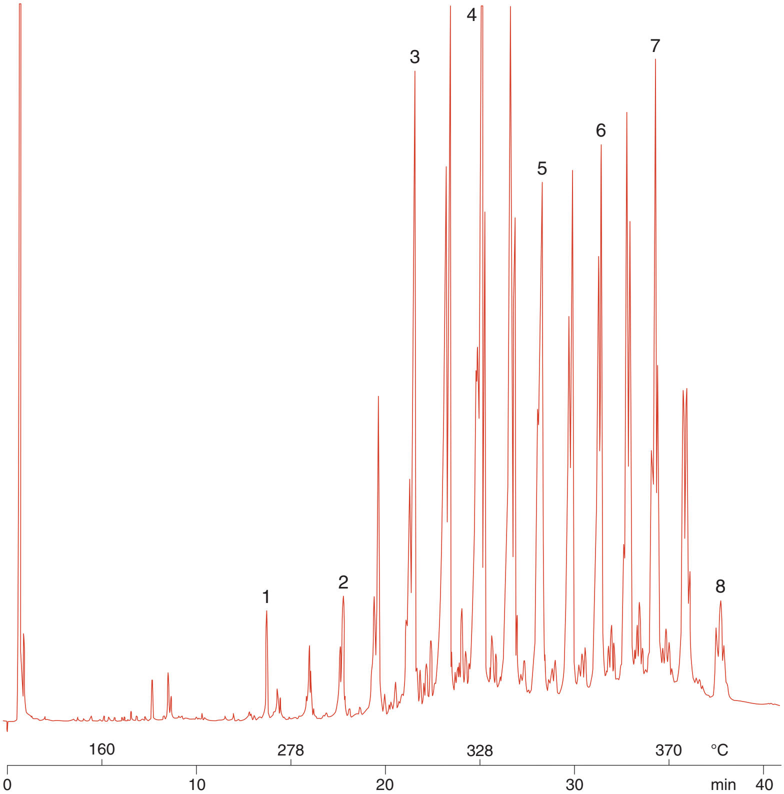


Analysis of triglycerides from butter

MN Appl. No. 201790

Column: OPTIMA® 1-TG, 25 m x 0.32 mm ID, REF 726132.25, max. temperature 370 °C
Injection: 0.5 µl
Carrier gas: 80 kPa H_2
Temperature: 80 °C (1 min) $\xrightarrow{20\ °C/min}$ 250 °C $\xrightarrow{5\ °C/min}$ 370 °C (10 min)
Detector: FID 380 °C

Peaks:
1. Cholesterol
2. T-30
3. T-34
4. T-38
5. T-42
6. T-46
7. T-50
8. T-54

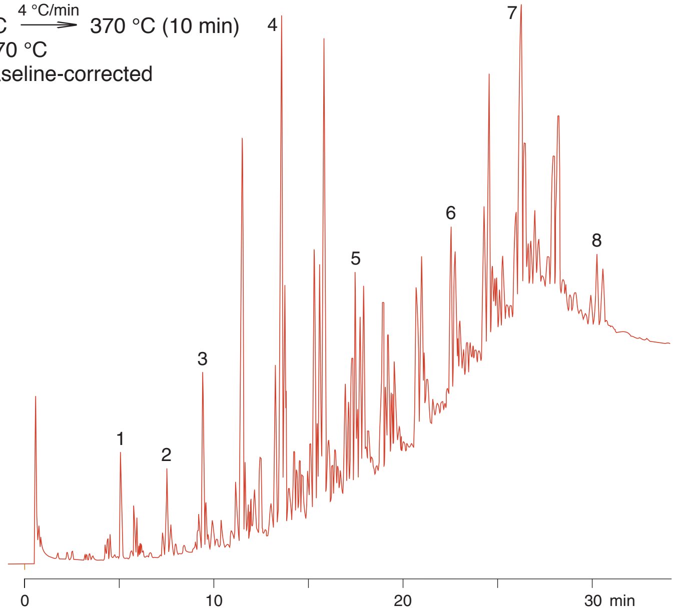


Analysis of triglycerides from butter

MN Appl. No. 201800

Column: OPTIMA® 17-TG, 25 m x 0.25 mm ID, REF 726130.25, max. temperature 370 °C
Injection: 1 µl
Carrier gas: 100 kPa H_2
Temperature: 260 °C $\xrightarrow{4\ °C/min}$ 370 °C (10 min)
Detector: FID 370 °C
not baseline-corrected

Peaks:
1. T-26
2. Cholesterol
3. T-30
4. T-36
5. T-40
6. T-46
7. T-50
8. T-54

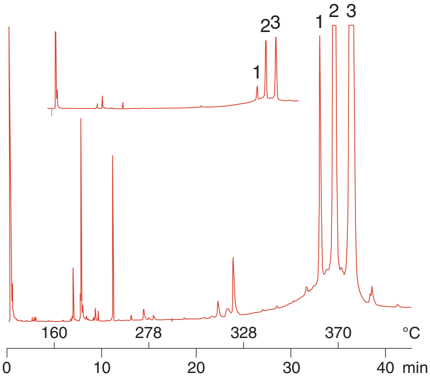


Analysis of triglycerides from olive oil

MN Appl. No. 201780

Column: OPTIMA® 1-TG, 25 m x 0.32 mm ID, REF 726132.25, max. temperature 370 °C
Injection: 0.5 µl
Carrier gas: 80 kPa H_2
Temperature: 80 °C (1 min) $\xrightarrow{20\ °C/min}$ 250 °C $\xrightarrow{5\ °C/min}$ 370 °C (10 min)
Detector: FID 380 °C

Peaks:
1. T-50
2. T-52
3. T-54



Ceramide analysis by GC/MS

MN Appl. No. 211980

Column:	OPTIMA® 5, 30 m x 0.32 mm ID, 0.1 μm film, REF 726313.30, max. temperature 340/360 °C
Injection:	0.5 μl, 320 °C, splitless
Carrier gas:	He, 0.6 bar He
Temperature:	260 °C —3 °C/min→ 360 °C (20 min)
Detector:	MSD

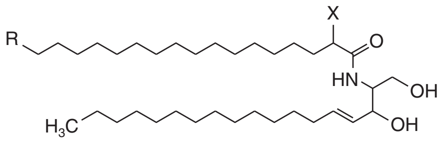
Peaks:

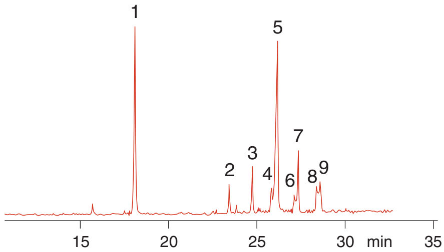
a) Ceramide IV (2-hydroxy fatty acid ceramides, X = OH)

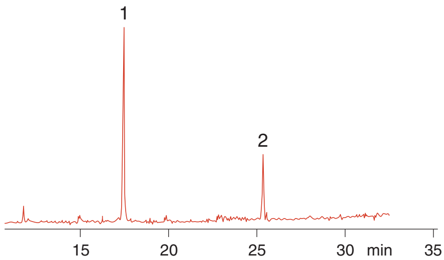
1. 18:0
2. 22:0
3. 23:0
4. 24:1
5. 24:0
6. 25:1
7. 25:0
8. 26:1
9. 26:0

b) Ceramide III (non-hydroxy fatty acid ceramides, X = H)

1. 18:0
2. 24:1







K. Raith, J. Darius, R.H.H. Neubert,
J. Chromatography A, **876** (2000) 229 – 233

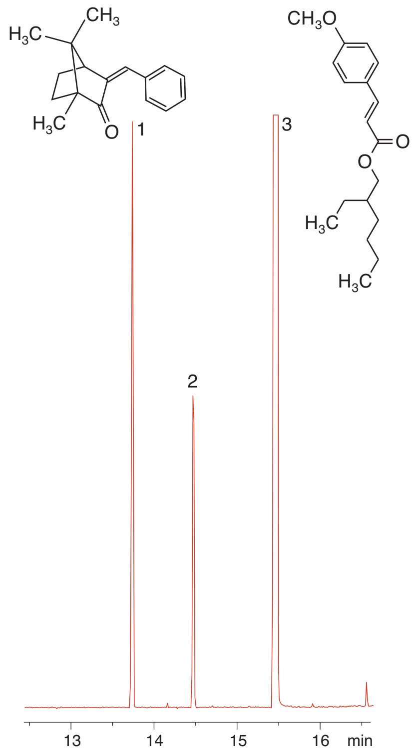
Analysis of parsols

MN Appl. No. 201240

Column:	OPTIMA® 5, 25 m x 0.20 mm ID, 0.20 μm film, REF 726857.25, max. temperature 340/360 °C
Injection:	1.0 μl parsol mixture, 1:1000 in MeOH, split 1:150
Carrier gas:	25 cm/s He
Temperature:	120 °C (3 min) —10 °C/min→ 220 °C —20 °C/min→ 330 °C
Detector:	MSD

Peaks:

1. Parsol 5000 = 3-(4'-Methylbenzylidene)camphor
2. Parsol MCX = *p*-Methoxycinnamic acid 2-ethylhexyl ester (*cis* isomer)
3. Parsol MCX (*trans* isomer)



Food and cosmetic components

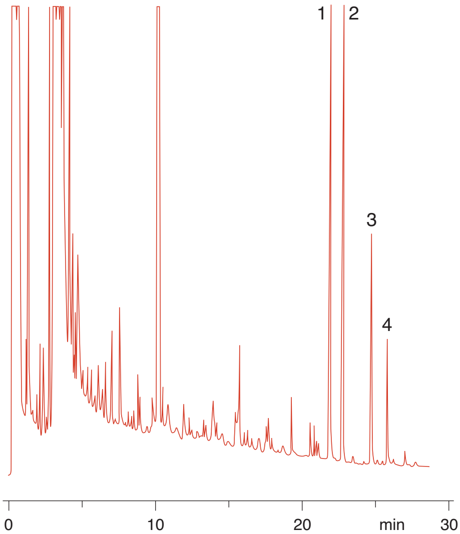
Determination of benzimidazole anthelmintics in meat samples

MN Appl. No. 212040

Column: OPTIMA® 1, 10 m x 0.25 mm ID, 0.25 μm film, REF 726050.10, max. temperature 340/360 °C
Injection: 1 μl, 270 °C, splitless
Carrier gas: 1 ml/min He
Temperature: 60 °C (0.5 min) $\xrightarrow{30\ °C/min}$ 150 °C $\xrightarrow{6\ °C/min}$ 300 °C
Detector: PND 350 °C

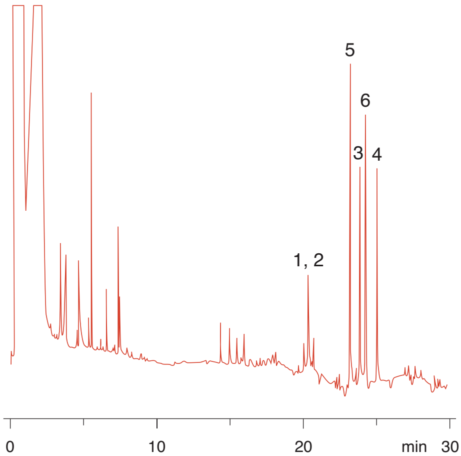
Chromatogram a)
extract of a kidney sample from a pig treated with fenbendazole, derivatized with pentafluorobenzyl bromide

Peaks:
1. and 2. PFB derivatives of fenbendazole
3. and 4. PFB derivatives of the metabolite fenbendazole sulphone

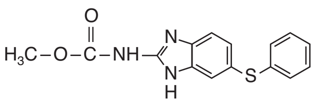


Chromatogram b)
extract of a blood sample from a pig treated with fenbendazole, derivatized with methyl iodide

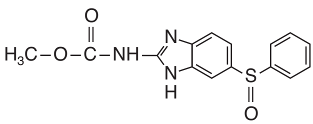
Peaks:
1. and 2. Me derivatives of fenbendazole
3. and 4. Me derivatives of the metabolite fenbendazole sulphone
5. and 6. Me derivatives of the metabolite oxfendazole



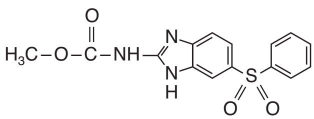
Fenbendazole



Oxfendazole



Fenbendazole sulphone



A.M. Marti, A.E. Mooser, H. Koch, J. Chromatography **498** (1990) 145 – 157

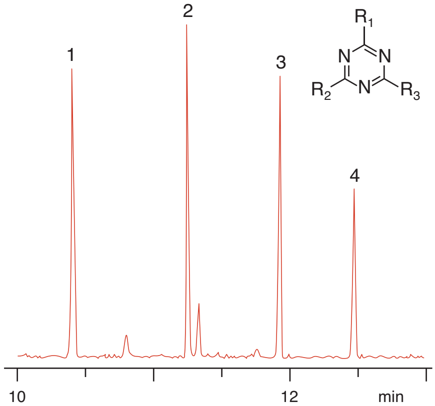
Determination of melamine, ammeline, ammelide and cyanuric acid in accordance with FDA regulations

MN Appl. No. 213300

Column: OPTIMA® 5 MS, 30 m x 0.25 mm ID, 0.25 μm film, REF 726220.30, max. temperature 340/360 °C
Injection: 1 μl, 250 °C, split 10 ml/min
Carrier gas: 0.5 ml/min He
Temperature: 75 °C (1 min) $\xrightarrow{15\ °C/min}$ 320 °C
Detector: MSD

Peaks:

1. Cyanuric acid ($R_1 = R_2 = R_3 = OH$)
2. Ammelide ($R_1 = NH_2$, $R_2 = R_3 = OH$)
3. Ammeline ($R_1 = R_2 = NH_2$, $R_3 = OH$)
4. Melamine ($R_1 = R_2 = R_3 = NH_2$)



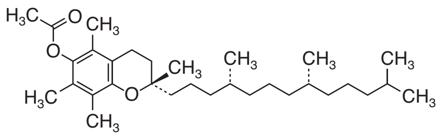
Analysis of D, L-α-tocopherol acetate (vitamin E acetate)

MN Appl. No. 210440

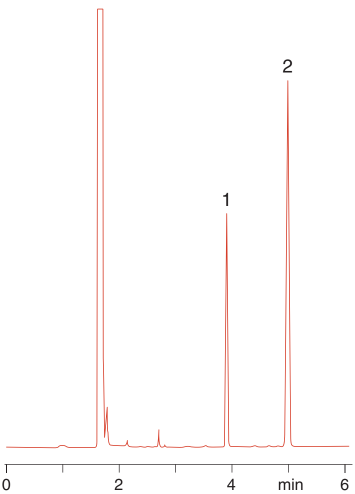
Column: OPTIMA® 1, 25 m x 0.25 mm ID, 0.25 μm film, REF 726050.25, max. temperature 340/360 °C
Injection: 1 μl, 320 °C, split 1:100
Carrier gas: 10 psi N_2
Temperature: 50 °C (3 min) $\xrightarrow{8\ °C/min}$ 290 °C
Detector: FID 320 °C

Peaks:

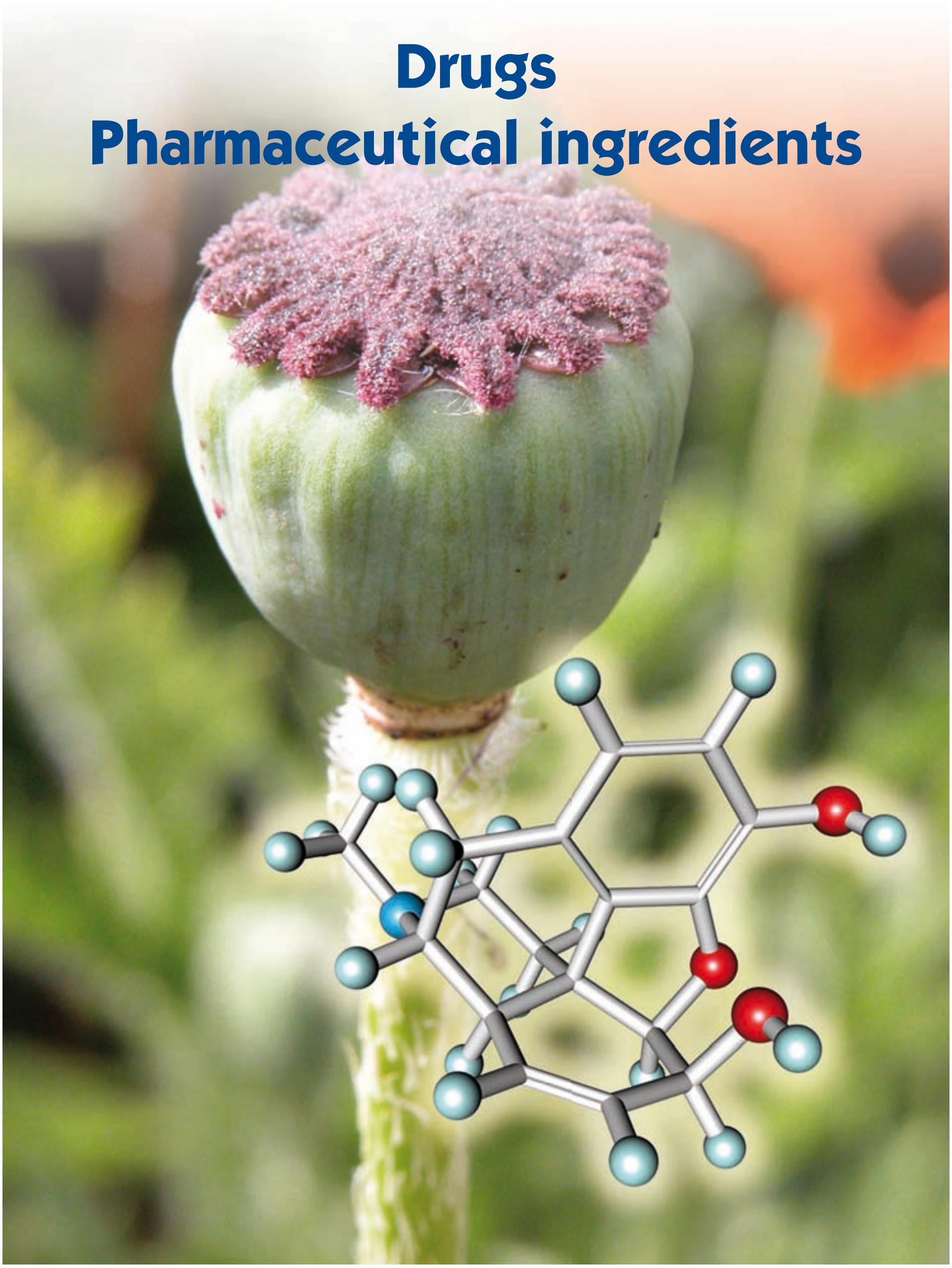
1. D,L-α-Tocopherol acetate [2.5 ng/ml]

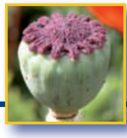


2. Tetratriacontane [5.0 ng/ml]



Drugs
Pharmaceutical ingredients





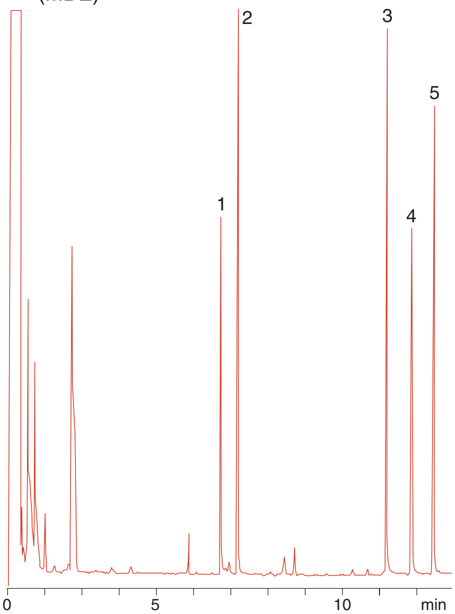
Analysis of amphetamines

MN App. No. 210460

Column:	OPTIMA® δ-3, 30 m x 0.25 mm ID, 0.25 µm film, REF 726420.30, max. temperature 340/360 °C
Injection:	1.0 µl, 20 µg/ml in methanol, 250 °C, split 10 ml/min
Carrier gas:	2 ml/min He (5.0)
Temperature:	60 °C (2 min) $\xrightarrow{20\ °C/min}$ 150 °C $\xrightarrow{6\ °C/min}$ 250 °C (5 min)
Detector:	MSD (Ion Trap)

Peaks:

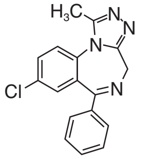
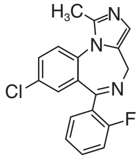
1. Amphetamine
2. Methamphetamine
3. 3,4-Methylenedioxyamphetamine (MDA)
4. 3,4-Methylenedioxymethamphetamine (MDMA)
5. 3,4-Methylenedioxyethylamphetamine (MDE)



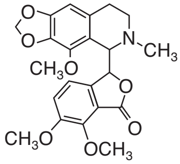
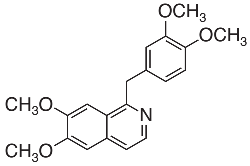
Courtesy of Mr. S. Motsch, Mr. P. Stein, Zollkriminalamt, Köln, Germany

Structures of selected drugs

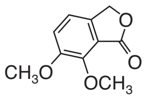
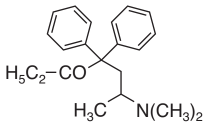
Compound	Structure
Alprazolam	Midazolam

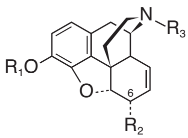
Noscapine = Narcotine	Papaverine

Meconin	Methadone

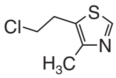
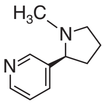
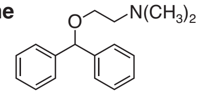
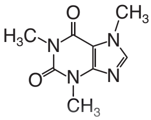
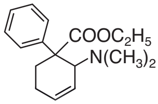
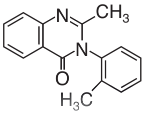
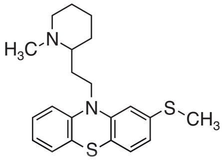
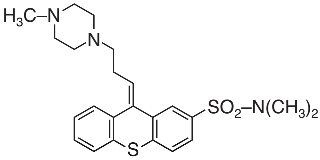
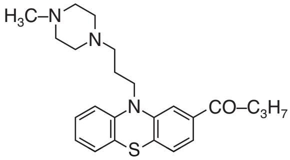
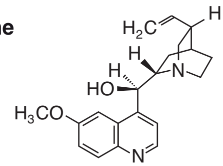
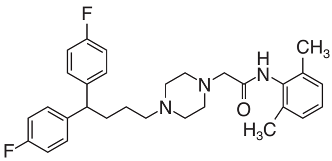



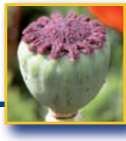
Morphine alkaloids



Substance	R_1	R_2	R_3
Morphine	H	OH	CH_3
Nalorphine	H	OH	CH_2-CH=CH_2
Codeine	CH_3	OH	CH_3
Heroin	$COCH_3$	$OCOCH_3$	CH_3

Drugs · Pharmaceutical ingredients

Compound	Structure	Compound	Structure
Clomethiazole		Nicotine	
Diphenhydramine		Caffeine	
Tilidine		Methaqualone	
Thioridazine		Thiothixene	
Butaperazine		Quinine	
Lidoflazine			



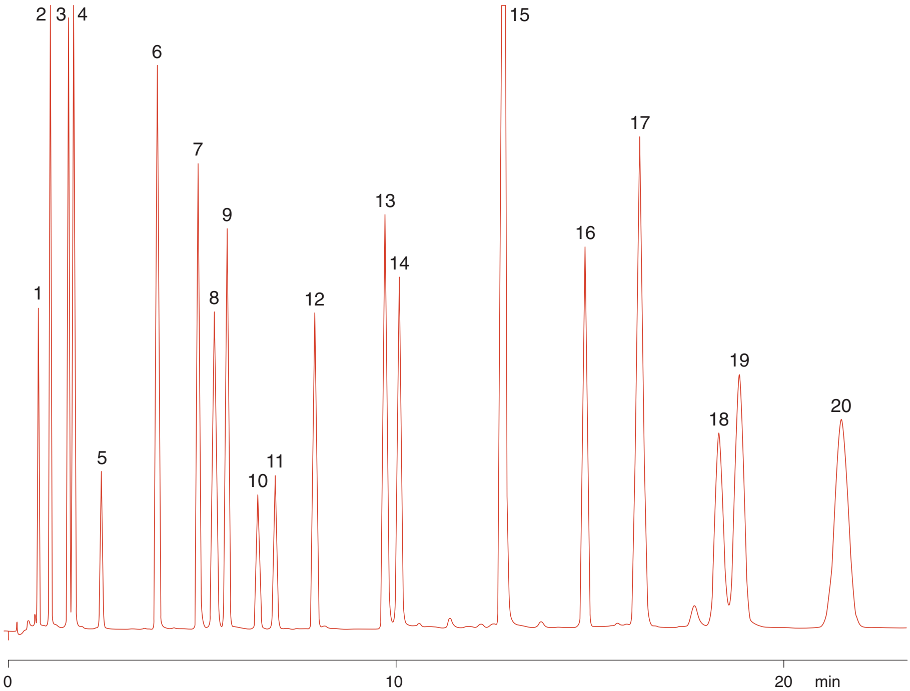
Drug screening analysis

MN Appl. No. 201300

Column: OPTIMA® 1, 15 m x 0.53 mm ID, 2.0 µm film, REF 726521.15, max. temperature 320/340 °C
Injection: 1 µl in methanol, 0.5 min splitless, 270 °C
Carrier gas: 10 ml/min H_2 (constant flow)
Temperature: $134\ °C \xrightarrow{10\ °C/min} 277\ °C$
Detector: N-FID 300 °C

Peaks: [ng]

1. Amphetamine [50]
2. Clomethiazole [50]
3. Nicotine [20]
4. Ephedrine [100]
5. Barbital [100]
6. Phenacetin [100]
7. Caffeine [20]
8. Diphenhydramine [50]
9. Tilidine [100]
10. Cyclobarbital (200)
11. 5-Chloro-2-aminobenzophenone (int. std.) [50]
12. Methaqualone [50]
13. Codeine [100]
14. Morphine [100]
15. Quinine [200]
16. Thioridazine (int. std.) [100]
17. Butaperazine [1006
18. Thiothixene } [100]
19. Thiothixene artefact } [100]
20. Lidoflazine [100]



Courtesy of Institut für Rechtsmedizin der Heinrich-Heine-Universität, Düsseldorf, Germany

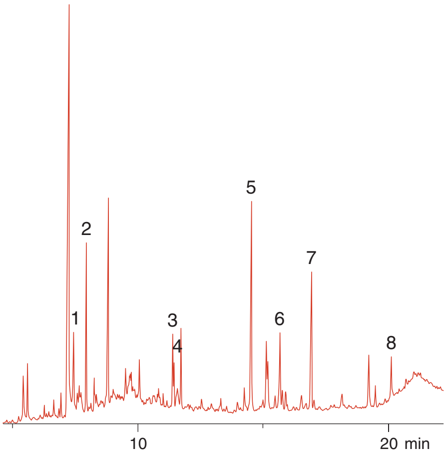
Drugs · Pharmaceutical ingredients

Analysis of drugs of abuse

MN Appl. No. 211900

Column: OPTIMA® 5 MS, 12 m x 0.2 mm ID, 0.2 µm film, REF 726210.12, max. temperature 340/360 °C
Injection: OCI/PTV, split ratio 28
Carrier gas: 1.0 ml/min, 57.9 cm/s
Total flow: 30.0 ml/min
Pressure: 58.7 kPa (3 min) $\xrightarrow{7\ \text{kPa/min}}$ 108 kPa $\xrightarrow{2.6\ \text{kPa/min}}$ 133 kPa $\xrightarrow{8\ \text{kPa/min}}$ 150 kPa (4.7 min)
Temperature: 70 °C (3 min) $\xrightarrow{20\ °\text{C/min}}$ 200 °C $\xrightarrow{7\ °\text{C/min}}$ 270 °C $\xrightarrow{20\ °\text{C/min}}$ 300 °C (4.7 min)
Detector: MSD 280 °C

Peaks:
1. Amphetamine
2. Methamphetamine
3. Methadone
4. Methaqualone
5. Codeine
6. Morphine
7. Nalorphine
8. Alprazolam



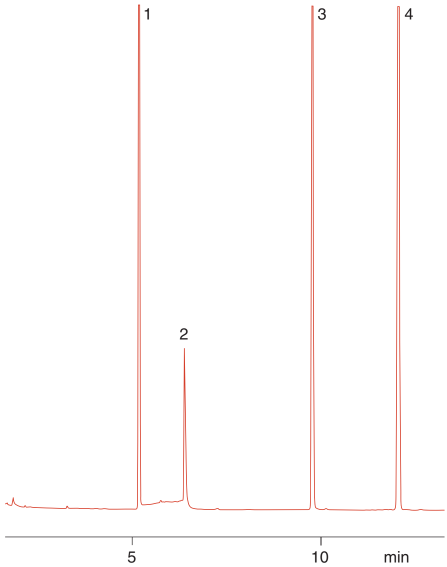
Courtesy of Mr. Szigan, Laboratorium Lembke-Lempfrid, Köln, Germany

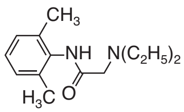
Analysis of cocaine

MN Appl. No. 210020

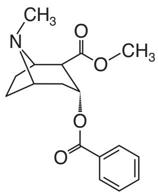
Column: OPTIMA® 1, 30 m x 0.25 mm ID, 0.25 µm film, REF 726050.30, max. temperature 340/360 °C
Sample: 4 mg of drug mixure dissolved in 600 µl CH_2Cl_2 and derivatised with MSTFA (REF 701270.201).
Injection: 1 µl
Carrier gas: N_2
Temperature: 170 °C $\xrightarrow{7.5\ °\text{C/min}}$ 280 °C (4 min)
Detector: FID 330 °C

Peaks:
1. H-Lidocaine, MSTFA derivative
2. N-Lidocaine, MSTFA derivative
3. Cocaine
4. Internal standard





Lidocain



Cocaine

Analysis of heroin

MN Appl. No. 210010

Column: OPTIMA® 1, 30 m x 0.25 mm ID, 0.25 μm film, REF 726050.30, max. temperature 340/360 °C

Sample preparation: 4 mg of a drug mixture are dissolved in 600 μl CH_2Cl_2 and derivatised with MSTFA (REF 701270.201).

Injection: 1 μl

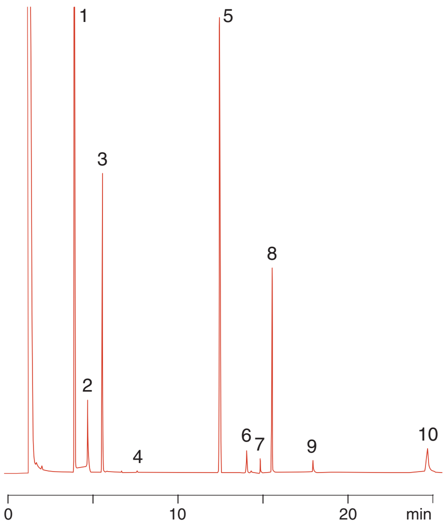
Carrier gas: N_2

Temperature: 170 °C (9.5 min) $\xrightarrow{7.5\ °C/min}$ 280 °C

Detector: FID 330 °C

Peaks:

1. Diparacetamol (MSTFA derivative)
2. Monoparacetamol ((MSTFA derivative)
3. Caffeine
4. Glucose (MSTFA derivative)
5. Internal standard
6. Acetylcodeine
7. Acetylmorphine (MSTFA derivative)
8. Diacetylmorphine (heroin)
9. Papaverine
10. Narcotine (MSTFA derivative)



Analysis of commercial heroin

MN Appl. No. 250360

Column: OPTIMA® 5, 30 m x 0.20 mm ID, 0.35 μm film, REF 726860.30, max. temperature 340/360 °C

Injection: 1 μl, 30 s splitless

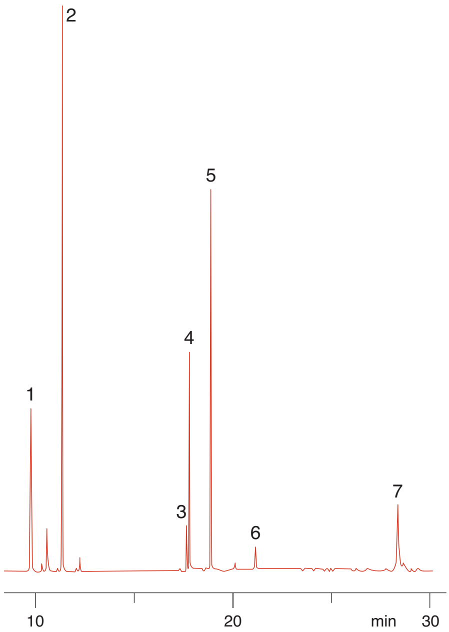
Carrier gas: 30 cm/s He

Temperature: 60 °C (1 min) $\xrightarrow{30\ °C/min}$ 120 °C $\xrightarrow{10\ °C/min}$ 280 °C

Detector: MSD

Peaks:

1. Paracetamol
2. Caffeine
3. Acetylcodeine
4. Monoacetylmorphine
5. Diacetylmorphine (heroin)
6. Papaverine
7. Narcotine



Courtesy of A. Jeger, Gerichtschemisches Institut, Basel, Switzerland

Drugs · Pharmaceutical ingredients

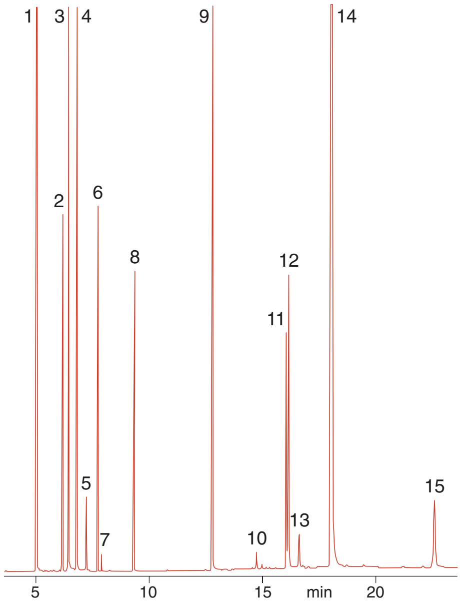
Analysis of heroin (street quality)

MN Appl. No. 210470

Column: OPTIMA® δ-3, 30 m x 0.25 mm ID, 0.25 µm film, REF 726420.30, max. temperature 340/360 °C
Sample: 5 mg heroin (street quality) + 1 mg tetracosane + 1 ml $CHCl_3$ + 200 µl pyridine + 150 µl MSTFA
Injection: 1.0 µl, 250 °C, split 30 ml/min
Carrier gas: 2 ml/min He (5.0)
Temperature: 150 °C $\xrightarrow{9\ °C/min}$ 280 °C (25 min)
Detector: MSD (ion trap)

Peaks:

1. Paracetamol di-TMS
2. Glucose TMS peak 1
3. Citric acid 4-TMS
4. Glucose TMS peak 2
5. Paracetamol TMS
6. Glucose TMS peak 3
7. Meconin
8. Caffeine
9. Tetracosane
10. Morphine di-TMS
11. Monoacetylmorphine TMS
12. Acetylcodeine
13. Acetylthebaol
14. Diacetylmorphine (heroin)
15. Papaverine



Courtesy of Mr. S. Motsch, Mr. P. Stein, Zollkriminalamt, Köln, Germany

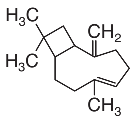
Analysis of hashish

MN Appl. No. 212072

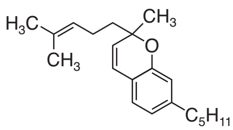
Column: OPTIMA® δ-3, 60 m x 0.25 mm ID, 0.25 µm film, REF 726420.60, max. temperature 340/360 °C
Carrier gas: 180 kPa (26 psi) He
Temperature: 100 °C $\xrightarrow{10\ °C/min}$ 360 °C
Detector: MSD

Peaks:

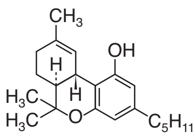
1. Caryophyllene



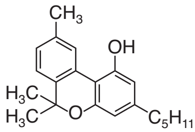
2. Cannabichromene

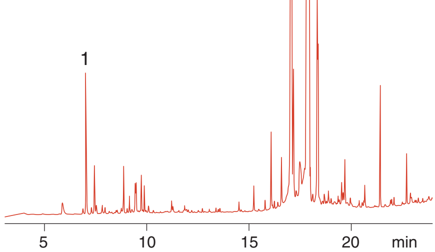


3. Tetrahydrocannabinol (THC)

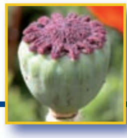


4. Cannabinol





N. Bertram, LTA Labor f. Toxikol. u. Analytik, Königswinter, Germany

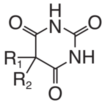


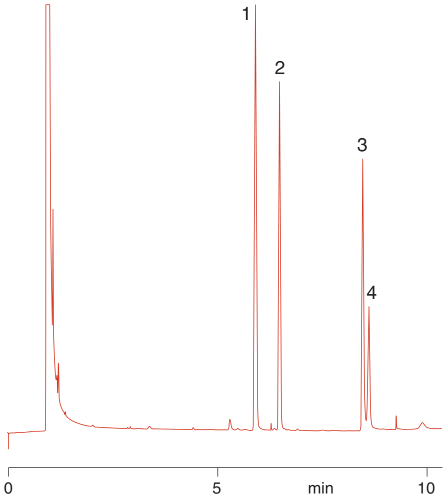
Analysis of barbiturates

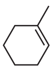
MN Appl. No. 201290

Column: OPTIMA® 5, 25 m x 0.25 mm ID, 0.25 µm film, REF 726056.25, max. temperature 340/360 °C
Injection: 1 µl, split 1:10
Carrier gas: 1.8 bar N_2
Temperature: 150 °C $\xrightarrow{8\ °C/min}$ 300 °C
Detector: FID 280 °C

Peaks:
1. Pentobarbital
2. Secobarbital
3. Phenobarbital
4. Cyclobarbital





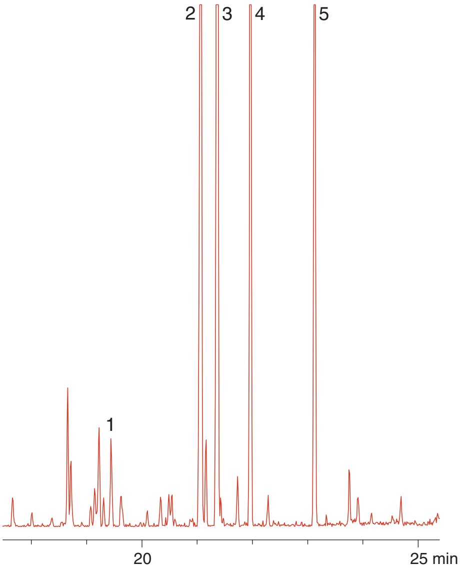
Compound	R_1	R_2
Barbital	C_2H_5	C_2H_5
Pentobarbital	C_2H_5	$CH(CH_3)\text{-}C_3H_7$
Secobarbital	$CH_2\text{-}CH{=}CH_2$	$CH(CH_3)\text{-}C_3H_7$
Phenobarbital	C_2H_5	C_6H_5
Cyclobarbital	C_2H_5	

Analysis of narcotic analgesic drugs in urine

MN Appl. No. 201270

Column: OPTIMA® 17, 25 m x 0.20 mm ID, 0.20 µm film, REF 726065.25, max. temperature 320/340 °C
Injection: 1.0 µl of a liquid extract of a urine sample, 1:10 in MeOH, concentration of peaks 2 – 5 approximately 0.5 µg/ml, 3 s splitless
Carrier gas: 25 cm/s He
Temperature: 130 °C (3 min) $\xrightarrow{8\ °C/min}$ 320 °C
Detector: MSD

Peaks:
1. Levomethorphan
2. Dextrorphan
3. unknown metabolite
4. Di(2-ethylhexyl) phthalate
5. unknown metabolite



Dextromethorphan and metabolites courtesy of Dr. Baumann, Hôpital Prilly, Switzerland

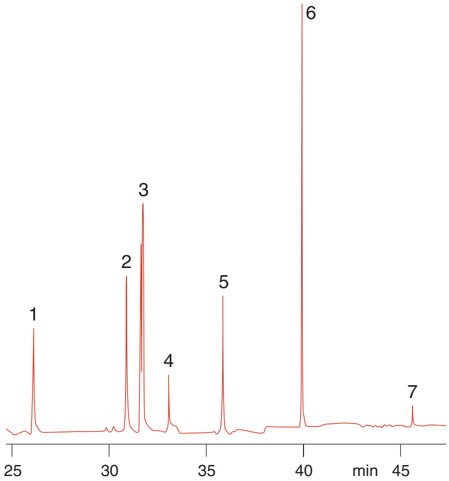
Drugs · Pharmaceutical ingredients

Analysis of β-agonists from urine

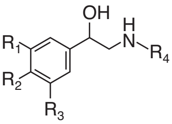
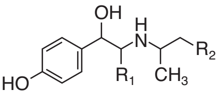
MN Appl. No. 210670

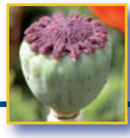
Column: OPTIMA® δ-3, 30 m x 0.25 mm ID, 0.25 µm film, REF 726420.30, max. temperature 340/360 °C
Injection: 1.0 µl, 10 µg/l from urine, derivatised with HMDS/TMCS 9:1, 280 °C, splitless
Temperature: 100 °C (1 min) $\xrightarrow{5\ ^\circ C/min}$ 300 °C
Detector: MSD 300 °C

Peaks:
1. Mabuterol-TMS
2. Salbutamol-TMS
3. Clenbuterol-TMS + Clenbuterol-D_6-TMS
4. Cimaterol-TMS
5. Hydroxymethyl-clenbuterol-TMS
6. Isoxsuprine-TMS
7. Ractopamine-TMS



Courtesy of Mr. Wohlfarth, Mr. Rosensprung, Staatl. Untersuchungsamt, Wiesbaden, Germany

Structure	Compound	R_1	R_2	R_3	R_4
	Mabuterol	CF_3	NH_2	Cl	$C(CH_3)_3$
	Clenbuterol	Cl	NH_2	Cl	$C(CH_3)_3$
	Cimaterol	CN	NH_2	H	$CH(CH_3)_2$
	Salbutamol	CH_2OH	OH	H	$C(CH_3)_3$
	Isoxsuprine	CH_3	$O–C_6H_5$	–	–
	Ractopamine	H	CH_2–*p*-C_6H_4–OH	–	–



Analysis of acidic drugs from waste water

MN Appl. No. 212000

Sample preparation: 100 µl sample is derivatised with 30 µl of a 0.2 M methanolic TMSH solution (REF 701520.101).

Column: OPTIMA® δ-3, 30 m x 0.25 mm ID, 0.25 µm film, REF 726420.30, max. temperature 340/360 °C

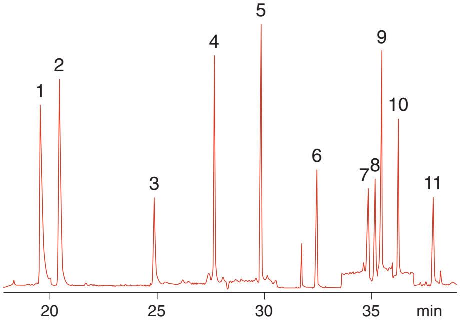
Injection: 2 µl (5 µl/s), 275 °C, splitless

Temperature: 70 °C (1 min) $\xrightarrow{15\ °C/min}$ 280 °C $\xrightarrow{5\ °C/min}$ 300 °C (10 min)

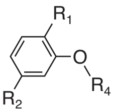
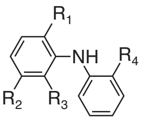
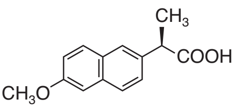
Detector: MSD

Peaks:

1. Clofibric acid
2. Ibuprofen
3. 2,3-Dichlorophenoxyacetic acid (int. std.)
4. Gemfibrozil
5. Fenoprofen
6. Naproxen
7. Ketoprofen
8. Indomethacin
9. Tolfenamic acid
10. Diclofenac
11. Meclofenamic acid



Courtesy of Staatliches Umweltamt Aachen, Germany

Structure	Compound	R_1	R_2	R_3	R_4
	Clofibric acid	H	Cl	–	$C(CH_3)_2$–COOH
	Gemfibrozil	CH_3	CH_3	–	$(CH_2)_3$– $C(CH_3)_2$–COOH
	Diclofenac	Cl	H	Cl	CH_2–COOH
	Meclofenamic acid	Cl	CH_3	Cl	COOH
	Tolfenamic acid	H	Cl	CH_3	COOH
	Naproxen	–	–	–	–

Other formulas see structure index from page 291.

Drugs · Pharmaceutical ingredients

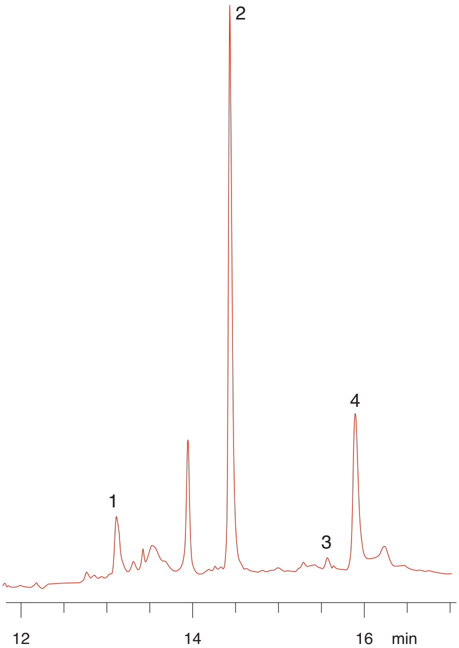
Determination of picogram levels of midazolam and metabolites in human plasma

MN Appl. No. 212580

Column: OPTIMA® 1, 25 m x 0.25 mm ID, 0.25 μm film, REF 726050.25, max. temperature 340/360 °C
Injection: 3 μl, 300 °C, pulsed splitless
Carrier gas: 1.1 ml/min He (8.6 psi, 43 cm/s)
Temperature: 85 °C (1 min) $\xrightarrow{30\ ^{\circ}C/min}$ 200 °C $\xrightarrow{10\ ^{\circ}C/min}$ 310 °C (1 min)
Detector: MSD

Peaks:

1. Midazolam
2. *N*-Ethyloxazepam (int. std.)
3. 4-Hydroxymidazolam
4. 1-Hydroxymidazolam



C. B. Eap et al., J. Chromatography B, **802** (2004) 339 – 345

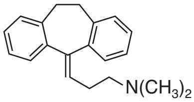
Analysis of amitriptyline

MN Appl. No. 210370

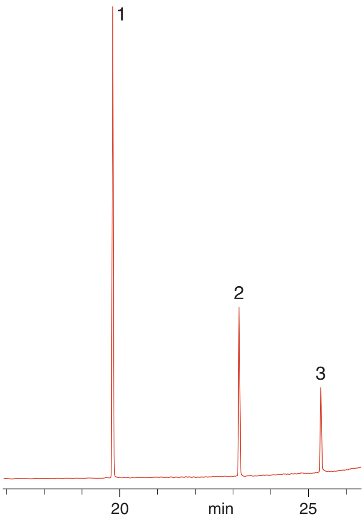
Column: OPTIMA® 5 Amine, 25 m x 0.20 mm ID, 0.35 μm film, REF 726355.25, max. temperature 300/320 °C
Injection: 310 °C
Carrier gas: 25 cm/s He
Temperature: 70 °C (3 min) $\xrightarrow{10\ ^{\circ}C/min}$ 290 °C
Detector: MSD

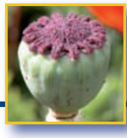
Peaks:

1. Diphenhydramine
2. Amitriptyline



3. 5-(*p*-Methylphenyl)-5-phenylhydantoin (MPPH)





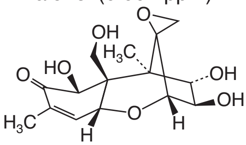
Analysis of *Fusarium* mycotoxins

MN Appl. No. 210660

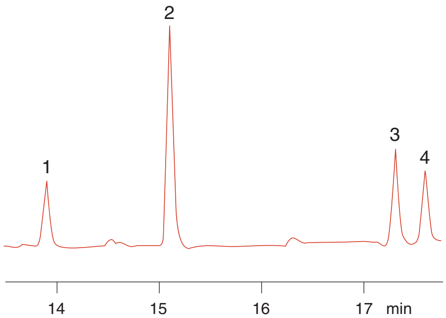
Column:	OPTIMA® 1701, 25 m x 0.32 mm ID, 0.35 µm film, REF 726824.25, max. temperature 300/320 °C
Injection:	1 µl, 250 °C, splitless
Carrier gas:	30 cm/s N_2, linear velocity at 160 °C
Temperature:	160 °C (3 min) $\xrightarrow{6\ °C/min}$ 240 °C $\xrightarrow{30\ °C/min}$ 270 °C (3 min)
Detector:	^{63}Ni-ECD 320 °C

Peaks:

1. Nivalenol (0.007 ppm)



2. Deoxynivalenol (0.006 ppm)
3. 15-*o*-Acetyl-4-deoxynivalenol (0.006 ppm)
4. 3-Acetyldeoxynivalenol (0.005 ppm)



F. Walker, B. Meier, Journal of AOAC Int. Vol. **81**, No. 4 (1998) 741 – 748

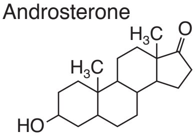
Analysis of free steroids

MN Appl. No. 201310

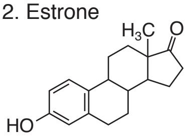
Column:	OPTIMA® 17, 25 m x 0.53 mm ID, 1.0 µm film, REF 726747.25, max. temperature 300/320 °C
Injection:	1 µl (0.1 % in CH_2Cl_2) split 1:30
Carrier gas:	40 kPa N_2
Temperature:	260 °C
Detector:	FID 280 °C

Peaks:

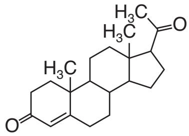
1. Androsterone



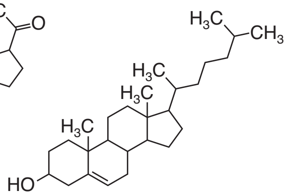
2. Estrone

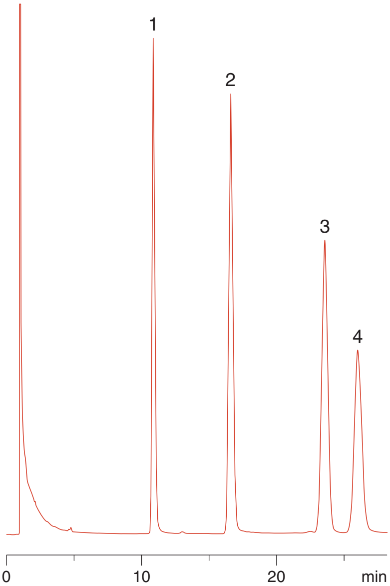


3. Progesterone



4. Cholesterol





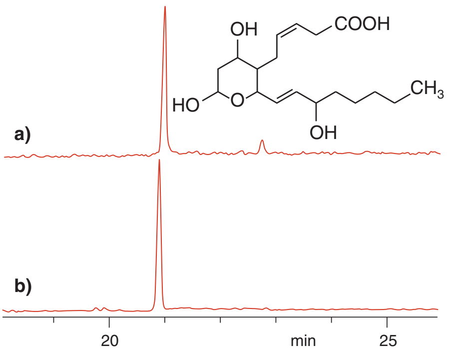
Quantification of 2,3-dinor-thromboxane B_2 and 2,3-dinor-6-oxo-prostaglandin F1α in human urine

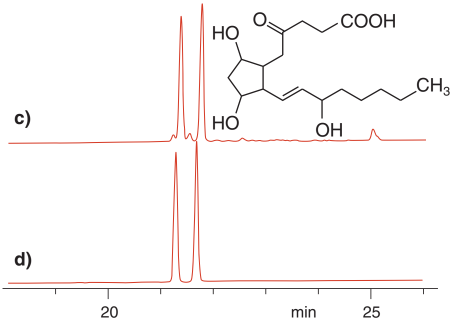
MN Appl. No. 211950

Column: OPTIMA® 17, 30 m x 0.25 mm ID, 0.25 µm film, REF 726022.30, max. temperature 320/340 °C
Injection: 280 °C, splitless
Carrier gas: 55 kPa He
Temperature: 70 °C (2 min) $\xrightarrow{25\ °C/min}$ 280 °C $\xrightarrow{4\ °C/min}$ 320 °C
Detector: MSD (quadrupole)

Chromatograms:

a) endogenous 2,3-dinorthromboxane B_2
b) tetradeuterated 2,3-dinorthromboxane B_2
c) endogenous 2,3-dinor-6-oxoprostaglandin $F_{1\alpha}$
d) tetradeuterated 2,3-dinor-6-oxoprostaglandin $F_{1\alpha}$





D. Tsikas, F.M. Böhme, I. Fuchs, J. Fröhlich, J. Chromatography A, **885** (2000) 351 – 359

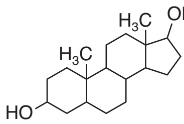
Analysis of steroids

MN Appl. No. 250300

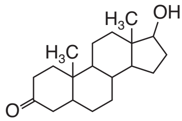
Column: OPTIMA® 5, 30 m x 0.20 mm ID, 0.35 µm film, REF 726860.30, max. temperature 340/360 °C
Carrier gas: He
Temperature: 200 °C (2 min) $\xrightarrow{3\ °C/min}$ 320 °C
Detector: MSD

Peaks:

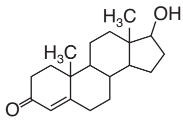
1. Androstanediol



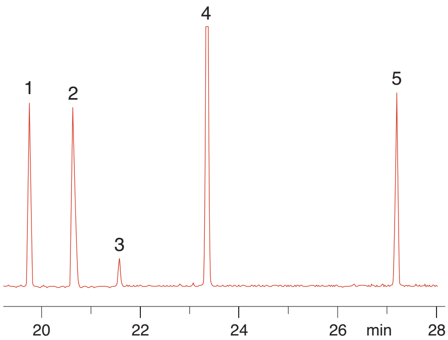
2. Androstanolone (1st isomer)
3. Androstanolone (2nd isomer)

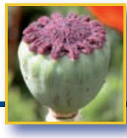


4. Testosterone



5. Progesterone





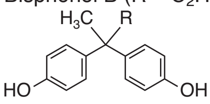
Separation of endocrinic compounds

MN Appl. No. 212620

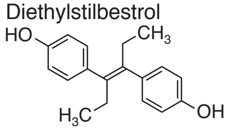
Column: OPTIMA® δ-6, 30 m x 0.32 mm ID, 0.35 µm film, REF 726481.30, max. temperature 340/360 °C
Injection: 5.0 µl standards 10 mg/l, nonylphenol (NP) 20 mg/l in methanol, splitless
Carrier gas: 5.0 ml/min H_2, constant flow
Temperature: 80 °C $\xrightarrow{12\ °C/min}$ 305 °C $\xrightarrow{60\ °C/min}$ 340 °C
Detector: FID 300 °C

Peaks:

1. 4-*t*-Octylphenol
2. tech. 4-Nonylphenol (NP)
3. Bisphenol A (R = CH_3)
4. Bisphenol B (R = C_2H_5)

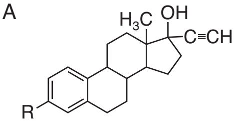


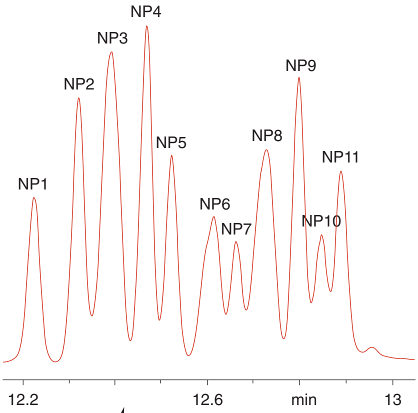
5. Diethylstilbestrol

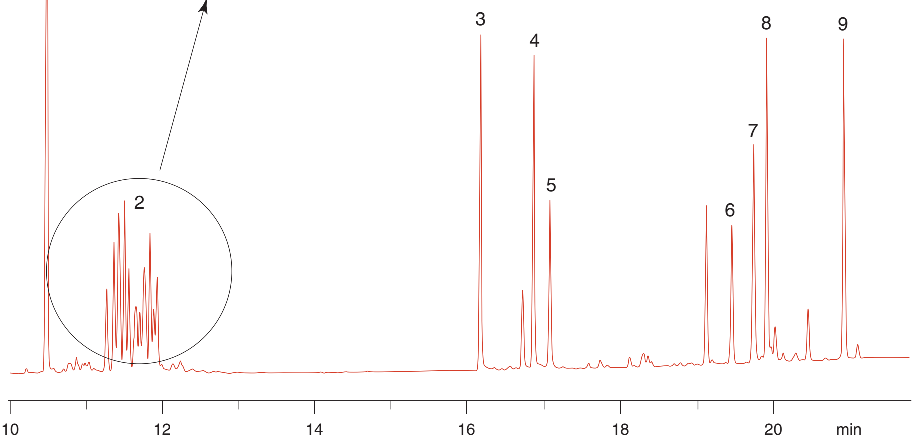


6. Mestranol (A, R = OCH_3)
7. Testosterone
8. Ethinylestradiol (A, R = OH)
9. Progesterone

A







Courtesy of Mr. Stollenwerk, Inst. f. Chemische Verfahrenstechnik, RWTH Aachen, Germany

Drugs · Pharmaceutical ingredients

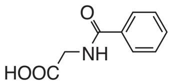
Separation of dicarboxylic acids for profiling of urinary acidic metabolites

MN Appl. No. 212590

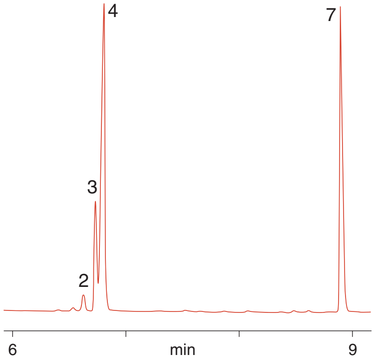
Column: OPTIMA® δ-6, 30 m x 0.25 mm ID, 0.25 µm film, REF 726470.30, max. temperature 340/360 °C
Injection: 2 µl, 220 °C, split 1:10
Carrier gas: 80 kPa H_2
Temperature: 80 °C $\xrightarrow{10\ °C/min}$ 310 °C
Detector: FID 280 °C

Peaks:

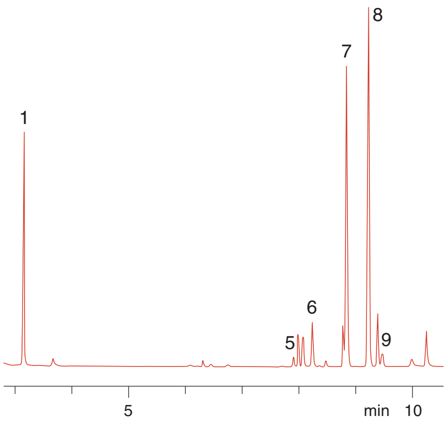
1. 3-Hydroxyisovaleric acid $(CH_3)_2C(OH)–CH_2–COOH$
2. Lactic acid [$H_3C)–CH(OH)–COOH$]
3. Succinic acid [$HOOC–(CH_2)_2–COOH$]
4. Fumaric acid [HOOC–CH=CH–COOH]
5. Glutaric acid [$HOOC–(CH_2)_3–COOH$]
6. 3-Methylglutaric acid
7. 2-Phenylbutyric acid (int. std.)
8. 3-Hydroxy-3-methylglutaric acid
9. Adipic acid [$HOOC–(CH_2)_4–COOH$]
10. 3-Hydroxyglutaric acid
11. 2-Oxoglutaric acid
12. Hippuric acid (benzoylglycine)



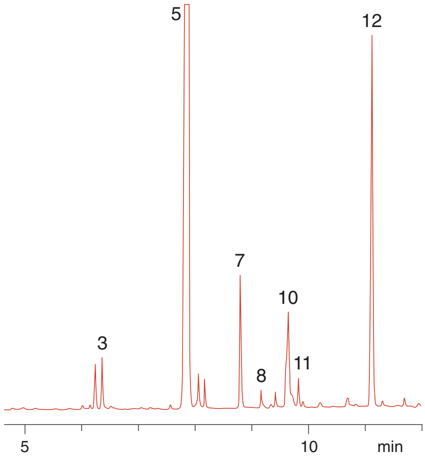
Sample: urine of a patient with fumarase enzyme impaired function, derivatised with ethyl chloroformate



Sample: urine of a patient with 3-hydroxy-3-methylglutaric acidurea, derivatised with ethyl chloroformate



Sample: urine of a patient with glutaric acidurea of the I. type, derivatised with ethyl chloroformate



P. Hušek et al., Chromatographia **58** (2003) 623 – 630


Petrochemical products
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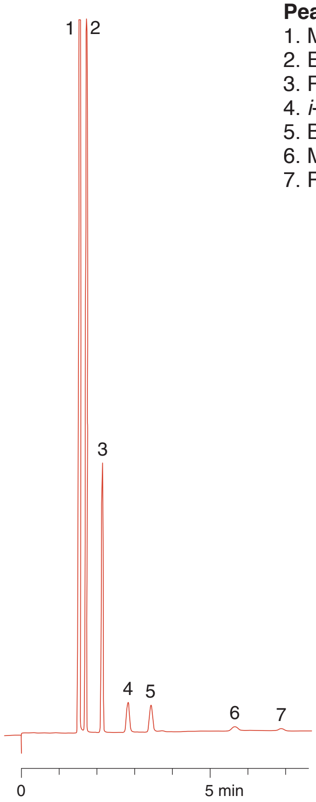
Petrochemical products

Analysis of hydrocarbons $C_1 – C_5$
MN Appl. No. 200030

Column: OPTIMA® 5, 15 m x 0.32 mm ID, 5.0 µm film, REF 726934.15, max. temperature 300/320 °C
Injection: 100 µl, split 60 ml/min
Carrier gas: 0.08 bar N_2
Temperature: 36 °C
Detector: FID

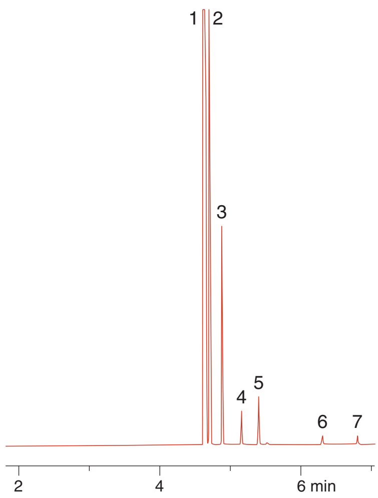
Peaks:
1. Methane
2. Ethane
3. Propane
4. *i*-Butane
5. Butane
6. Methylbutane
7. Pentane



Analysis of hydrocarbons $C_1 – C_5$
MN Appl. No. 200041

Column: PERMABOND® P-100, 100 m x 0.25 mm ID, 0.5 µm film, REF 723890.100, max. temperature 300/320 °C
Injection: 100 µl, split 200 ml/min
Carrier gas: 200 kPa H_2 (2.3 ml/min)
Temperature: 31 °C
Detector: FID 250 °C

Peaks:
1. Methane
2. Ethane
3. Propane
4. *i*-Butane
5. Butane
6. Methylbutane
7. Pentane

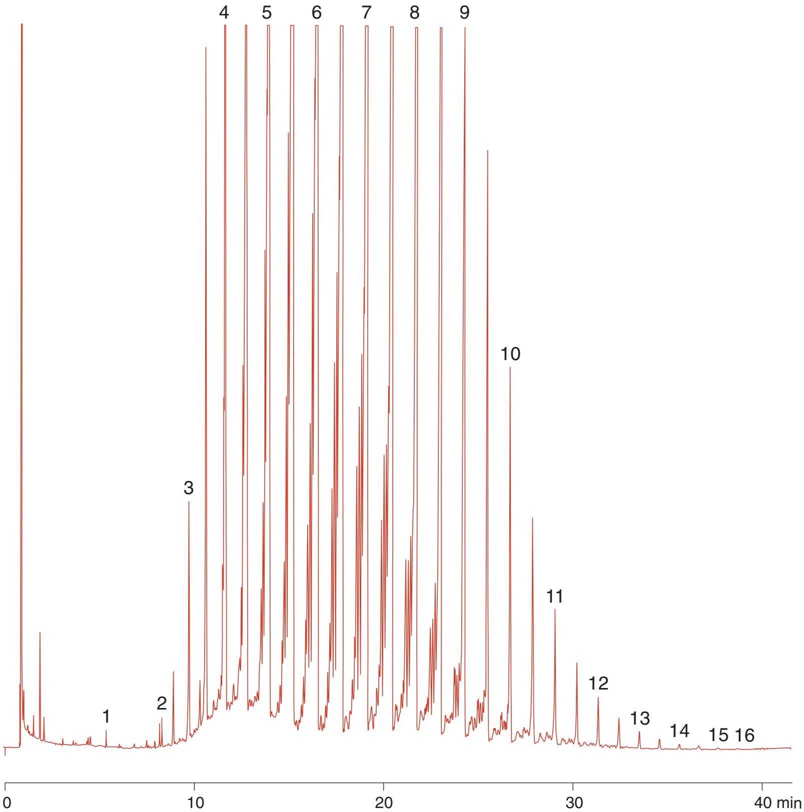


Analysis of tea warmer candle

MN Appl. No. 200050

Column: OPTIMA® 1-TG, 25 m x 0.32 mm ID, REF 726132.25, max. temperature: 370 °C
Injection: 1.0 µl, split 100 ml/min
Carrier gas: 50 kPa H_2 (3.5 ml/min)
Temperature: 80 °C (1 min) $\xrightarrow{20\ °C/min}$ 200 °C $\xrightarrow{5\ °C/min}$ 370 °C (5 min)
Detector: FID 380 °C, baseline corrected

Peaks:
1. C14
2. C18
3. C20
4. C22
5. C24
6. C26
7. C28
8. C30
9. C32
10. C34
11. C36
12. C38
13. C40
14. C42
15. C44
16. C45

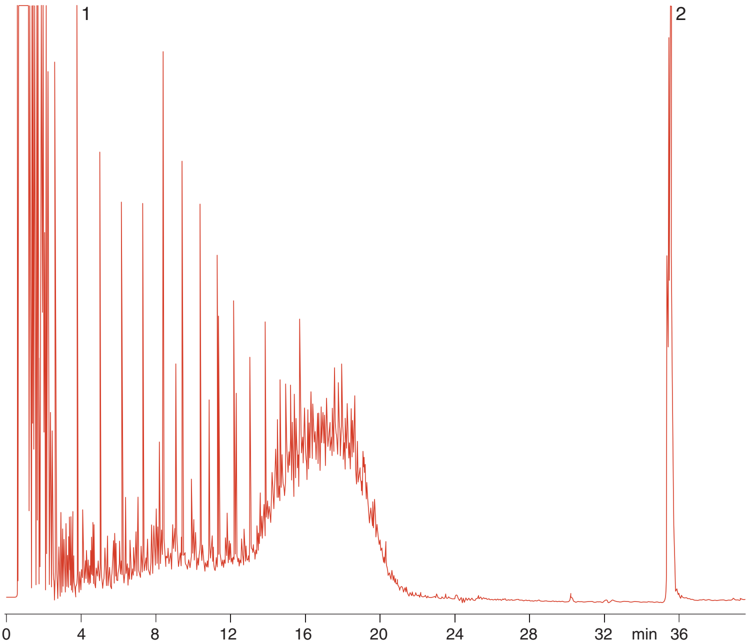


Analysis of hydrocarbons acc. to ISO DIS 9377-4 (H-53)

MN Appl. No. 210600

Sample: standard (1 mg/l) extracted with 50:900 ml *n*-hexane:H_2O, pH 2 with H_2SO_4, (extraction solvent *n*-hexane with *n*-C10 and *n*-C40 standard), then evaporated with N_2 to 1 ml
Column: OPTIMA® 1, 25 m x 0.32 mm ID, 0.25 µm film, REF 726302.25, max. temperature 340/360 °C
Injection: 1.0 µl on column
Carrier gas: 3 ml/min H_2
Temperature: 60 °C (1 min) $\xrightarrow{15\ °C/min}$ 350 °C (19 min)
Detector: FID (30:300:40 ml/min H_2:O_2:He)

Peaks:
1. *n*-C_{10}
2. *n*-C_{40}



For a sample chromatogram of a mixture of diesel and heavy oil see application 210600 at *www.mn-net.com*

Courtesy of Mr. W. Elling, INFU, Dortmund, Germany

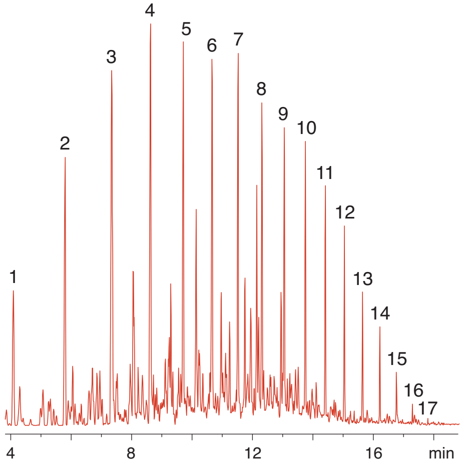
Analysis of commercial gas oil

MN Appl. No. 200060

Column:	OPTIMA® 17, 25 m x 0.20 mm ID, 0.2 μm film, REF 726065.25, max. temperature 320/340 °C
Injection:	2.0 μl gas oil, diluted 1:100 in MeOH, split 1:120
Carrier gas:	25 cm/s He
Temperature:	80 °C (4 min) $\xrightarrow{15\ °C/min}$ 320 °C
Detector:	MSD

Peaks:

1. C10
2. C11
3. C12
4. C13
5. C14
6. C15
7. C16
8. C17
9. C18
10. C19
11. C20
12. C21
13. C22
14. C23
15. C24
16. C25
17. C26



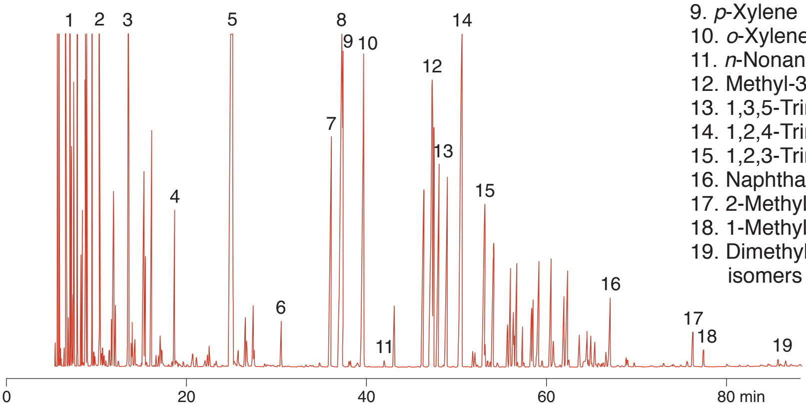
Analysis of unleaded gasoline

MN Appl. No. 200071

Column:	PERMABOND® P-100, 100 m x 0.25 mm ID, REF 726890.100, max. temperature 300/320 °C
Injection:	0.5 μl, split 70 ml/min
Carrier gas:	200 kPa H_2 (2.3 ml/min)
Temperature:	35 °C (15 min) $\xrightarrow{2\ °C/min}$ 200 °C (5 min)
Detector:	FID 250 °C

Peaks:

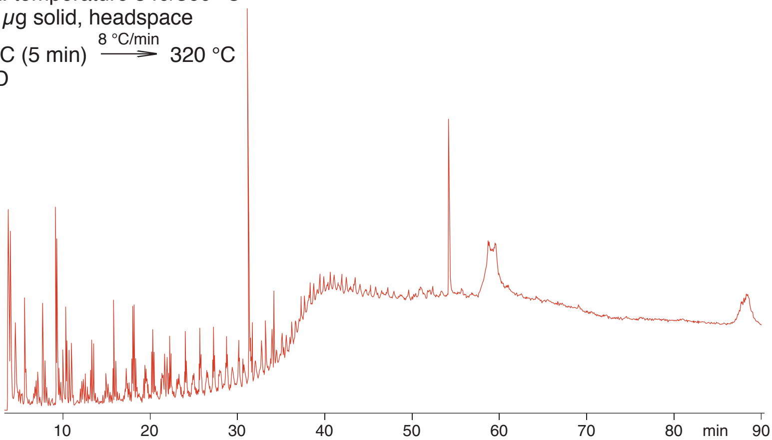
1. *n*-Pentane
2. *n*-Hexane
3. Benzene
4. *n*-Heptane
5. Toluene
6. *n*-Octane
7. Ethylbenzene
8. *m*-Xylene
9. *p*-Xylene
10. *o*-Xylene
11. *n*-Nonane
12. Methyl-3-ethylbenzene
13. 1,3,5-Trimethylbenzene
14. 1,2,4-Trimethylbenzene
15. 1,2,3-Trimethylbenzene
16. Naphthalene
17. 2-Methylnaphthalene
18. 1-Methylnaphthalene
19. Dimethylnaphthalene isomers



Pyrolysis GC of polyethylene and polypropylene

MN Appl. No. 210030

Column: OPTIMA® 5 MS, 60 m x 0.32 mm ID, 1 µm film, REF 726212.60, max. temperature 340/360 °C
Injection: 270 µg solid, headspace
Temperature: 60 °C (5 min) $\xrightarrow{8\ °C/min}$ 320 °C
Detector: MSD

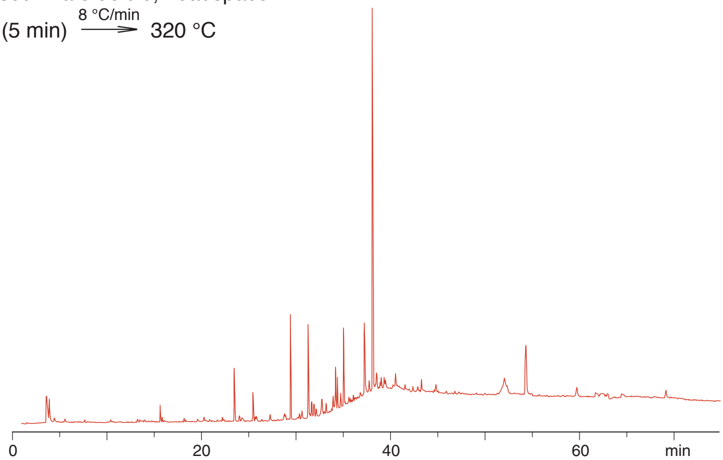


Courtesy of Mrs. Engel, VW, Wolfsburg, Germany

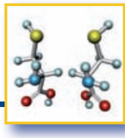
Pyrolysis GC of chloroprene rubber

MN Appl. No. 210040

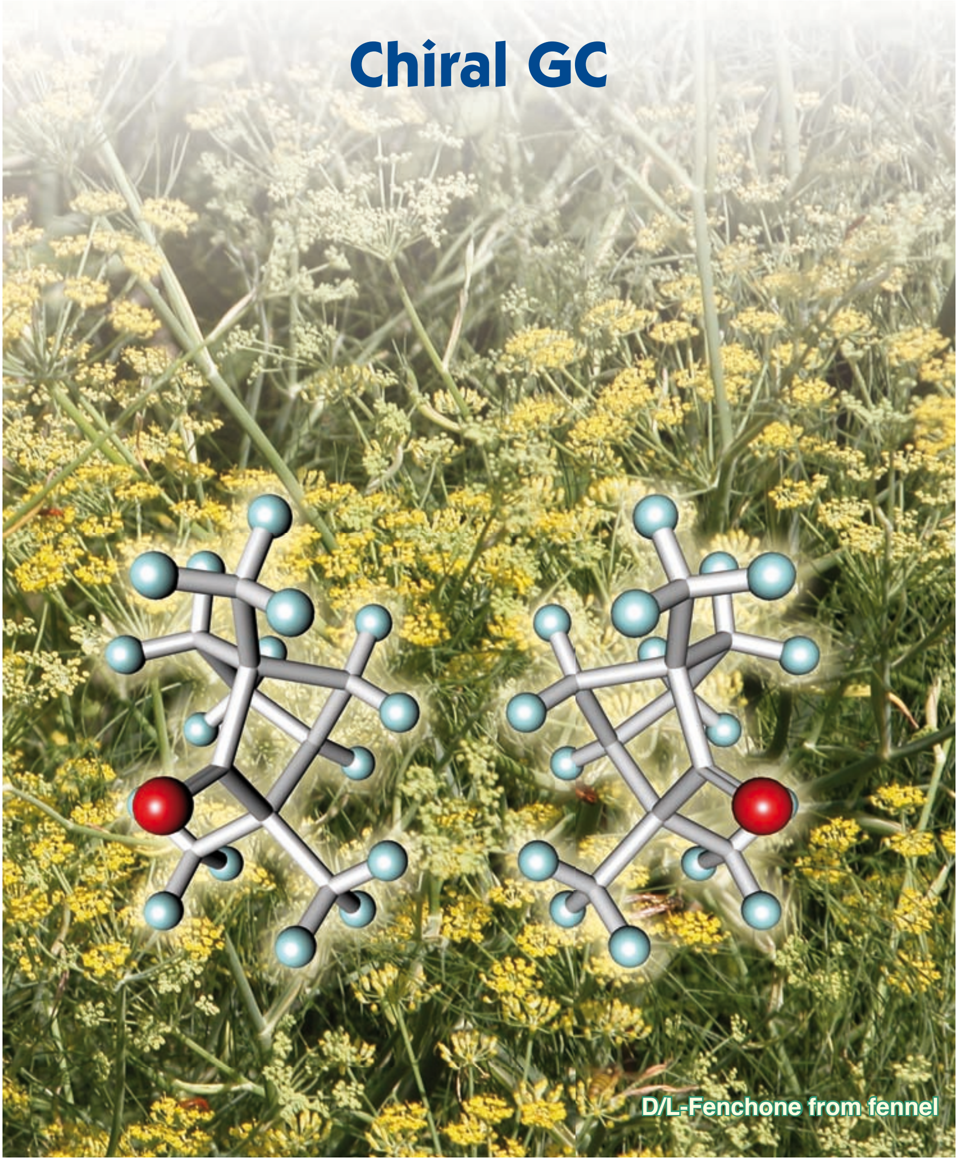
Column: OPTIMA® 5 MS, 60 m x 0.32 mm ID, 1 µm film, REF 726212.60, max. temperature 340/360 °C
Injection: 1 g solid is dissolved in 10 ml of hexane or methanol, 100 µl of this solution are pyrolysed in a crucible, headspace
Temperature: 60 °C (5 min) $\xrightarrow{8\ °C/min}$ 320 °C
Detector: MSD



Courtesy of Mrs. Engel, VW, Wolfsburg, Germany



Chiral GC



Please note: enantiomer separations have been arranged by increasing molecular size. Several chromatograms show separations of homologous series; they are listed according to the smallest molecule of the mixture. Related molecules or families of compounds may be found on earlier or later pages depending on size. Specific compounds can be found in the chromatogram index from page 276.

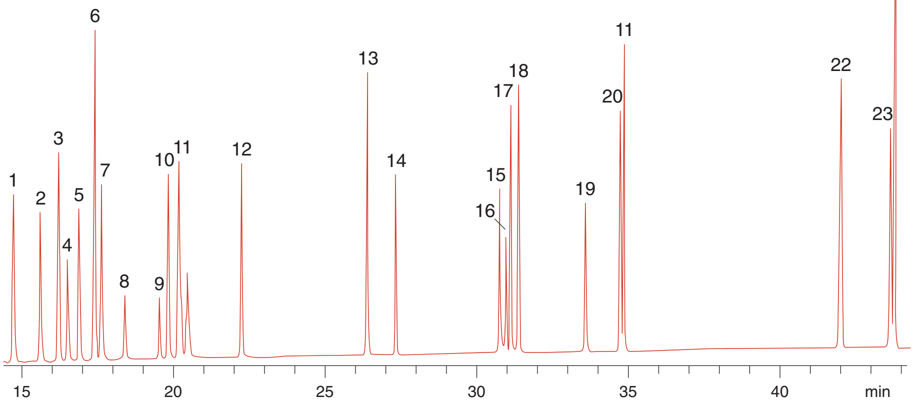
Analysis of amino acid enantiomers

MN Appl. No. 212761

Column:	FS-LIPODEX® E, 25 m x 0.25 mm ID, REF 723368.25, max. temp. 200/220 °C
Injection:	250 °C
Carrier gas:	1.2 ml/min He, purge flow 65.9 ml/min
Temperature:	60 °C (5 min) $\xrightarrow{3\ °C/min}$ 185 °C (15 min)
Detector:	MSD 280 °C

Peaks: (N-pentafluoropropionyl 2-propyl esters)

1. Aminoisobutyric acid
2. L-Isovaline
3. D-Isovaline
4. D-Valine
5. D-Alanine
6. L-Alanine
7. L-Valine
8. D-Isoleucine
9. D-Leucine
10. L-Isoleucine
11. L-Leucine
12. Glycine
13. L-Proline
14. D-Proline
15. D-Aspartic acid
16. D-Methionine
17. L-Methionine
18. L-Aspartic acid
19. D-Phenylalanine
20. D-Glutamic acid
21. L-Glutamic acid
22. D-Ornithine
23. D-Lysine
24. L-Lysine



O. Vandenabeele-Trambouze et al., Chromatographia **53** (2001) Suppl., S-332 – S-339

Summary of important amino acids

Formula	Common name	Systematic name	Structure
$C_2H_5NO_2$	glycine	aminoethanoic acid	NH_2-CH_2-COOH
$C_3H_7NO_2$	alanine	2-aminopropanoic acid	CH_3-$CH(NH_2)$-COOH
$C_4H_7NO_4$	aspartic acid	2-aminobutanedioic acid	HOOC-CH_2-$CH(NH_2)$-COOH
$C_4H_9NO_2$	aminoisobutyric acid	2-amino-2-methylpropanoic acid	$(CH_3)_2C(NH_2)$-COOH
$C_5H_9NO_2$	proline	pyrrolidine-2-carboxylic acid	
$C_5H_9NO_4$	glutamic acid	2-aminopentanedioic acid	HOOC-$(CH_2)_2$-$CH(NH_2)$-COOH
$C_5H_{11}NO_2$	valine	2-amino-3-methylbutanoic acid	$(CH_3)_2CH$-$CH(NH_2)$-COOH
$C_5H_{11}NO_2$	isovaline	2-amino-2-methylbutanoic acid	H_5C_2-$C(CH_3)(NH_2)$-COOH
$C_5H_{11}NO_2S$	methionine	2-amino-4-(methylsulfanyl)-butanoic acid	CH_3-S-$(CH_2)_2$-$CH(NH_2)$-COOH
$C_5H_{12}N_2O_2$	ornithine	2,5-diaminopentanoic acid	H_2N-$(CH_2)_3$-$CH(NH_2)$-COOH
$C_6H_{13}NO_2$	leucine	2-amino-4-methylpentanoic acid	$(CH_3)_2CH$-CH_2-$CH(NH_2)$-COOH
$C_6H_{13}NO_2$	isoleucine	2-amino-3-methylpentanoic acid	C_2H_5-$CH(CH_3)$-$CH(NH_2)$-COOH
$C_6H_{14}N_2O_2$	lysine	2,6-diaminohexanoic acid	H_2N-$(CH_2)_4$-$CH(NH_2)$-COOH
$C_9H_{11}NO_2$	phenylalanine	2-amino-3-phenyl-propanoic acid	C_6H_5-CH_2-$CH(NH_2)$-COOH

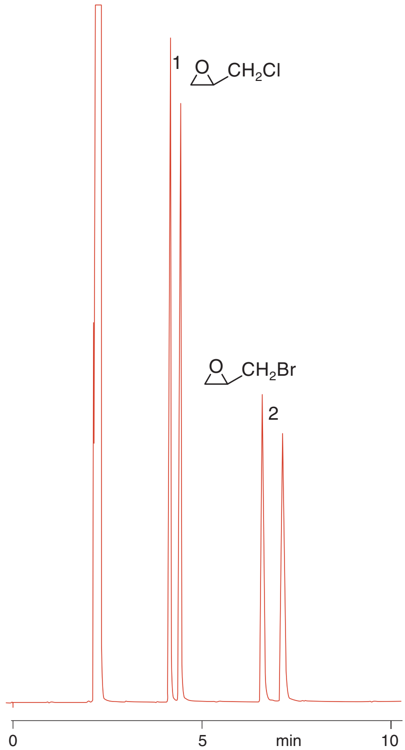
Enantiomer separation of epichloro- and epibromohydrin

MN Appl. No. 202621

Column:	FS-LIPODEX® A, 50 m x 0.25 mm ID, REF 723360.50, max. temperature 200/220 °C
Injection:	0.5 µl (1 % in CH_2Cl_2) split 245 ml/min
Carrier gas:	110 kPa H_2 (2.3 ml/min)
Temperature:	65 °C
Detector:	FID 240 °C

Peaks:

1. Epichlorohydrin (C_3H_5ClO)
2. Epibromohydrin (C_3H_5BrO)



Enantiomer separation of epichlorohydrin

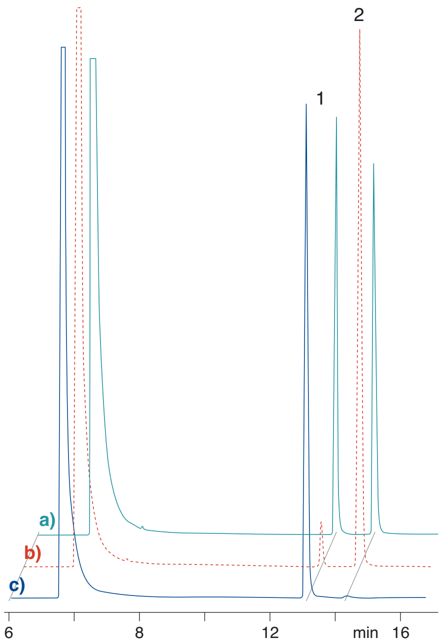
MN Appl. No. 212880

Column:	FS-LIPODEX® A, 50 m x 0.25 mm ID, REF 723360.50, max. temperature 200/220 °C
Sample:	compounds dissolved in MeOH (1:100)
Injection:	0.2 µl sample + 0.3 µl air, split 80 ml/min, 230 °C
Carrier gas:	85 kPa N_2
Temperature:	50 °C
Detector:	FID 250 °C

a) racemate (S/R 50:50)
b) S/R 2:98
c) S/R 99:1

Peaks:

1. S-Epichlorohydrin (C_3H_5ClO)
2. R-Epichlorohydrin



Courtesy of B. Mischke, Schulung und Chromatographie, Berlin (Germany)

Chiral separations

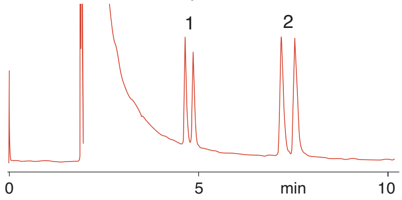
Enantiomer separation of propane-1,2-diol and butane-1,3-diol (TFA)

MN Appl. No. 202881

Column: LIPODEX® D, 25 m x 0.25 mm ID, REF 723366.50, max. temperature 200/220 °C
Carrier gas: 0.7 bar H_2
Temperature: 105 °C
Detector: FID

Peaks:
1. Propane-1,2-diol ($C_3H_8O_2$)
2. Butane-1,3-diol ($C_4H_{10}O_2$)

W.A. König et al., HRC **11** (1988) 506 – 509

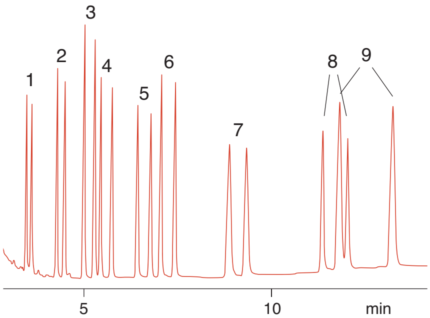


Enantiomer separation of chiral amines and amino alcohols (N,O-TFA)

MN Appl. No. 202421

Column: LIPODEX® D, 50 m x 0.25 mm ID, REF 723366.50, max. temperature 200/220 °C
Carrier gas: 1 bar H_2
Temperature: 140 °C $\xrightarrow{2\ °C/min}$ 170 °C
Detector: FID

Peaks: R enantiomers are eluted first.
1. 2-Aminopentane ($C_5H_{13}N$)
2. 2-Aminohexane ($C_6H_{15}N$)
3. 2-Amino-5-methylhexane ($C_7H_{17}N$)
4. 2-Aminoheptane ($C_7H_{17}N$)
5. 2-Amino-6-methylheptane ($C_8H_{19}N$)
6. 2-Aminooctane ($C_8H_{19}N$)
7. Valinol ($C_5H_{13}NO$)
8. Phenylethylamine ($C_8H_{11}N$)
9. Alaninol (C_3H_9NO)



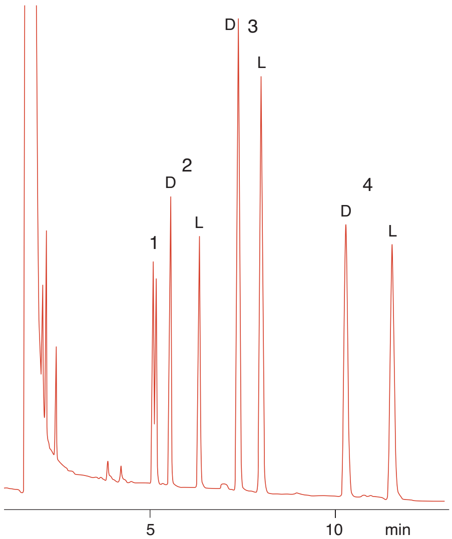
W.A. König et al., HRC **11** (1988) 506 – 509

Enantiomer separation of amino alcohols (N,O-TFA)

MN Appl. No. 202431

Column: LIPODEX® B, 50 m x 0.25 mm ID, REF 723362.50, max. temperature 200/ 220 °C
Carrier gas: H_2
Temperature: 150 °C
Detector: FID

Peaks:
1. 1-Aminopropan-2-ol (C_3H_9NO)
2. Alaninol = 2-aminopropan-1-ol (C_3H_9NO)
3. 2-Aminobutanol ($C_4H_{11}NO$)
4. Leucinol ($C_6H_{15}NO$)



Courtesy of Prof. W.A. König, Hamburg, Germany

Enantiomer separation of 1-butin-3-ol (TFA)

MN Appl. No. 202751

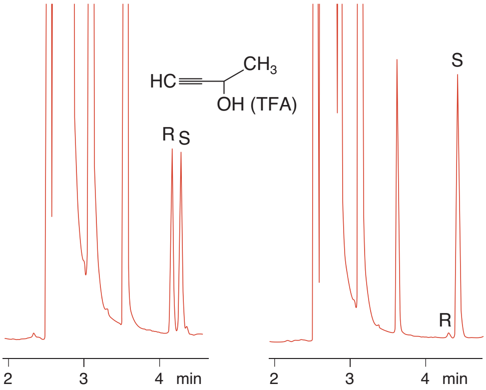
Column: LIPODEX® C,
50 m x 0.25 mm ID,
REF 723364.50,
max. temperature 200/220 °C

Carrier gas: 1 bar H_2

Temperature: 20 °C

Detector: FID

C_4H_6O



W.A. König et al., HRC **12** (1989) 35 – 39

Enantiomer analysis of 1,2-diols (cyclic carbonates)

MN Appl. No. 202861

Column: LIPODEX® B, 50 m x 0.25 mm ID, REF 723362.50, max. temperature 200/220 °C

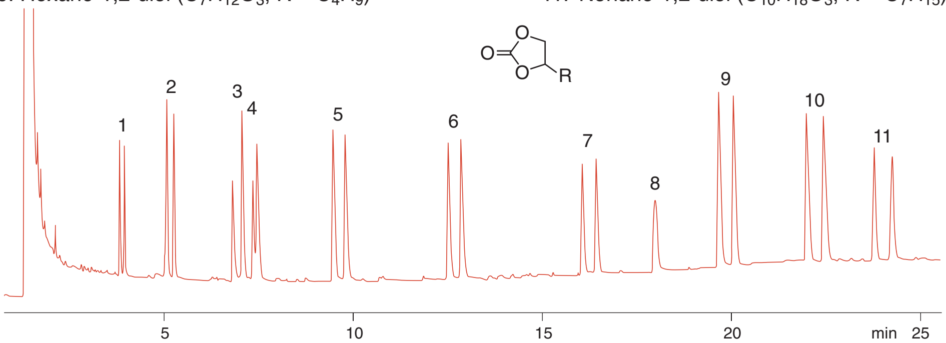
Carrier gas: 1 bar H_2

Temperature: 165 °C $\xrightarrow{2\ °C/min}$ 210 °C

Detector: FID

Peaks:

1. 3,3-Dimethylbutane-1,2-diol ($C_7H_{12}O_3$, R = t-C_4H_9)
2. 3-Methylbutane-1,2-diol ($C_6H_{10}O_3$, R = $CH(CH_3)_2$)
3. Propane-1,2-diol ($C_4H_6O_3$, R = CH_3)
4. Butane-1,2-diol ($C_5H_8O_3$, R = C_2H_5)
5. Pentane-1,2-diol ($C_6H_{10}O_3$, R = C_3H_7)
6. Hexane-1,2-diol ($C_7H_{12}O_3$, R = C_4H_9)
7. Heptane-1,2-diol ($C_8H_{14}O_3$, R = C_5H_{11})
8. Phenylglycol ($C_9H_8O_3$, R = C_6H_5)
9. Octane-1,2-diol ($C_9H_{16}O_3$, R = C_6H_{13})
10. 1-Octene-7,8-diol ($C_9H_{14}O_3$, R = $(CH_2)_4$-CH=CH_2)
11. Nonane-1,2-diol ($C_{10}H_{18}O_3$, R = C_7H_{15})



W.A. König et al., HRC **11** (1988) 621 – 625

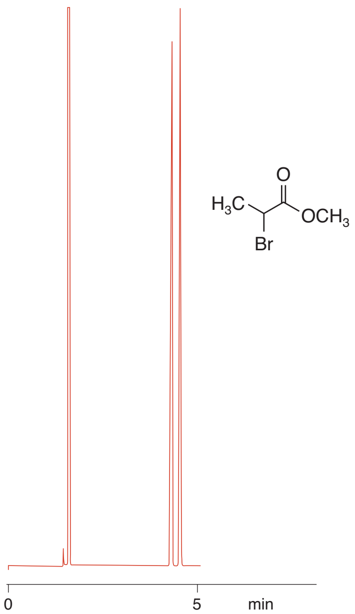
Chiral separations

Enantiomer separation of 2-bromopropionic acid methyl ester

MN Appl. No. 210580

Column:	FS-LIPODEX® A, 25 m x 0.25 mm ID, REF 723360.25, max. temperature 200/220 °C
Injection:	1 μl (1% in CH_2Cl_2) split 200 ml/min
Carrier gas:	11 psi He
Temperature:	60 °C
Detector:	FID 250 °C

$C_4H_7BrO_2$



Courtesy of Mr. B. Sievers, Riedel-de Haen AG, Seelze, Germany

Enantiomer separation of 2-chloropropionic acid methyl ester

MN Appl. No. 202512

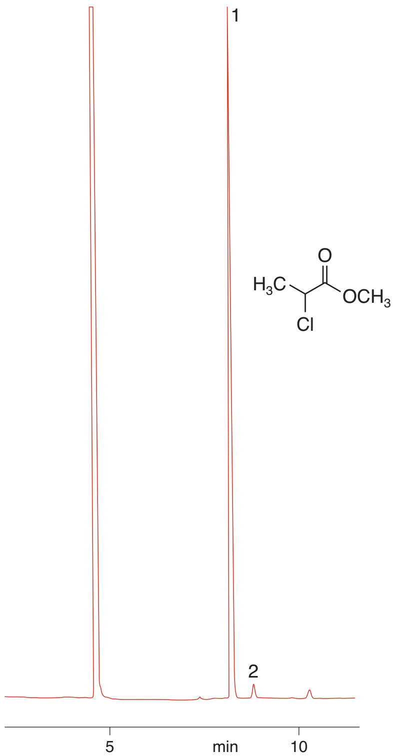
Column:	FS-LIPODEX® C, 50 m x 0.25 mm ID, REF 723364.50, max. temperature 200/220 °C
Split:	200 ml/min
Carrier gas:	150 kPa He
Temperature:	70 °C
Detector:	FID 200 °C

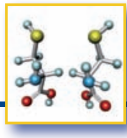
Peaks:

1. L-2-Chloropropionic acid methyl ester
2. D-2-Chloropropionic acid methyl ester

} ee = 96%

$C_4H_7ClO_2$





Enantiomer separation of 1,2-epoxyalkanes

MN Appl. No. 202611

Column: FS-LIPODEX® E, 25 m x 0.25 mm ID, REF 723368.25, max. temperature 200/220 °C

Injection: 0.5 μl split 135 ml/min

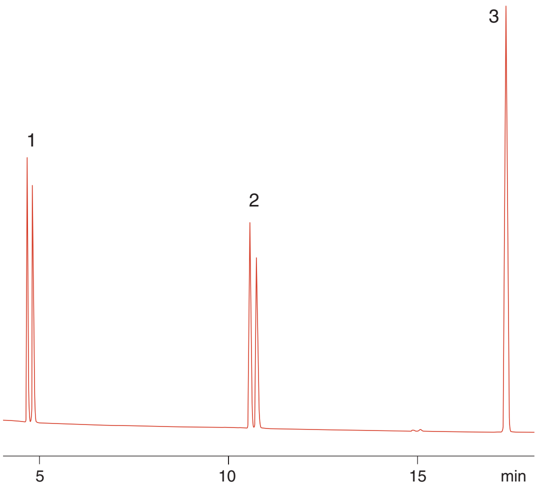
Carrier gas: 50 kPa H_2 (1.2 ml/min)

Temperature: 40 °C (3 min) $\xrightarrow{4\ °C/min}$ 120 °C

Detector: FID 250 °C

Peaks:

1. 1,2-Epoxybutane (C_4H_8O)
2. 1,2-Epoxyhexane ($C_6H_{12}O$)
3. 1,2-Epoxyoctane ($C_8H_{16}O$)



Enantiomer separation of aldols (TFA)

MN Appl. No. 202961

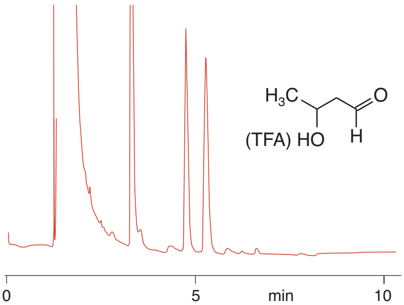
Column: LIPODEX® B, 50 m x 0.25 mm ID, REF 723362.50, max. temperature 200/220 °C

Carrier gas: 1 bar H_2

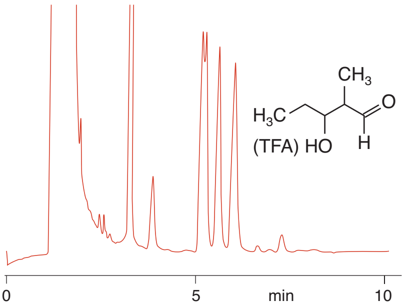
Temperature: 85 °C

Detector: FID

3-Hydroxybutyraldehyde ($C_4H_8O_2$)



2-Methyl-3-hydroxyvaleraldehyde ($C_6H_{12}O_2$)



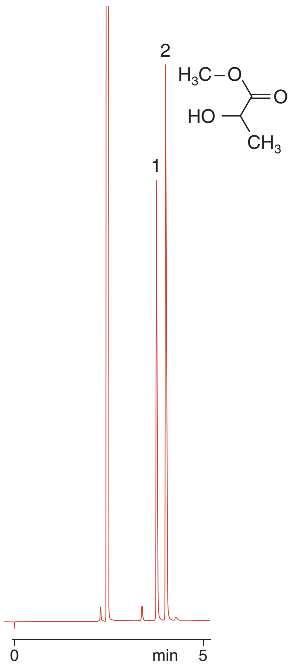
W.A. König et al., HRC **11** (1988) 621 – 625

Enantiomer separation of methyl lactate

MN Appl. No. 202762

Column:	FS-LIPODEX® A, 50 m x 0.25 mm ID, REF 723360.50, max. temperature 200/220 °C
Injection:	0.1 µl (1 % in CH_2Cl_2) split 320 ml/min
Carrier gas:	120 kPa H_2 (2.2 ml/min)
Temperature:	80 °C
Detector:	FID 250 °C

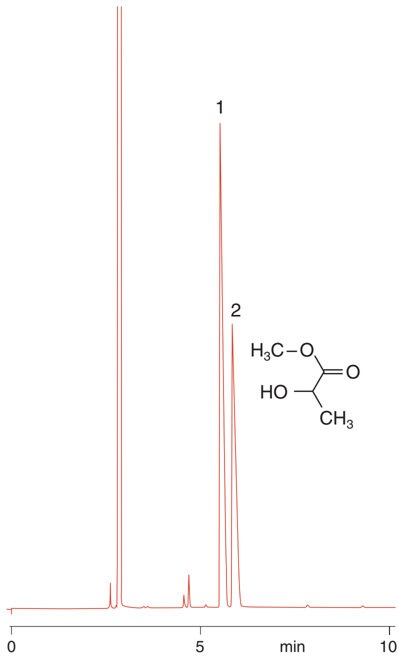
Peaks: ($C_4H_8O_3$)
1. S-(–)
2. R-(+)

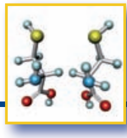


MN Appl. No. 202772

Column:	FS-HYDRODEX β-PM, 50 m x 0.25 mm ID, REF 723370.50, max. temperature 230/250 °C
Injection:	0.1 µl (1 % in CH_2Cl_2) split 150 ml/min
Carrier gas:	120 kPa H_2 (1.7 ml/min)
Temperature:	90 °C
Detector:	FID 250 °C

Peaks: ($C_4H_8O_3$)
1. R-(+)
2. S-(–)



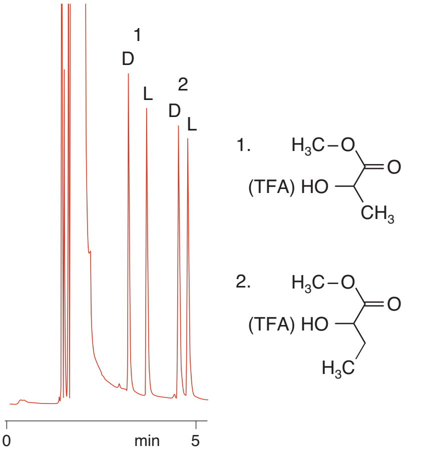


Enantiomer separation of lactic and 2-hydroxybutyric acid methyl esters (TFA)

MN Appl. No. 202752

Column: LIPODEX® A, 50 m x 0.25 mm ID, REF 723360.50, max. temperature 200/220 °C
Carrier gas: H_2
Temperature: 50 °C
Detector: FID

Peaks:
1. Lactic acid methyl ester ($C_4H_8O_3$)
2. 2-Hydroxybutyric acid methyl ester ($C_5H_{10}O_3$)



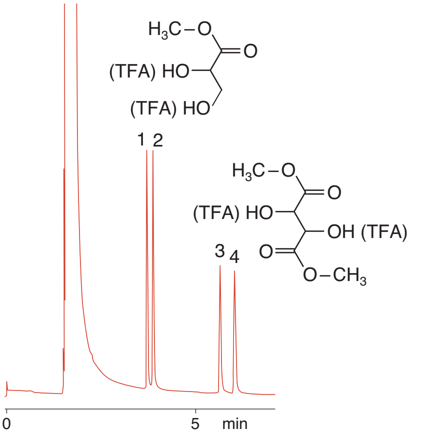
Courtesy of Prof. W.A. König, Hamburg, Germany

Enantiomer separation of glyceric and tartaric acid methyl esters (TFA)

MN Appl. No. 202732

Column: LIPODEX® A, 50 m x 0.25 mm ID, REF 723360.50, max. temperature 200/220 °C
Carrier gas: 1 bar H_2
Temperature: 90 °C
Detector: FID

Peaks:
1. D-Glyceric acid methyl ester ($C_4H_8O_4$)
2. L-Glyceric acid methyl ester
3. L-Tartaric acid dimethyl ester ($C_6H_{10}O_6$)
4. D-Tartaric acid dimethyl ester



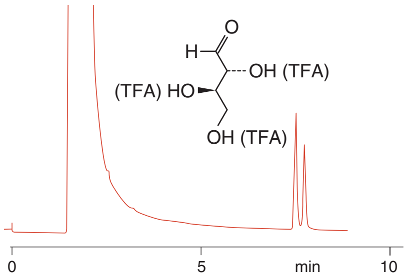
W.A. König, S. Lutz, G. Wenz, Angew. Chem. Int. Ed. Engl. **27** (1988) 979-980

Enantiomer separation of erythrose (TFA)

MN Appl. No. 202362

Column: LIPODEX® A, 50 m x 0.25 mm ID, REF 723360.50, max. temperature 200/220 °C
Carrier gas: H_2
Temperature: 80 °C
Detector: FID

$C_4H_8O_4$



Courtesy of Prof. W.A. König, Hamburg, Germany

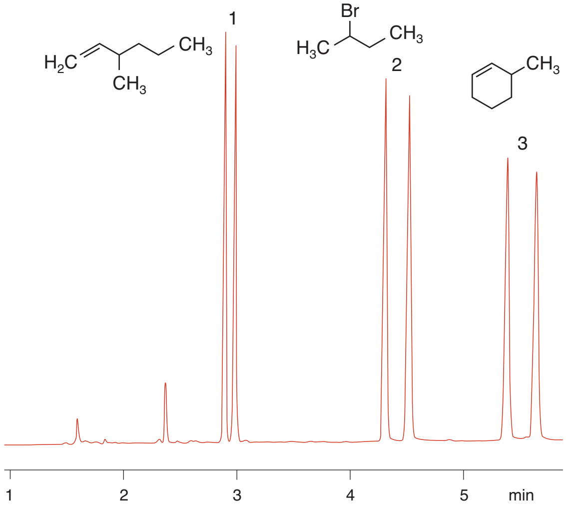
Chiral separations

Enantiomer separation of 3-methyl-1-hexene, 2-bromobutane and 3-methylcyclohexene

MN Appl. No. 201880

Column: LIPODEX® C, 50 m x 0.25 mm ID, REF 723364.50, max. temperature 200/220 °C
Injection: headspace
Carrier gas: 1 bar H_2
Temperature: 30 °C
Detector: FID

Peaks:
1. 3-Methyl-1-hexene (C_7H_{14})
2. 2-Bromobutane (C_4H_9Br)
3. 3-Methylcyclohexene (C_7H_{12})



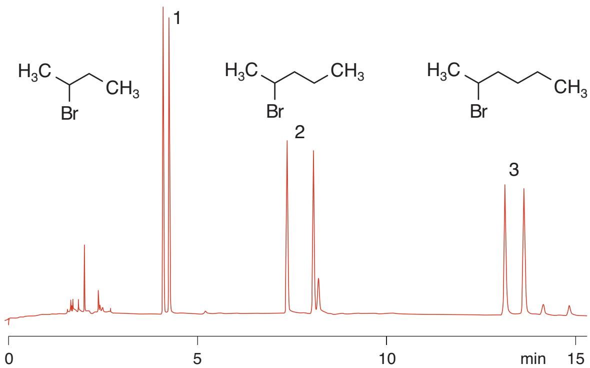
W.A. König et al., HRC **12** (1989) 35 – 39

Enantiomer separation of chiral alkyl bromides

MN Appl. No. 202250

Column: LIPODEX® C, 50 m x 0.25 mm ID, REF 723364.50, max. temperature 200/220 °C
Carrier gas: H_2
Temperature: 50 °C
Detector: FID

Peaks:
1. 2-Bromobutane (C_4H_9Br)
2. 2-Bromopentane ($C_5H_{11}Br$)
3. 2-Bromohexane ($C_6H_{13}Br$)



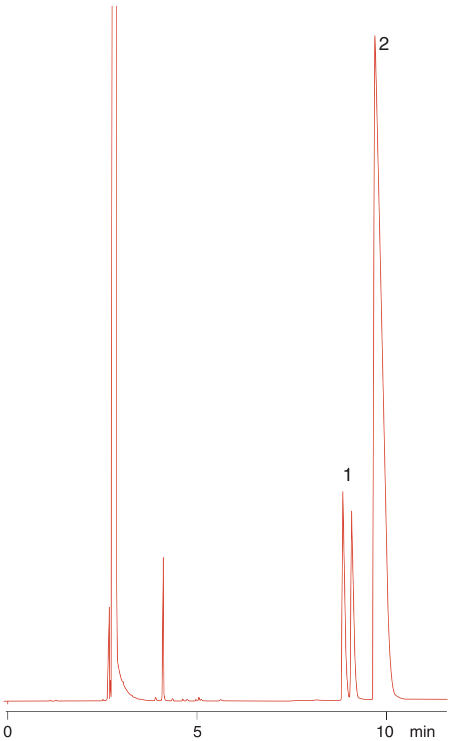
Courtesy of Prof. W.A. König, Hamburg, Germany

Enantiomer separation of butane-2,3-diol

MN Appl. No. 202901

Column:	FS-HYDRODEX β-PM, 50 m x 0.25 mm ID REF 723370.50, max. temperature 230/250 °C
Injection:	1 μl (1 % in CH_2Cl_2) split 150 ml/min
Carrier gas:	120 kPa H_2 (1.7 ml/min)
Temperature:	100 °C
Detector:	FID 250 °C

Peaks: ($C_4H_{10}O_2$)
1. RR/SS
2. meso

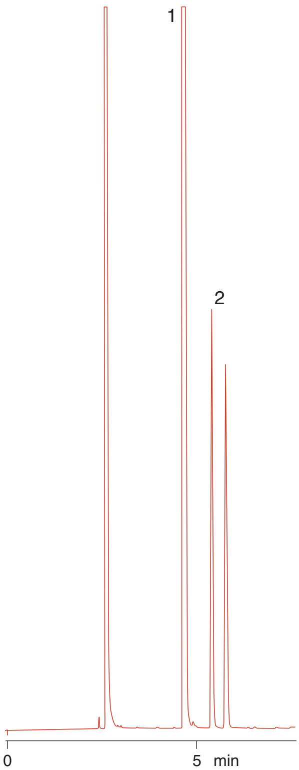


Enantiomer separation of butane-2,3-diol (TFA)

MN Appl. No. 202891

Column:	FS-LIPODEX® E, 50 m x 0.25 mm ID, REF 723368.50, max. temperature 200/220 °C
Injection:	0.5 μl (1 % in CH_2Cl_2) split 200 ml/min
Carrier gas:	120 kPa H_2 (2.1 ml/min)
Temperature:	80 °C
Detector:	FID 250 °C

Peaks: ($C_4H_{10}O_2$)
1. meso
2. RR/SS



Chiral separations

Enantiomer separation of butane-1,3-diol

MN Appl. No. 211320

Columns: all 25 m x 0.25 mm ID:
a) FS-HYDRODEX β-6TBDM (REF 723381.25),
b) FS-LIPODEX® E (REF 723368.25),
c) FS-HYDRODEX β-PM (REF 723370.25)
Injection: 1 μl, split, 250 °C
Carrier gas: 1.1 ml/min He
Detector: FID 250 °C

	a	b	c
Temperature:	95 °C	65 °C	85 °C
Resolution:	<0.5	2.33	0.66

partial TFA derivative

MN Appl. No. 211330

Column a)
Temperature: 75 °C
Resolution: 9.98

TFA derivative

MN Appl. No. 211340

Column a)
Temperature: 75 °C
Resolution: 8.79

Courtesy of H. Casabianca, CNRS Service Central d'Analyse, Vernaison, France

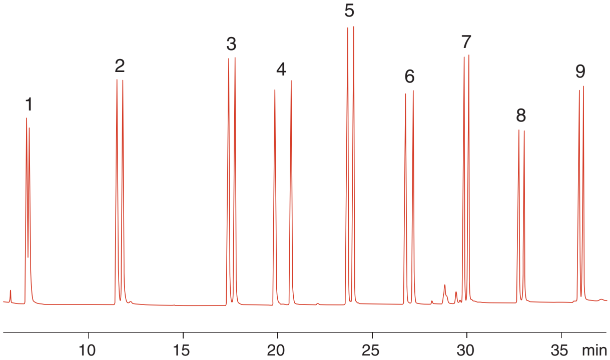
Enantiomer analysis of 1,2-diols (TFA)

MN Appl. No. 202851

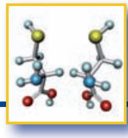
Column: LIPODEX® A,
50 m x 0.25 mm ID,
REF 723360.50,
max. temperature 200/220 °C
Carrier gas: H_2
Temperature: 48 °C (5 min) $\xrightarrow{2\ °C/min}$ 120 °C
Detector: FID

Peaks:

1. Butane-1,2-diol ($C_4H_{10}O_2$)
2. Pentane-1,2-diol ($C_5H_{12}O_2$)
3. Hexane-1,2-diol ($C_6H_{14}O_2$)
4. Cyclohexane-*trans*-1,2-diol ($C_6H_{12}O_2$)
5. Heptane-1,2-diol ($C_7H_{16}O_2$)
6. Cycloheptane-*trans*-1,2-diol ($C_7H_{14}O_2$)
7. Octane-1,2-diol ($C_8H_{18}O_2$)
8. Phenylglycol ($C_8H_{10}O_2$)
9. Nonane-1,2-diol ($C_9H_{20}O_2$)



Courtesy of Prof. W.A. König, Hamburg, Germany

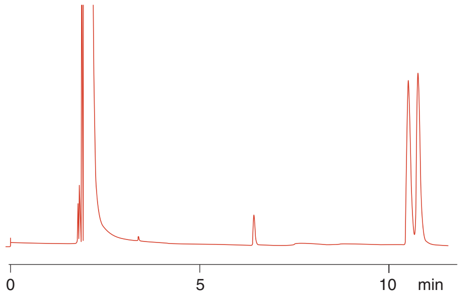


Enantiomers separation of butane-1,2,4-triol (TFA)

MN Appl. No. 202931

Column: LIPODEX® A, 50 m x 0.25 mm ID, REF 723360.50, max. temperature 200/220 °C
Carrier gas: H_2
Temperature: 70 °C
Detector: FID

$C_4H_{10}O_3$



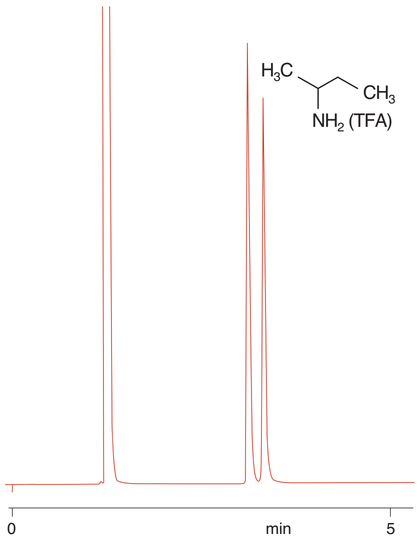
Courtesy of Prof. W.A. König, Hamburg, Germany

Enantiomer separation of 2-butylamine (TFA)

MN Appl. No. 202340

Column: FS-LIPODEX® D, 25 m x 0.25 mm ID, REF 723366.25, max. temperature 200/220 °C
Injection: 0.1 µl (1 % in CH_2Cl_2) split 190 ml/min
Carrier gas: 50 kPa H_2 (1.5 ml/min)
Temperature: 105 °C
Detector: FID 250 °C

$C_4H_{11}N$



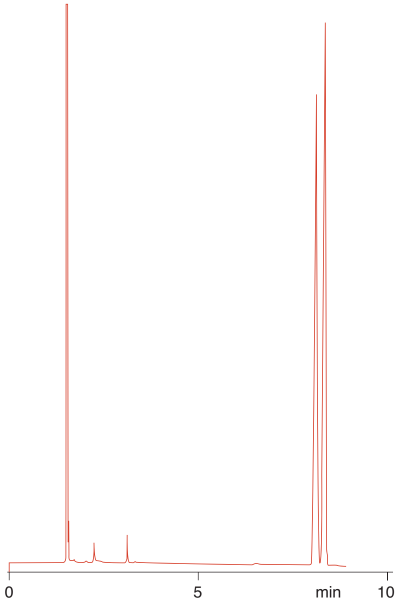
Chiral separations

Enantiomer separation of 2-aminobutanol-1 (N,O-TFA)

MN Appl. No. 210570

Column:	FS-LIPODEX® A, 25 m x 0.25 mm ID, REF 723360.25, max. temperature 200/220 °C
Injection:	1 µl (1 % in CH_2Cl_2) split 200 ml/min
Carrier gas:	11 psi He
Temperature:	90 °C
Detector:	FID 250 °C

$C_4H_{11}NO$



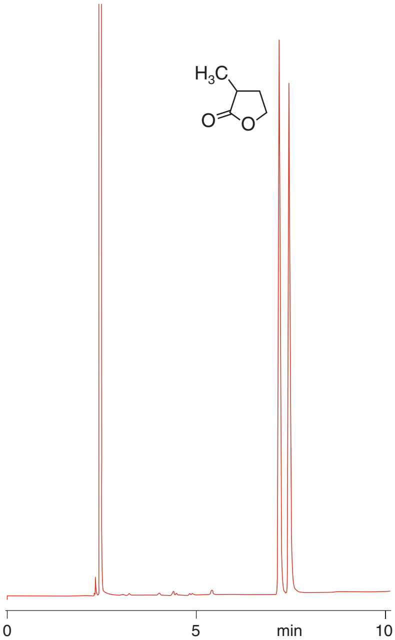
Courtesy of Mr. B. Sievers, Riedel-de Haen AG, Seelze, Germany

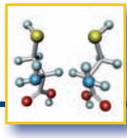
Enantiomer separation of α-methylbutyrolactone

MN Appl. No. 202842

Column:	FS-LIPODEX® A, 50 m x 0.25 mm ID, REF 723360.50, max. temperature 200/220 °C
Injection:	0.1 µl (1 % in CH_2Cl_2) split 245 ml/min
Carrier gas:	110 kPa H_2 (2.3 ml/min)
Temperature:	90 °C
Detector:	FID 240 °C

$C_5H_8O_2$



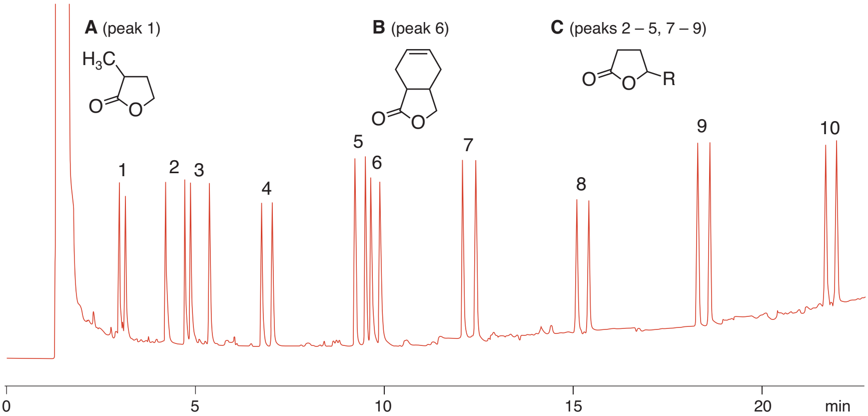


Enantiomer analysis of γ-lactones

MN Appl. No. 202982

Column: LIPODEX® B, 50 m x 0.25 mm ID, REF 723362.50, max. temperature 200/220 °C
Carrier gas: H_2
Temperature: 135 °C $\xrightarrow{3\ °C/min}$ 200 °C
Detector: FID

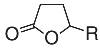
Peaks:
1. α-Methylbutyrolactone (structure A, $C_5H_8O_2$)
2. γ-Valerolactone (structure C, $C_5H_8O_2$, R = CH_3)
3. γ-Hexalactone (structure C, $C_6H_{10}O_2$, R = C_2H_5)
4. γ-Heptalactone (structure C, $C_7H_{12}O_2$, R = C_3H_7)
5. γ-Octalactone (structure C, $C_8H_{14}O_2$, R = C_4H_9)
6. Tetrahydroisobenzofuranone (structure B, $C_8H_{10}O_2$)
7. γ-Nonalactone (structure C, $C_9H_{16}O_2$, R = C_5H_{11})
8. γ-Decalactone (structure C, $C_{10}H_{18}O_2$, R = C_6H_{13})
9. γ-Undecalactone (structure C, $C_{11}H_{20}O_2$, R = C_7H_{15})
10. γ-Dodecalactone (structure C, $C_{12}H_{22}O_2$, R = C_8H_{17})



Courtesy of Prof. W.A. König, Hamburg, Germany

Chiral separations

Enantiomer analysis of γ-lactones



Columns:	all 25 m x 0.25 mm ID: a) FS-HYDRODEX β-6TBDM (REF 723381.25), b) FS-LIPODEX® E (REF 723368.25), c) FS-HYDRODEX β-PM (REF 723370.25)
Injection:	1 μl, split, 250 °C
Carrier gas:	1.1 ml/min He
Detector:	FID 250 °C

γ-Valerolactone
MN Appl. No. 211350

	a	b	c
Temperature:	90 °C	105 °C	85 °C
Resolution:	4.29	2.88	1.15

γ-Hexalactone
MN Appl. No. 211360

	a	b	c
Temperature:	100 °C	115 °C	95 °C
Resolution:	4.13	7.54	1.39

γ-Heptalactone
MN Appl. No. 211390

	a	b	c
Temperature:	115 °C	115 °C	110 °C
Resolution:	5.74	10.27	1.63

γ-Octalactone
MN Appl. No. 211440

	a	b	c
Temperature:	125 °C	115 °C	120 °C
Resolution:	5.99	11.83	1.39

γ-Nonalactone
MN Appl. No. 211480

	a	b	c
Temperature:	135 °C	120 °C	130 °C
Resolution:	3.57	7.27	1.05

γ-Decalactone
MN Appl. No. 211660

	a	b	c
Temperature:	140 °C	130 °C	140 °C
Resolution:	2.77	5.18	0.63

For separation of γ-decalactone also see appl. 212530 at *www.mn-net.com*

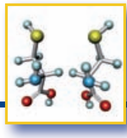
γ-Undecalactone
MN Appl. No. 211720

	a	b	c
Temperature:	160 °C	140 °C	150 °C
Resolution:	<0.5	4.51	0.3

γ-Dodecalactone
MN Appl. No. 211750

	a	b	c
Temperature:	175 °C	135 °C	150 °C
Resolution:	0.99	1.64	<0.5

Courtesy of H. Casabianca, CNRS Service Central d’Analyse, Vernaison, France



Enantiomer separation of 1-O-alkylglycerols (cyclic carbonates)

MN Appl. No. 202951

Column: LIPODEX® B,
50 m x 0.25 mm ID,
REF 723362.50,
max. temperature 200/220 °C

Sample: O-alkylglycerols derivatised with phosgene (very toxic)

Carrier gas: 1 bar H_2

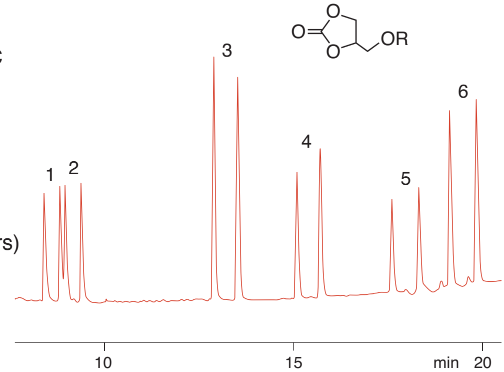
Temperature: 160 °C $\xrightarrow{2\ °C/min}$ 200 °C

Detector: FID

Peaks:

(R enantiomers are eluted before S enantiomers)

1. 1-O-Methylglycerol ($C_5H_8O_4$, R = – CH_3)
2. 1-O-Ethylglycerol ($C_6H_{10}O_4$, R = – C_2H_5)
3. 1-O-Isobutylglycerol ($C_8H_{14}O_4$, R = – CH_2 – $CH(CH_3)_2$)
4. 1-O-Butylglycerol ($C_8H_{14}O_4$, R = – $(CH_2)_3$ – CH_3)
5. 1-O-Isopentylglycerol ($C_9H_{16}O_4$, R = – $(CH_2)_2$ – $CH(CH_3)_2$)
6. 1-O-Pentylglycerol ($C_9H_{16}O_4$, R = – $(CH_2)_4$ – CH_3)



W.A. König et al., HRC **11** (1988) 621 – 625

Enantiomer separation of cyanohydrins (TFA)

MN Appl. No. 202280

Column: LIPODEX® C,
50 m x 0.25 mm ID,
REF 723364.50,
max. temperature 200/ 220 °C

Carrier gas: 1 barH_2

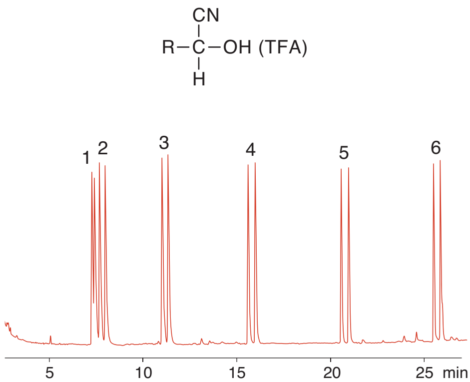
Temperature: 50 °C $\xrightarrow{2\ °C/min}$ 180 °C

Detector: FID

Peaks:

1. R = *n*-propyl (C_5H_9NO)
2. R = *i*-butyl ($C_6H_{11}NO$)
3. R = *n*-butyl ($C_6H_{11}NO$)
4. R = *n*-pentyl ($C_7H_{13}NO$)
5. R = *n*-hexyl ($C_8H_{15}NO$)
6. R = *n*-heptyl ($C_9H_{17}NO$)

R enantiomers are eluted before S enantiomers.



W.A. König et al., HRC **12** (1989) 35 – 39

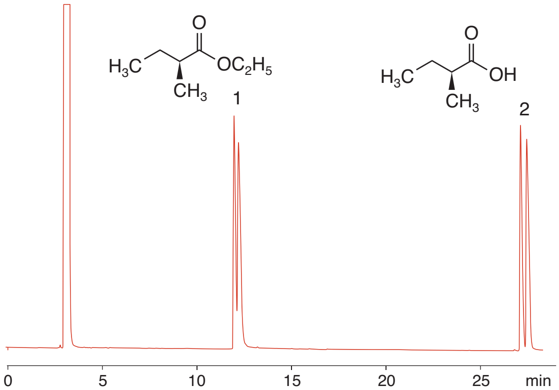
Enantiomer separation of 2-methylbutyric acid and ethyl ester

MN Appl. No. 202462

Column: FS-HYDRODEX β-PM, 50 m x 0.25 mm ID, REF 723370.50, max. temperature 230/250 °C
Injection: 1 μl (0.5 % in CH_2Cl_2) split 1:100
Carrier gas: 110 kPa H_2
Temperature: 65 °C (12 min) $\xrightarrow{4\ °C/min}$ 130 °C
Detector: FID 250 °C

Peaks:

1. 2-Methylbutyric acid ethyl ester ($C_7H_{14}O_2$)
2. 2-Methylbutyric acid ($C_5H_{10}O_2$)



Enantiomer separation of 2,3-epoxy-3-methylbutanol-1

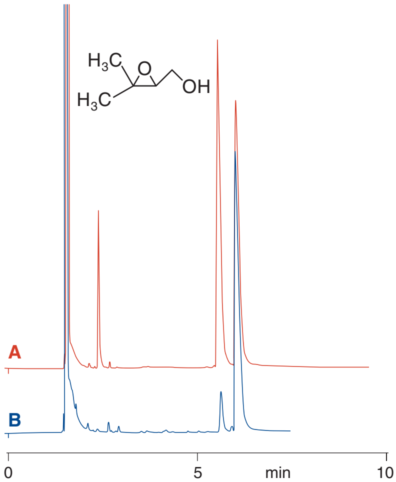
MN Appl. No. 202681/202691

Column: FS-LIPODEX® E, 25 m x 0.25 mm ID, REF 723368.25, max. temperature 200/220 °C
Injection: 0.5 μl, split 135 ml/min
Carrier gas: 50 kPa H_2 (1.2 ml/min)
Temperature: 100 °C
Detector: FID 250 °C

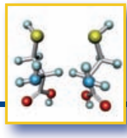
A) racemate (Appl. 202681)

B) ee = 83 % (Appl. 202691)

$C_5H_{10}O_2$



2,3-epoxy-3-methylbutanol-1 can also be separated on HYDRODEX β-PM (applications 202661/202671) or LIPODEX® A (applications 202701/202711). See our application database at *www.mn-net.com*.



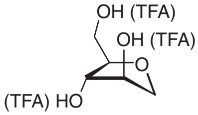
Enantiomer separation of 1,4- and 1,5-anhydroarabinitol (TFA)

MN Appl. No. 203021

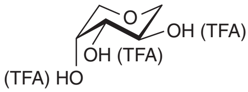
Column: LIPODEX® A, 50 m x 0.25 mm ID, REF 723360.50, max. temperature 200/220 °C
Carrier gas: H_2
Temperature: 90 °C
Detector: FID

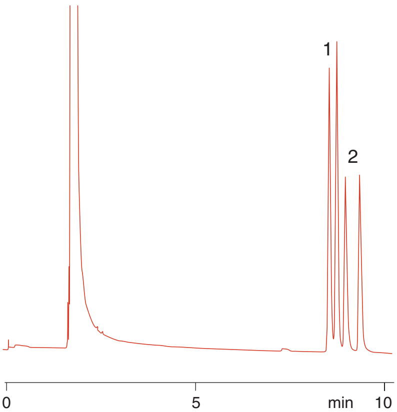
Peaks:

1. 1,4-Anhydroarabinitol (TFA), $C_5H_{10}O_4$



2. 1,5-Anhydroarabinitol (TFA), $C_5H_{10}O_4$





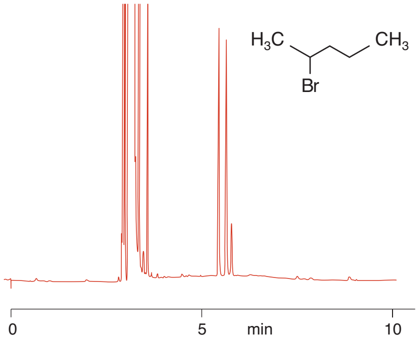
Courtesy of Prof. W.A. König, Hamburg, Germany

Enantiomer separation of 2-bromopentane

MN Appl. No. 202240

Column: FS-LIPODEX® C, 50 m x 0.25 mm ID, REF 723364.50, max. temperature 200/220 °C
Injection: 1 μl, split 1:100
Carrier gas: 100 kPa H_2
Temperature: 60 °C
Detector: FID 250 °C

$C_5H_{11}Br$



Chiral separations

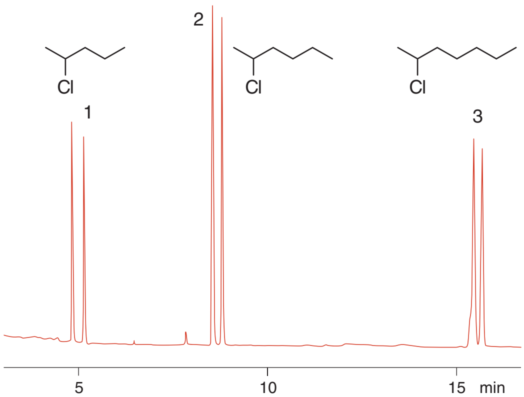
Enantiomer separation of chiral alkyl chlorides

MN Appl. No. 202260

Column: LIPODEX® C, 50 m x 0.25 mm ID, REF 723364.50, max. temperature 200/ 220 °C
Carrier gas: 1 bar H_2
Temperature: 60 °C
Detector: FID

Peaks:
1. 2-Chloropentane ($C_5H_{11}Cl$)
2. 2-Chlorohexane ($C_6H_{13}Cl$)
3. 2-Chloroheptane ($C_7H_{15}Cl$)

W.A. König et al., HRC **12** (1989) 35 – 39

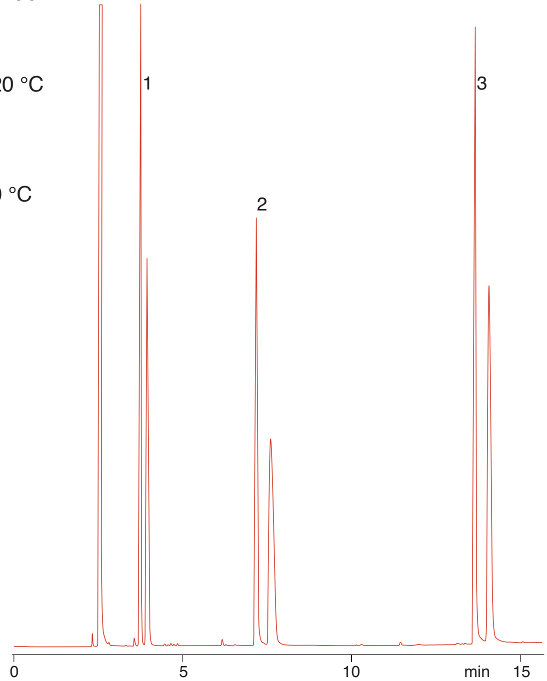


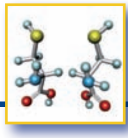
Enantiomer separation of 2-alkanols

MN Appl. No. 202451

Column: FS-LIPODEX® E, 50 m x 0.25 mm ID, REF 723368.50, max. temperature 200/ 220 °C
Injection: 0.1 μl (1 % in CH_2Cl_2) split 200 ml/min
Carrier gas: 120 kPa H_2 (2.1 ml/min)
Temperature: 80 °C (4 min) $\xrightarrow{4\ °C/min}$ 130 °C
Detector: FID 250 °C

Peaks:
1. R/S-Pentanol-2 ($C_5H_{12}O$)
2. R/S-Heptanol-2 ($C_7H_{16}O$)
3. R/S-Nonanol-2 ($C_9H_{20}O$)



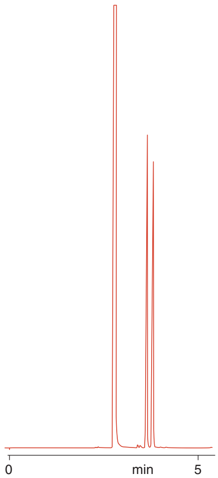


Enantiomer separation of pentanol-2 (TFA)

MN Appl. No. 202471

Column: FS-LIPODEX® E, 50 m x 0.25 mm ID, REF 723368.50, max. temperature 200/220 °C
Injection: 0.1 µl (1 % in CH_2Cl_2) split 200 ml/min
Carrier gas: 120 kPa H_2 (2.1 ml/min)
Temperature: 60 °C
Detector: FID 250 °C

$C_5H_{12}O$

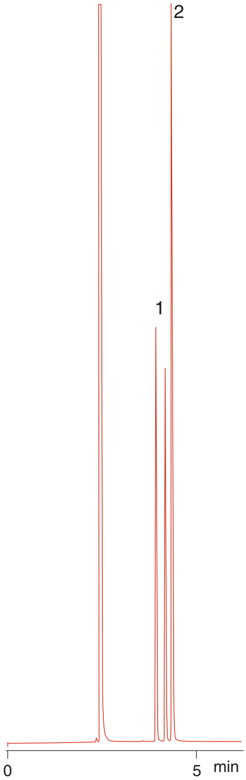


Enantiomer separation of pentane-2,4-diol (TFA)

MN Appl. No. 202911

Column: FS-LIPODEX® E, 50 m x 0.25 mm ID, REF 723368.50, max. temperature 200/220 °C
Injection: 0.1 µl (1 % in CH_2Cl_2) split 200 ml/min
Carrier gas: 120 kPa H_2 (2.1 ml/min)
Temperature: 100 °C
Detector: FID 250 °C

Peaks: ($C_5H_{12}O_2$)
1. RR/SS
2. meso



Chiral separations

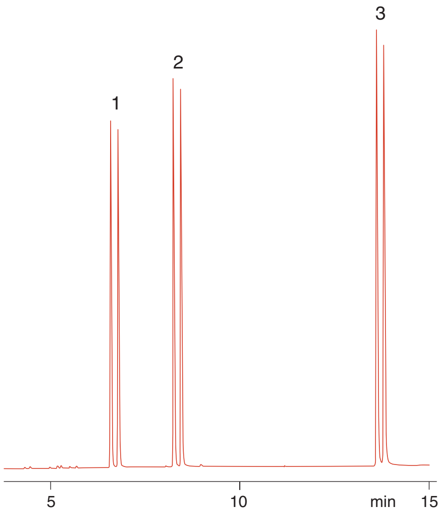
Enantiomer separation of 1,2-diols (TFA)

MN Appl. No. 202921

Column:	FS-LIPODEX® E, 50 m x 0.25 mm ID, REF 723368.50, max. temperature 200/220 °C
Injection:	0.1 μl (1 % in CH_2Cl_2) split 200 ml/min
Carrier gas:	120 kPa H_2 (2.1 ml/min)
Temperature:	80 °C $\xrightarrow{3\ °C/min}$ 130 °C
Detector:	FID 250 °C

Peaks:

1. Pentane-1,2-diol (TFA), $C_5H_{12}O_2$
2. Hexane-1,2-diol (TFA), $C_6H_{14}O_2$
3. Octane-1,2-diol (TFA), $C_8H_{18}O_2$

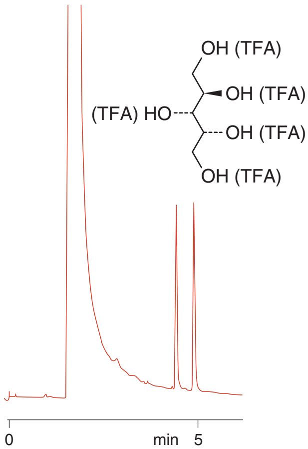


Enantiomer separation of arabinitol (TFA)

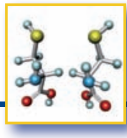
MN Appl. No. 203011

Column:	LIPODEX® A, 50 m x 0.25 mm ID, REF 723360.50, max. temperature 200/220 °C
Carrier gas:	H_2
Temperature:	110 °C
Detector:	FID

$C_5H_{12}O_5$



Courtesy of Prof. W.A. König, Hamburg, Germany

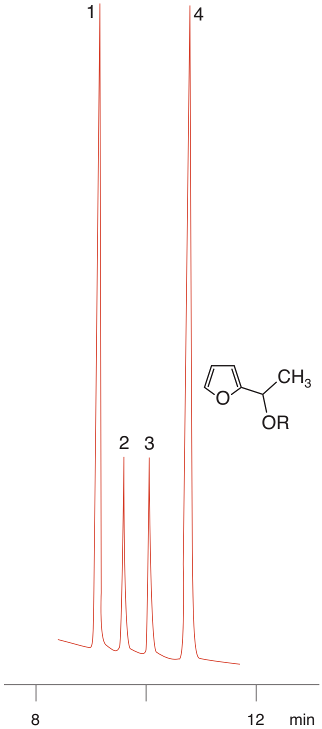


Enantiomer separation of R/S-1-(2-furyl)ethanol and R/S-1-(2-furyl)ethanol acetate

MN Appl. No. 213260

Column: equivalent to FS-HYDRODEX β-6TBDM, 25 m x 0.25 mm ID, REF 723381.25, max. temperature 230/250 °C
Injector: 250 °C
Carrier gas: 60 kPa H_2
Temperature: 85 °C
Detector: FID 300 °C

Peaks:
1. *(S)*-1-(2-furyl)ethanol acetate (R = CO-CH_3)
2. *(R)*-1-(2-furyl)ethanol (R = H)
3. *(S)*-1-(2-furyl)ethanol ($C_6H_8O_2$)
4. *(R)*-1-(2-furyl)ethanol acetate ($C_8H_{10}O_3$)



Courtesy of A. Ghanem, V. Schurig, Institute of Organic Chemistry, University of Tübingen, Germany

Enantiomer separation of lactide

MN Appl. No. 202832

Column: FS-LIPODEX® A, 25 m x 0.25 mm ID, REF 723360.25, max. temperature 200/220 °C

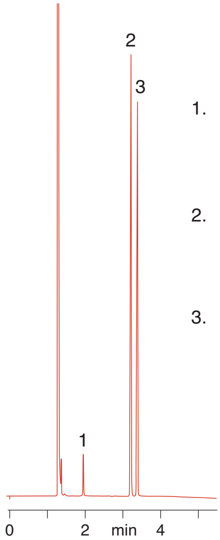
Injection: 0.5 μl (1 % in CH_2Cl_2) split 180 ml/min

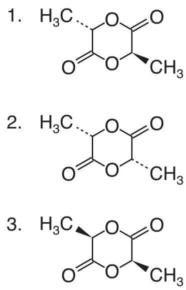
Carrier gas: 60 kPa H_2 (1.8 ml/min)

Temperature: 150 °C

Detector: FID 250 °C

Peaks: ($C_6H_8O_4$)
1. meso
2. SS
3. RR





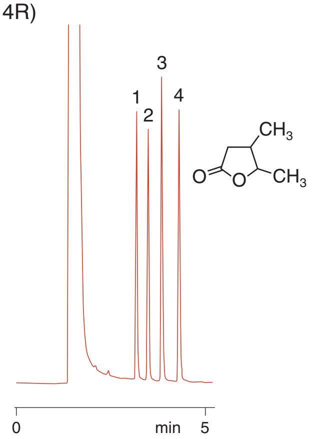
Lactide can also be separated on HYDRODEX β-PM (see application 202822 at *www.mn-net.com*).

Chiral separations

Analysis of 4 stereoisomers of 3,4-dimethylbutyrolactone
MN Appl. No. 202892

Column: LIPODEX® B, 50 m x 0.25 mm ID, REF 723362.50, max. temperature 200/220 °C
Carrier gas: 1 bar H_2
Temperature: 135 °C
Detector: FID

Peaks: ($C_6H_{10}O_2$)
1. (3S, 4R)
2. (3R, 4S)
3. (3S, 4S)
4. (3R, 4R)

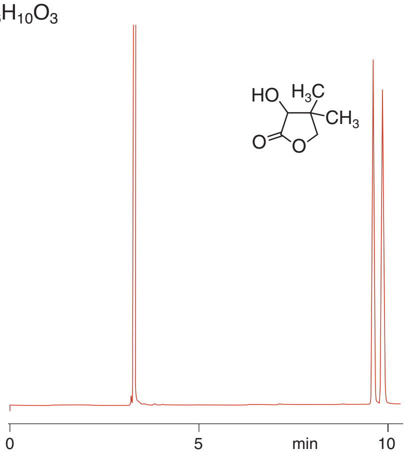


W.A. König et al., HRC **11** (1988) 621 – 625

Enantiomer analysis of pantolactone
MN Appl. No. 202912

Column: FS-HYDRODEX β-PM, 50 m x 0.25 mm ID, REF 723370.50, max. temperature 230/250 °C
Injection: 0.5 µl, split 1:100
Carrier gas: 100 kPa H_2
Temperature: 160 °C
Detector: FID 250 °C

$C_6H_{10}O_3$



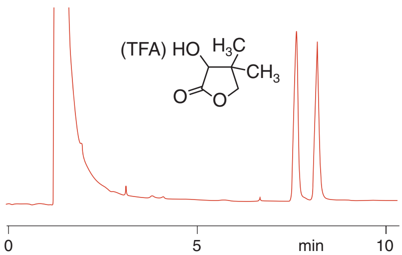
Pantolactone can also be separated on LIPODEX® E (applications 202902). See our application database at *www.mn-net.com*.

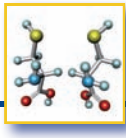
Enantiomer analysis of pantolactone (TFA)
MN Appl. No. 202922

Column: LIPODEX® B, 50 m x 0.25 mm ID, REF 723362.50, max. temperature 200/220 °C
Carrier gas: H_2
Temperature: 110 °C
Detector: FID

$C_6H_{10}O_3$

Courtesy of Prof. W.A. König, Hamburg, Germany

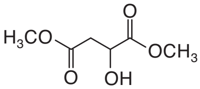




Enantiomer separation of dimethyl malate

MN Appl. No. 211370

Column: FS-HYDRODEX β-6TBDM, 25 m x 0.25 mm ID, REF 723381.25
Injection: 1 μl, split, 250 °C
Carrier gas: 1.1 ml/min He
Temperature: 100 °C
Detector: FID 250 °C



$C_6H_{10}O_5$

Resolution: 8.22

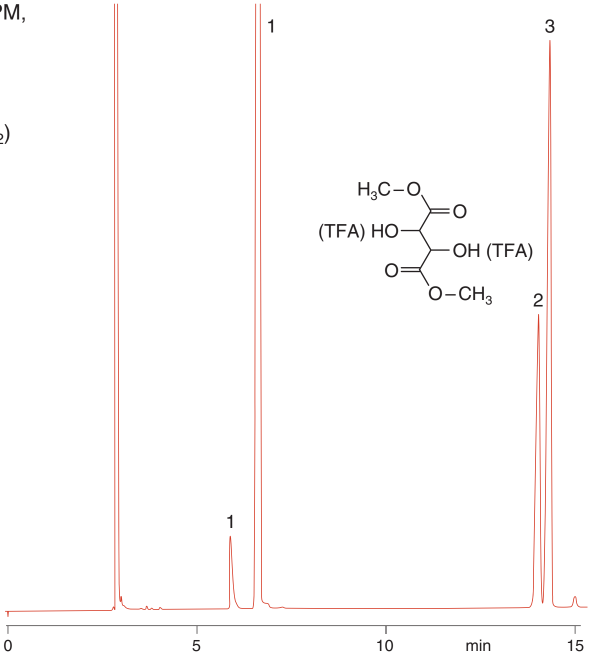
Courtesy of H. Casabianca, CNRS Service Central d’Analyse, Vernaison, France

Enantiomer separation of tartaric acid dimethyl esters (TFA)

MN Appl. No. 202712

Column: FS-HYDRODEX β-PM, 50 m x 0.25 mm ID, REF 723370.50, max. temperature 230/250 °C
Injection: 0.5 μl (1 % in CH_2Cl_2) split 150 ml/min
Carrier gas: 120 kPa H_2 (1.7 ml/min)
Temperature: 135 °C
Detector: FID 250 °C

Peaks: ($C_6H_{10}O_6$)
1. impurities
2. D-(–)
3. L-(+)



Tartaric acid dimethyl ester can also be separated on HYDRODEX β-PM (application 202722) or LIPODEX® A (application 202702).
See our application database at *www.mn-net.com*.

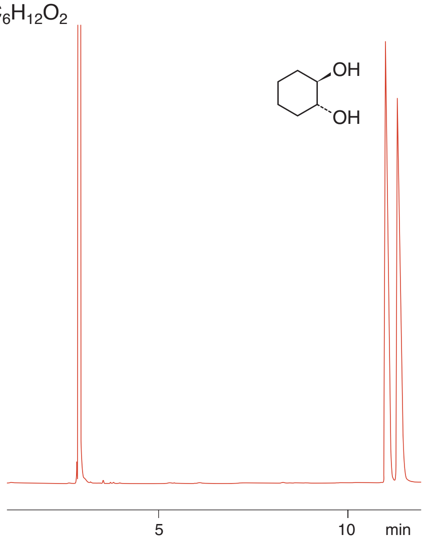
Chiral separations

Enantiomer separation of *trans*-1,2-cyclohexanediol

MN Appl. No. 202841

Column:	FS-HYDRODEX β-PM, 50 m x 0.25 mm ID, REF 723370.50, max. temperature 230/250 °C
Injection:	0.5 *μ*l, split 1:100
Carrier gas:	100 kPa H_2
Temperature:	150 °C
Detector:	FID 250 °C

$C_6H_{12}O_2$

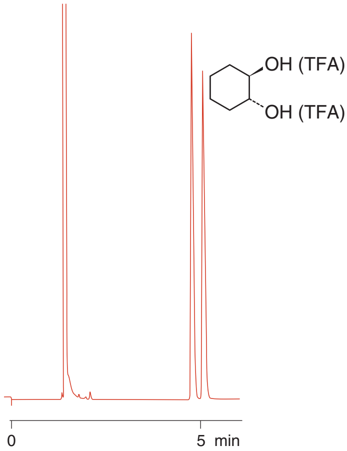


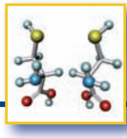
trans-1,2-cyclohexanediol can also be separated on LIPODEX® A (see application 202821 at *www.mn-net.com*).

Enantiomer separation of *trans*-1,2-cyclohexanediol (TFA)

MN Appl. No. 202831

Column:	FS-LIPODEX® E, 25 m x 0.25 mm ID, REF 723368.25, max. temperature 200/ 220 °C
Injection:	0.5 *μ*l, split 1:100
Carrier gas:	60 kPa H_2
Temperature:	105 °C
Detector:	FID 250 °C

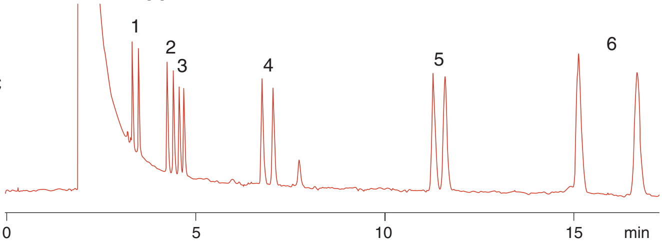




Enantiomer analysis of *trans*-1,2- and *trans*-1,3-cycloalkanediols (TFA)

MN Appl. No. 202871

Column: LIPODEX® D,
25 m x 0.25 mm ID,
REF 723366.25,
max. temperature 200/220 °C
Carrier gas: 0.7 bar H_2
Temperature: 150 °C
Detector: FID



Peaks:

1. Cyclohexane-*trans*-1,2-diol ($C_6H_{12}O_2$)
2. Cycloheptane-*trans*-1,2-diol ($C_7H_{14}O_2$)
3. Cycloheptane-*trans*-1,3-diol ($C_7H_{14}O_2$)
4. Cyclooctane-*trans*-1,2-diol ($C_8H_{16}O_2$)
5. Cyclodecane-*trans*-1,2-diol ($C_{10}H_{20}O_2$)
6. Cyclodecane-*trans*-1,3-diol ($C_{10}H_{20}O_2$)

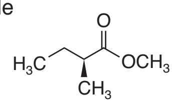
W.A. König, S. Lutz, G. Wenz, E. von der Bey, HRC **11** (1988) 506 – 509

Enantiomer separation of 2-methylbutyric acid methyl ester

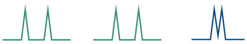
MN Appl. No. 211380

Columns: all 25 m x 0.25 mm ID:
a) FS-HYDRODEX β-6TBDM (REF 723381.25),
b) FS-LIPODEX® E (REF 723368.25),
c) FS-HYDRODEX β-PM (REF 723370.25)
Injection: 1 µl, split, 250 °C
Carrier gas: 1.1 ml/min He
Detector: FID 250 °C

$C_6H_{12}O_2$



	a	b	c
Temperature:	50 °C	40 °C	50 °C
Resolution:	2.86	2.02	0.66



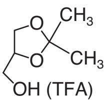
Courtesy of H. Casabianca, CNRS Service Central d'Analyse, Vernaison, France

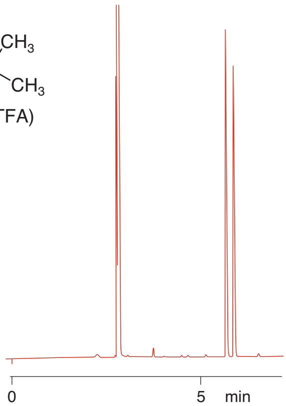
Enantiomer separation of solketal (TFA)

MN Appl. No. 202971

Column: FS-HYDRODEX β-PM,
50 m x 0.25 mm ID,
REF 723370.50,
max. temperature 230/250 °C
Injection: 0.1 µl (1 % in CH_2Cl_2)
split 150 ml/min
Carrier gas: 120 kPa H_2 (1.7 ml/min)
Temperature: 120 °C
Detector: FID 250 °C

$C_6H_{12}O_3$





Solketal can also be separated on LIPODEX® A (see application 202981 at *www.mn-net.com*).

Chiral separations

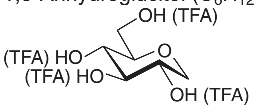
Enantiomer separation of 1,5-anhydro-glucitol, -galactitol und -mannitol (TFA)

MN Appl. No. 203031

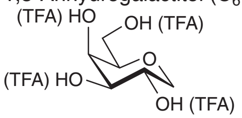
Column:	LIPODEX® A, 50 m x 0.25 mm ID, REF 723360.50, max. temperature 200/220 °C
Carrier gas:	H_2
Temperature:	120 °C
Detector:	FID

Peaks:

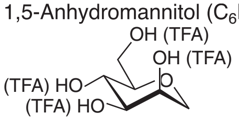
1. 1,5-Anhydroglucitol ($C_6H_{12}O_5$)

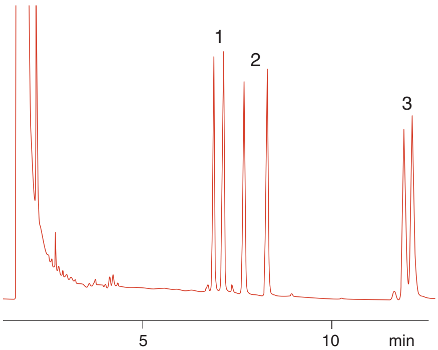


2. 1,5-Anhydrogalactitol ($C_6H_{12}O_5$)



3. 1,5-Anhydromannitol ($C_6H_{12}O_5$)





Courtesy of Prof. W.A. König, Hamburg, Germany

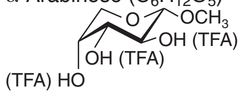
Enantiomer separation of arabinose (α- and β-anomers, methylglycosides, TFA)

MN Appl. No. 202372

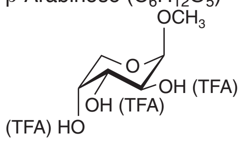
Column:	LIPODEX® A, 50 m x 0.25 mm ID, REF 723360.50, max. temperature 200/220 °C
Carrier gas:	H_2
Temperature:	100 °C
Detector:	FID

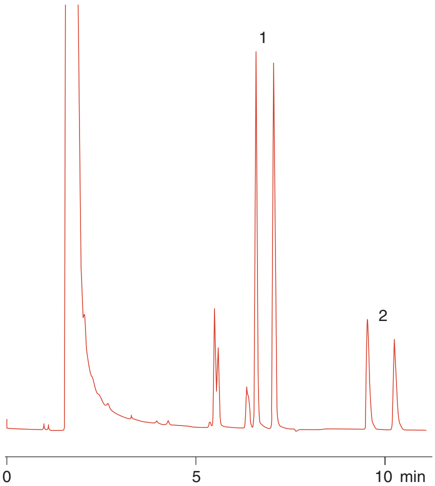
Peaks:

1. α-Arabinose ($C_6H_{12}O_5$)



2. β-Arabinose ($C_6H_{12}O_5$)





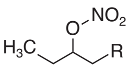
Courtesy of Prof. W.A. König, Hamburg, Germany

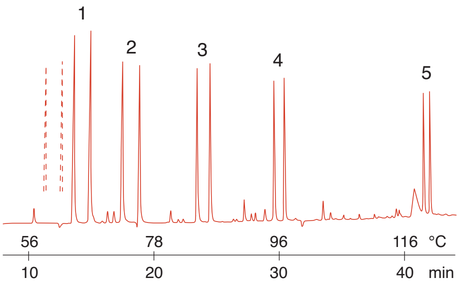
For separation of other sugar anomers on LIPODEX® A see applications 202432, 202392, 202382 at *www.mn-net.com*.

Separation of chiral alkyl nitrates
MN Appl. No. 212050

Column:	FS-LIPODEX® D, 25 m x 0.25 mm ID, REF 723366.25, max. temperature 200/220 °C
Injection:	on-column
Carrier gas:	70 kPA H_2, 55 cm/s, 100 °C
Temperature:	40 °C (2 min) $\xrightarrow{2\ °C/min}$ 190 °C
Detector:	ECD 240 °C

Peaks:
1. *n*-Hexyl-3-nitrate ($C_6H_{13}NO_3$, R = C_2H_5)
2. *n*-Heptyl-3-nitrate ($C_7H_{15}NO_3$, R = C_3H_7)
3. *n*-Octyl-3-nitrate ($C_8H_{17}NO_3$, R = C_4H_9)
4. *n*-Nonyl-3-nitrate ($C_9H_{19}NO_3$, R = C_5H_{11})
5. *n*-Undecyl-3-nitrate ($C_{11}H_{23}NO_3$, R = C_7H_{15})





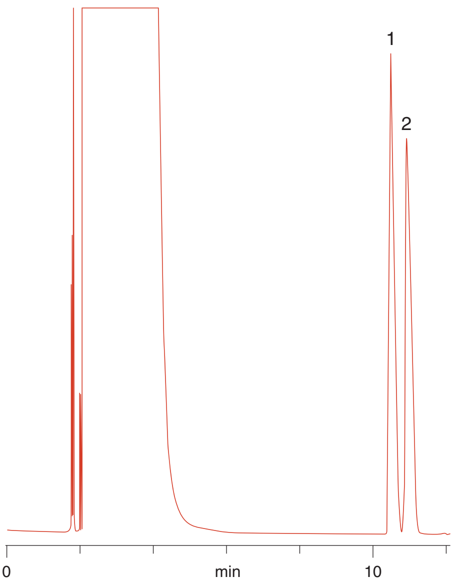
dashed lines indicate where peak 1 would be expected to elute

M. Schneider, K. Ballschmiter,
J. Chromatography A **852** (1999) 525 – 534

Enantiomer separation of 2-methylpentanol-1
MN Appl. No. 212450

Column:	FS-HYDRODEX® β-TBDAc, 50 m x 0.25 mm ID, REF 723384.50, max. temperature 220/240 °C
Sample:	0.1 % in CH_2Cl_2
Carrier gas:	1.5 bar H_2
Temperature:	80 °C
Detector:	FID

Peaks: ($C_6H_{14}O$)
1. (*R*)-2-Methylpentanol-1
2. (*S*)-2-Methylpentanol-1



Enantiomer separation of sorbitol (TFA)

MN Appl. No. 203001

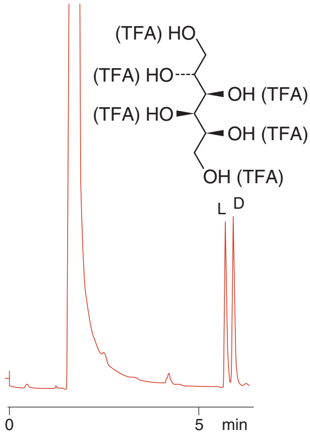
Column: LIPODEX® A,
50 m x 0.25 mm ID,
REF 723360.50,
max. temperature 200/220 °C

Carrier gas: H_2

Temperature: 110 °C

Detector: FID

$C_6H_{14}O_6$



Courtesy of Prof. W.A. König, Hamburg, Germany

Enantiomer separation of thioacetic acid cyclopent-2-enyl ester

Carrier gas: 100 kPa H_2

Temperature: 70 °C (2 min) $\xrightarrow{10\ °C/min}$ 100 °C (2 min) $\xrightarrow{10\ °C/min}$ 130 °C (2 min)

Detector: FID

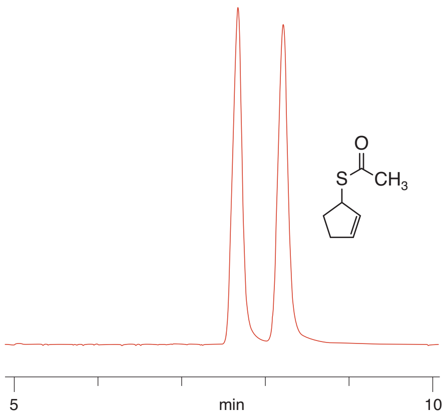
MN Appl. No. 212270

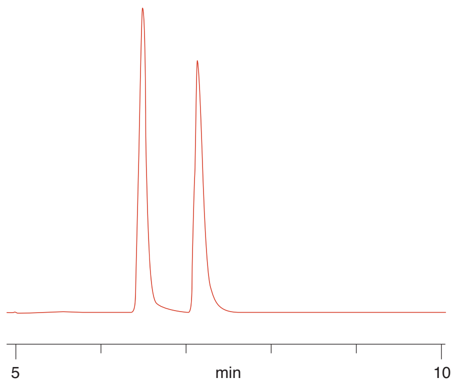
Column: FS-LIPODEX® E,
25 m x 0.25 mm ID,
REF 723368.25,
max. temperature 200/220 °C

MN Appl. No. 212280

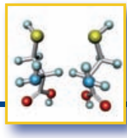
Column: FS-LIPODEX® G,
25 m x 0.25 mm ID,
REF723379.25,
max. temperature 220/240 °C

$C_7H_{10}OS$





Courtesy of Mrs. Vermeeren, AK Prof. Gais, Inst. für Org. Chemie, RWTH Aachen, Germany



Enantiomer separation of acetic acid cyclopent-2-enyl ester

MN Appl. No. 212300

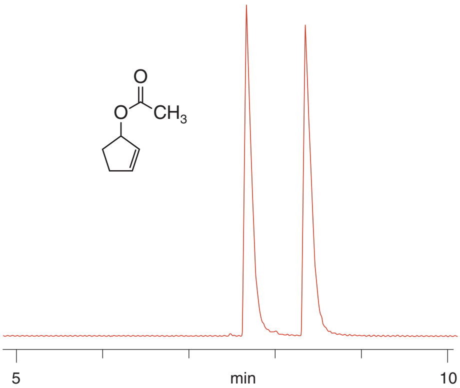
Column: FS-LIPODEX® G, 25 m x 0.25 mm ID, REF 723379.25, max. temperature 220/240 °C

Carrier gas: 100 kPa H_2

Temperature: 50 °C (5 min) $\xrightarrow{10\ °C/min}$ 80 °C (5 min)

Detector: FID

$C_7H_{10}O_2$



Courtesy of Mrs. Vermeeren, AK Prof. Gais, Inst. für Org. Chemie, RWTH Aachen, Germany

Enantiomer separation of cyclopent-2-enyl methyl carbonate

MN Appl. No. 212330

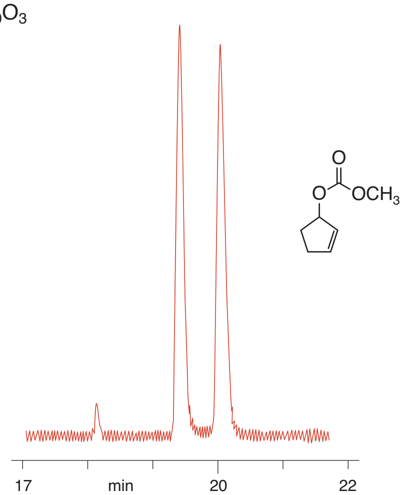
Column: FS-LIPODEX® E, 25 m x 0.25 mm ID, REF 723368.25, max. temperature 200/220 °C

Carrier gas: 100 kPa H_2

Temperature: 50 °C (15 min) $\xrightarrow{10\ °C/min}$ 80 °C (5 min) $\xrightarrow{10\ °C/min}$ 120 °C (5 min)

Detector: FID

$C_7H_{10}O_3$



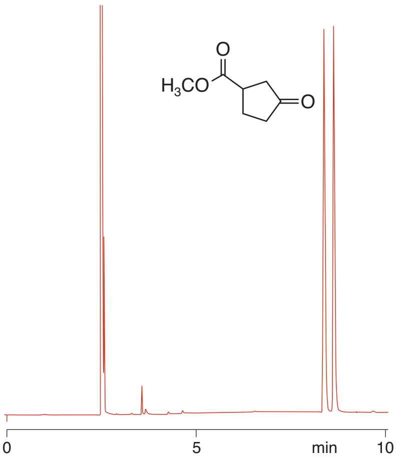
Courtesy of Mrs. Vermeeren, AK Prof. Gais, Inst. für Org. Chemie, RWTH Aachen, Germany

Enantiomer separation of cyclopentanonecarboxylic acid methyl ester

MN Appl. No. 202080

Column:	FS-LIPODEX® A, 50 m x 0.25 mm ID, REF 723360.50, max. temperature 200/220 °C
Injection:	0.1 µl (1 % in CH_2Cl_2) split 320 ml/min
Carrier gas:	120 kPa H_2 (2.2 ml/min)
Temperature:	120 °C
Detector:	FID 250 °C

$C_7H_{10}O_3$

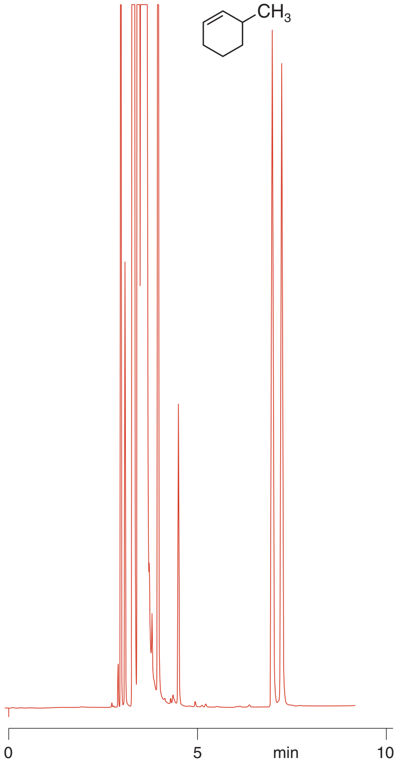


Enantiomer separation of 3-methylcyclohexene

MN Appl. No. 201860

Column:	FS-LIPODEX® C, 50 m x 0.25 mm ID, REF 723364.50, max. temperature 200/220 °C
Injection:	1.0 µl, split 1:100
Carrier gas:	100 kPa H_2
Temperature:	35 °C
Detector:	FID 250 °C

C_7H_{12}



3-methylcyclohexene can also be separated on LIPODEX® A
(see application 201870 at *www.mn-net.com*).

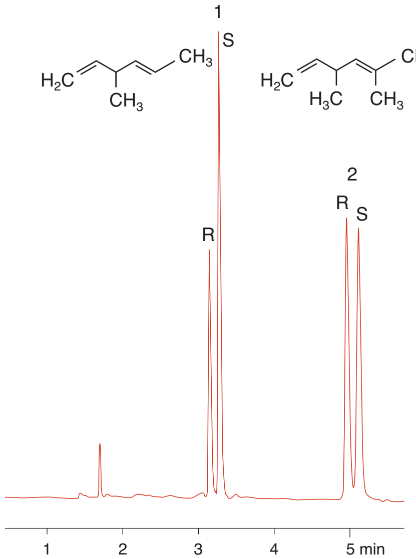
Enantiomer separation of 3-methyl-1,4(Z)-hexadiene and 3,5-dimethyl-1,4-hexadiene

MN Appl. No. 201890

Column: LIPODEX® C, 50 m x 0.25 mm ID, REF 723364.50, max. temperature 200/220 °C
Injection: headspace
Carrier gas: 1 bar H_2
Temperature: 30 °C
Detector: FID

Peaks:

1. 3-Methyl-1,4-hexadiene (C_7H_{12})
2. 3,5-Dimethyl-1,4-hexadiene (C_8H_{14})



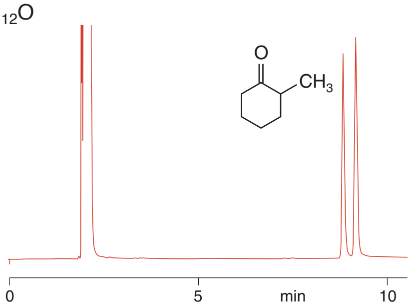
W.A. König et al., HRC **12** (1989) 35 – 39

Enantiomer separation of 2-methylcyclohexanone

MN Appl. No. 202050

Column: FS-LIPODEX® A, 50 m x 0.25 mm ID, REF 723360.50, max. temperature 200/220 °C
Injection: 1 µl (1 % in CH_2Cl_2) split 245 ml/min
Carrier gas: 110 kPa H_2 (2.3 ml/min)
Temperature: 70 °C
Detector: FID 240 °C

$C_7H_{12}O$



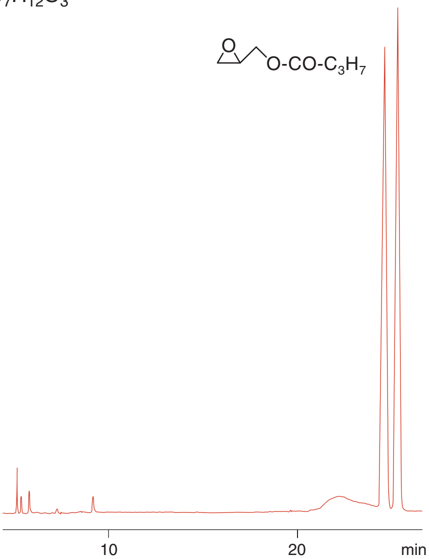
Chiral separations

Enantiomer separation of glycidyl butyrate

MN Appl. No. 202731

Column: FS-LIPODEX® A, 25 m x 0.25 mm ID, REF 723360.25, max. temperature 200/220 °C
Injection: 1 µl (1 % in CH_2Cl_2) split 180 ml/min
Carrier gas: 60 kPa H_2 (1.8 ml/min)
Temperature: 60 °C
Detector: FID 250 °C

$C_7H_{12}O_3$

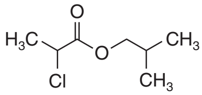


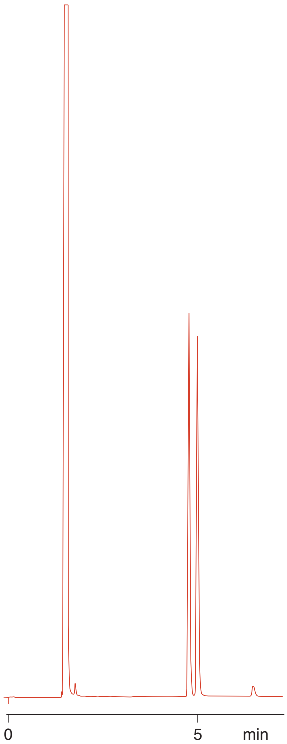
Enantiomer separation of 2-chloropropionic acid isobutyl ester

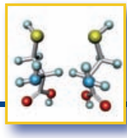
MN Appl. No. 202532

Column: FS-LIPODEX® E, 25 m x 0.25 mm ID, REF 723368.25, max. temperature 200/220 °C
Injection: 1 µl, 1 % in CH_2Cl_2, split 125 ml/min
Carrier gas: 50 kPa H_2 (1.5 ml/min)
Temperature: 90 °C
Detector: FID 250 °C

$C_7H_{13}ClO_2$





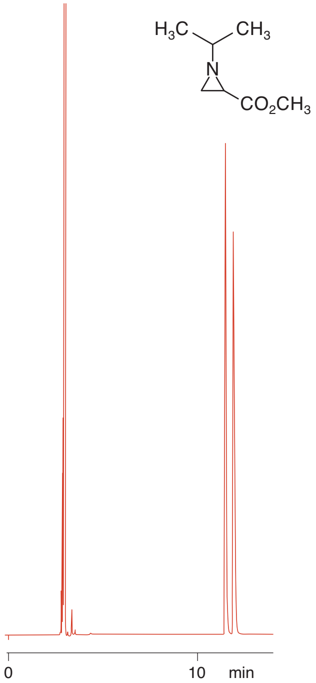


Enantiomer separation of 1-*i*-propyl-2-carboxymethyl aziridine

MN Appl. No. 202361

Column: FS-HYDRODEX β-PM, 50 m x 0.25 mm ID, REF 723370.50, max. temperature 230/250 °C
Injection: 0.1 µl (1 % in CH_2Cl_2) split 100 ml/min
Carrier gas: 120 kPa H_2 (1.7 ml/min)
Temperature: 110 °C
Detector: FID 250 °C

$C_7H_{13}NO_2$



Enantiomers separation of 2-methylbutyric acid ethyl ester

MN Appl. No. 211400

Columns: all 25 m x 0.25 mm ID:
a) FS-HYDRODEX β-6TBDM (REF 723381.25),
b) FS-LIPODEX® E (REF 723368.25),
c) FS-HYDRODEX β-PM (REF 723370.25)
Injection: 1 µl, split, 250 °C
Carrier gas: 1.1 ml/min He
Detector: FID 250 °C

$C_7H_{14}O_2$

	a	b	c
Temperature:	55 °C	40 °C	50 °C
Resolution:	2.93	1.31	0.98

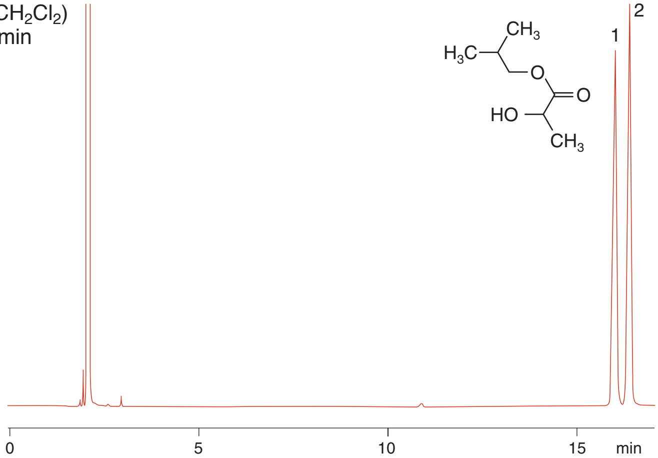
Courtesy of H. Casabianca, CNRS Service Central d'Analyse, Vernaison, France

Enantiomer separation of isobutyl lactate

MN Appl. No. 202802

Column: FS-LIPODEX® A, 50 m x 0.25 mm ID,REF 723360.50, max. temperature 200/220 °C
Injection: 1 µl (1 % in CH_2Cl_2) split 220 ml/min
Carrier gas: 120 kPa H_2 (2.5 ml/min)
Temperature: 60 °C
Detector: FID 250 °C

$C_7H_{14}O_3$



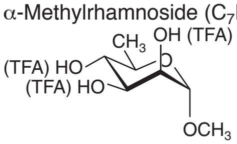
Enantiomer separation of α-methylrhamnoside and α-methylquinovoside (TFA)

MN Appl. No. 203041

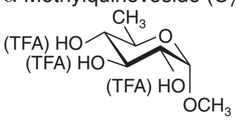
Column: LIPODEX® C, 50 m x 0.25 mm ID, REF 723364.50, max. temperature 200/220 °C
Carrier gas: 1 bar H_2
Temperature: 90 °C
Detector: FID

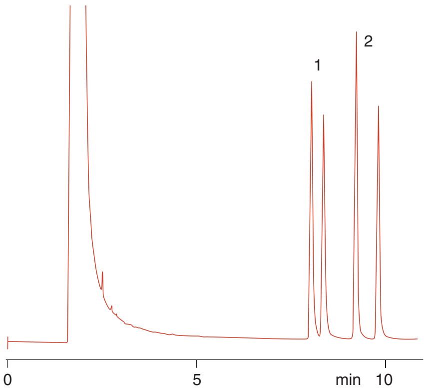
Peaks:

1. α-Methylrhamnoside ($C_7H_{14}O_5$)

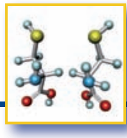


2. α-Methylquinovoside ($C_7H_{14}O_5$)





W.A. König et al., HRC **12** (1989) 35 – 39



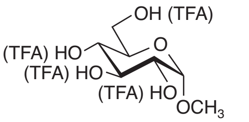
Enantiomer separation of glucose and mannose (α- and β-anomers, methylglycosides, TFA)

MN Appl. No. 202412

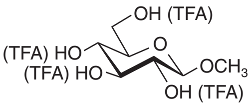
Column: LIPODEX® B, 50 m x 0.25 mm ID, REF 723362.50, max. temperature 200/220 °C
Carrier gas: H_2
Temperature: 155 °C
Detector: FID

Peaks: ($C_7H_{14}O_6$)

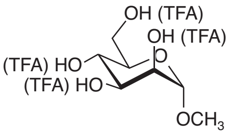
1. α-Glucose



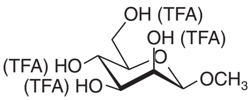
2. β-Glucose

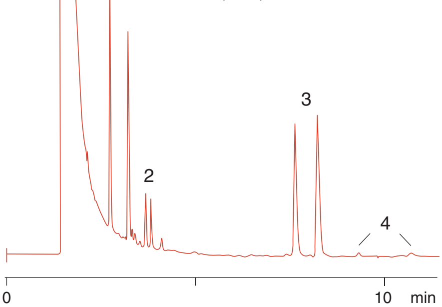


3. α-Mannose



4. β-Mannose





Courtesy of Prof. W.A. König, Hamburg, Germany

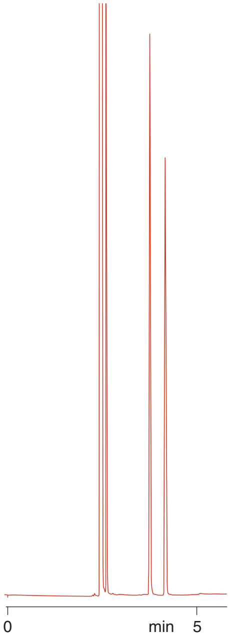
See application 202402 at *www.mn-net.com* for separation of glucose anomer methylglycosides on LIPODEX® A

Enantiomer separation of 2-heptanol (TFA)

MN Appl. No. 202511

Column: FS-LIPODEX® A, 50 m x 0.25 mm ID, REF 723360.50, max. temperature 200/220 °C
Injection: 0.1 µl (1 % in CH_2Cl_2) split 320 ml/min
Carrier gas: 120 kPa H_2 (2.2 ml/min)
Temperature: 80 °C
Detector: FID 250 °C

$C_7H_{16}O$



2-heptanol (TFA) can also be separated on LIPODEX® E
(see application 202501 at *www.mn-net.com*).

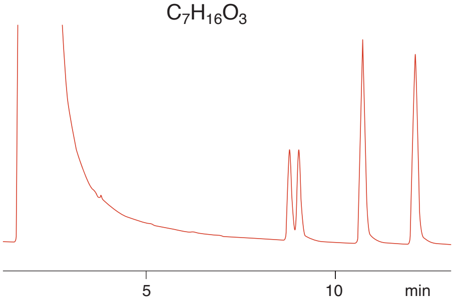
Chiral separations

Analysis of 4 stereoisomers of heptane-1,2,3-triol (TFA)

MN Appl. No. 202941

Column:	LIPODEX® A, 50 m x 0.25 mm ID, REF 723360.50, max. temperature 200/220 °C
Carrier gas:	H_2
Temperature:	85 °C
Detector:	FID

$C_7H_{16}O_3$



Courtesy of Prof. W.A. König, Hamburg, Germany

Enantiomer separation of styrene oxide

MN Appl. No. 211410

Columns:	all 25 m x 0.25 mm ID: a) FS-HYDRODEX β-6TBDM (REF 723381.25), b) FS-LIPODEX® E (REF 723368.25), c) FS-HYDRODEX β-PM (REF 723370.25)
Injection:	1 μl, split, 250 °C
Carrier gas:	1.1 ml/min He
Detector:	FID 250 °C

C_8H_8O

	a	b	c
Temperature:	90 °C	80 °C	85 °C
Resolution:	4.81	13.06	1.69

Courtesy of H. Casabianca, CNRS Service Central d'Analyse, Vernaison, France

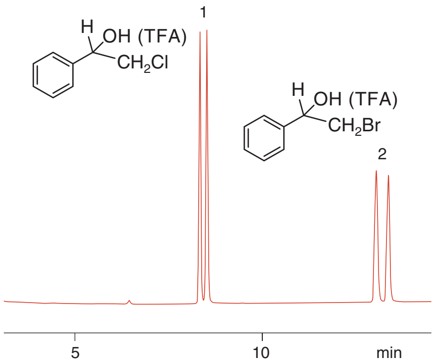
Enantiomer separation of 2-chloro- and 2-bromo-1-phenylethanol (TFA)

MN Appl. No. 202531

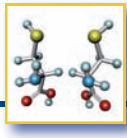
Column:	LIPODEX® A, 50 m x 0.25 mm ID, REF 723360.50, max. temperature 200/220 °C
Carrier gas:	H_2
Temperature:	110 °C
Detector:	FID

Peaks:

1. 2-Chloro-1-phenylethanol (TFA) (C_8H_9ClO)
2. 2-Bromo-1-phenylethanol (TFA) (C_8H_9BrO)



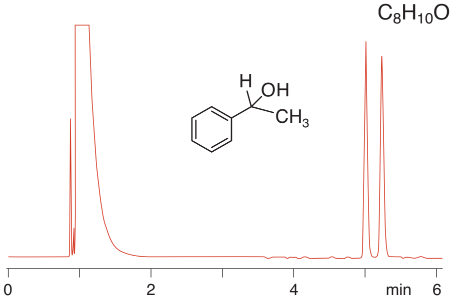
Courtesy of Prof. W.A. König, Hamburg, Germany



Enantiomer separation of α-methylbenzyl alcohol = α-phenylethanol

MN Appl. No. 212400

Column: FS-HYDRODEX® β-TBDAc, 25 m x 0.25 mm ID, REF 723384.25, max. temperature 220/240 °C
Carrier gas: 0.6 bar H_2
Temperature: 130 °C
Detector: FID



α-Phenylethanol can also be separated on HYDRODEX β-PM (application 202541), HYDRODEX β-3P (application 202571), LIPODEX® A (application 202561).
See our application database at *www.mn-net.com*.

MN Appl. No. 211420

Columns: all 25 m x 0.25 mm ID:
a) FS-HYDRODEX β-6TBDM (REF 723381.25),
b) FS-LIPODEX® E (REF 723368.25),
c) FS-HYDRODEX β-PM (REF 723370.25)
Injection: 1 µl, split, 250 °C
Carrier gas: 1.1 ml/min He
Detector: FID 250 °C

	a	b	c
Temperature:	115 °C	80 °C	100 °C
Resolution:	<0.5	3.52	3.47

Courtesy of H. Casabianca, CNRS Service Central d'Analyse, Vernaison, France

Enantiomer separation of α-phenylethanol (TFA)

MN Appl. No. 211430

Columns: all 25 m x 0.25 mm ID:
a) FS-HYDRODEX β-6TBDM (REF 723381.25),
b) FS-LIPODEX® E (REF 723368.25),
c) FS-HYDRODEX β-PM (REF 723370.25)
Injection: 1 µl, split, 250 °C
Carrier gas: 1.1 ml/min He
Detector: FID 250 °C

	a	b	c
Temperature:	90 °C	80 °C	100 °C
Resolution:	2.4	3.52	3.47

Courtesy of H. Casabianca, CNRS Service Central d'Analyse, Vernaison, France

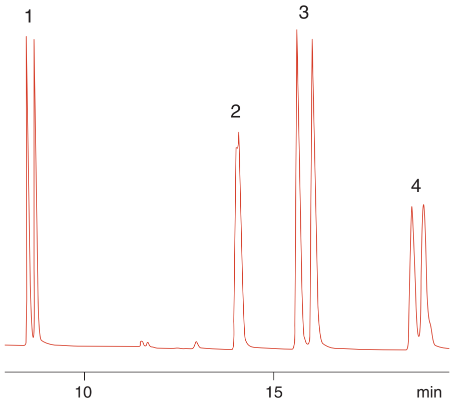
α-Phenylethanol (TFA) can also be separated on HYDRODEX β-3P (application 202601) or LIPODEX® A (application 202591).
See our application database at *www.mn-net.com*.

Enantiomer separation of 1-phenylethanol and *o*-, *m*-, *p*-methyl derivatives (TFA)

MN Appl. No. 202521

Column: LIPODEX® A, 50 m x 0.25 mm ID, REF 723360.50, max. temperature 200/220 °C
Carrier gas: H_2
Temperature: 75 °C
Detector: FID

Peaks:
1. 1-Phenylethanol ($C_8H_{10}O$)
2. 1-(2-Methylphenyl)ethanol ($C_9H_{12}O$)
3. 1-(3-Methylphenyl)ethanol
4. 1-(4-Methylphenyl)ethanol



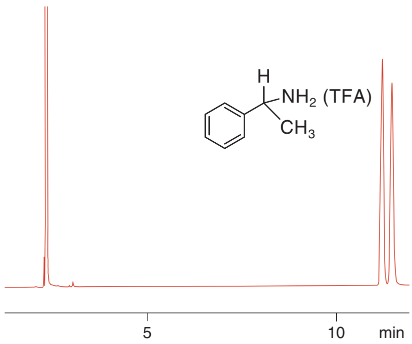
Courtesy of Prof. W.A. König, Hamburg, Germany

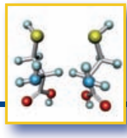
Enantiomer separation of α-phenylethylamine (TFA)

MN Appl. No. 202290

Column: FS-LIPODEX® A, 50 m x 0.25 mm ID, REF 723360.50, max. temperature 200/220 °C
Injection: 1 µl (1 % in CH_2Cl_2) split 245 ml/min
Carrier gas: 110 kPa H_2 (2.3 ml/min)
Temperature: 120 °C
Detector: FID 240 °C

$C_8H_{11}N$



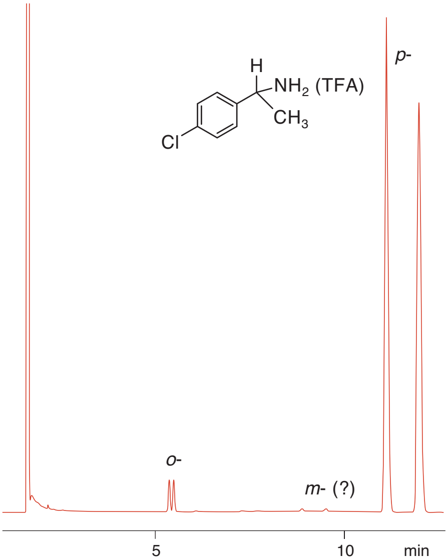


Enantiomer separation of *p*-chloro-phenylethylamine (TFA)

MN Appl. No. 202300

Column: FS-LIPODEX® D, 25 m x 0.25 mm ID, REF 723366.25, max. temperature 200/220 °C
Injection: 0.1 µl (5 % in CH_2Cl_2) split 130 ml/min
Carrier gas: 50 kPa H_2 (1.1 ml/min)
Temperature: 170 °C
Detector: FID 250 °C
R is eluted before S.

$C_8H_{11}ClN$

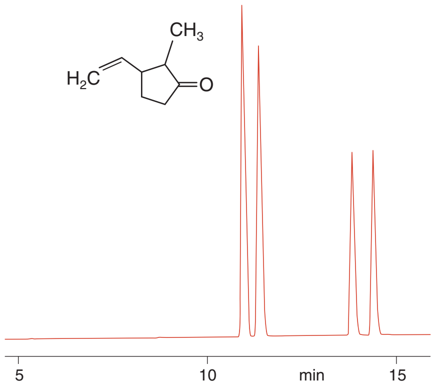


Enantiomer separation of 2-methyl-3-vinylcyclopentanone

MN Appl. No. 202060

Column: FS-LIPODEX® E, 25 m x 0.25 mm ID, REF 723368.25, max. temperature 200/220 °C
Injection: 0.2 µl, split 80 ml/min
Carrier gas: 50 kPa H_2 (1.2 ml/min)
Temperature: 70 °C (3 min) $\xrightarrow{2\ °C/min}$ 110 °C
Detector: FID 250 °C

$C_8H_{12}O$



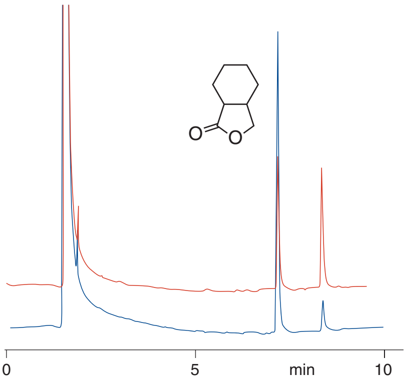
Chiral separations

Enantiomer composition of a bicyclic lactone (hexahydroisobenzofuranone)

MN Appl. No. 202962

Column:	LIPODEX® D, 50 m x 0.25 mm ID, REF 723366.50, max. temperature 200/220 °C
Carrier gas:	H_2
Temperature:	170 °C
Detector:	FID

$C_8H_{12}O_2$



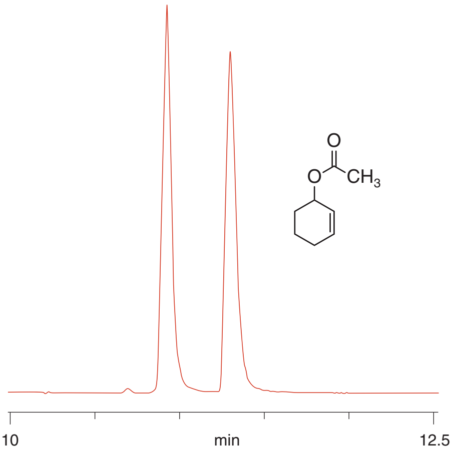
Courtesy of Prof. W.A. König, Hamburg, Germany

Enantiomer separation of acetic acid cyclohex-2-enyl ester

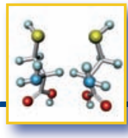
MN Appl. No. 212290

Column:	FS-LIPODEX® G, 25 m x 0.25 mm ID, REF723379.25, max. temperature 220/240 °C
Carrier gas:	100 kPa H_2
Temperature:	50 °C (5 min) $\xrightarrow{10\ °C/min}$ 80 °C (5 min) 10 °C/min
Detector:	FID

$C_8H_{12}O_2$



Courtesy of Mrs. Vermeeren, AK Prof. Gais, Inst. für Org. Chemie, RWTH Aachen, Germany



Enantiomer separation of *(E)*-2,3-epoxy-4-octin-1-ol (TFA)

MN Appl. No. 202631

Column: LIPODEX® A,
50 m x 0.25 mm ID,
REF 723360.50,
max. temperature 200/220 °C

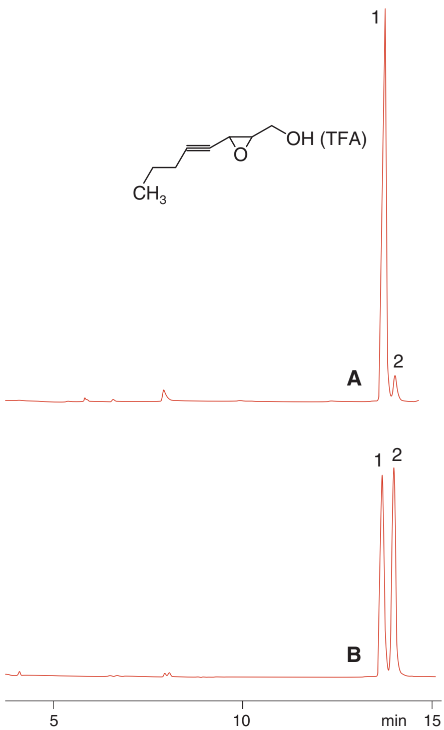
Carrier gas: 1 bar H_2

Temperature: 80 °C

Detector: FID

Peaks:

$C_8H_{12}O_2$, 1. (2S,3S), 2. (2R,3R)
Trace A: ee = 89.3 %, trace B = racemate



W.A. König et al., Angew. Chem. Int. Ed. Engl. **28** (1989) 178

Separation of 4 stereoisomers of 5-aminomethylnorbornene (N-TFA)

MN Appl. No. 202350

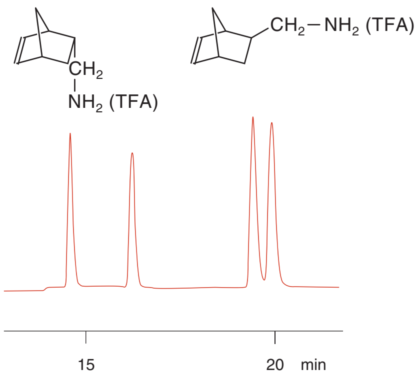
Column: LIPODEX® D,
50 m x 0.25 mm ID,
REF 723366.50,
max. temperature 200/220 °C

Temperature: 150 °C

Carrier gas: 1 bar H_2

Detector: FID

$C_8H_{13}N$



W.A. König, S. Lutz, G. Wenz, E. von der Bey, HRC **11** (1988) 506 – 509

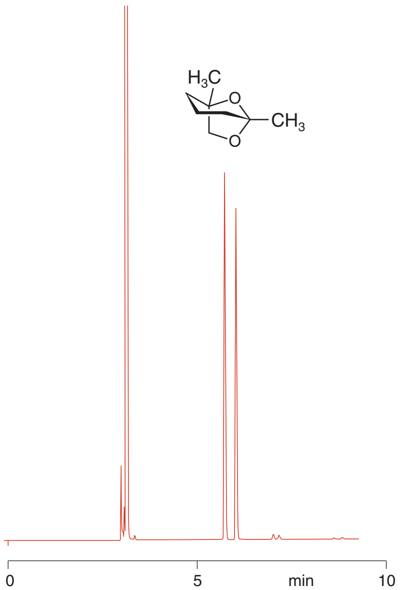
Chiral separations

Enantiomer separation of frontalin

MN Appl. No. 202190

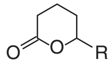
Column:	FS-LIPODEX® E, 50 m x 0.25 mm ID, REF 723368.50, max. temperature 200/220 °C
Injection:	0.5 µl, split 180 ml/min
Carrier gas:	100 kPa H_2 (1.5 ml/min)
Temperature:	100 °C
Detector:	FID 250 °C

$C_8H_{14}O_2$



Enantiomer analysis of δ-lactones

Columns:	all 25 m x 0.25 mm ID: a) FS-HYDRODEX β-6TBDM (REF 723381.25), b) FS-LIPODEX® E (REF 723368.25), c) FS-HYDRODEX β-PM (REF 723370.25)
Injection:	1 µl, split, 250 °C
Carrier gas:	1.1 ml/min He
Detector:	FID 250 °C



δ-Octalactone ($C_8H_{14}O_2$)

MN Appl. No. 211450

	a	b	c
Temperature:	120 °C	115 °C	120 °C
Resolution:	5.92	1.2	1.32

δ-Nonalactone ($C_9H_{16}O_2$)

MN Appl. No. 211490

	a	b	c
Temperature:	130 °C	120 °C	130 °C
Resolution:	6	7.65	1.07

δ-Decalactone ($C_{10}H_{18}O_2$)

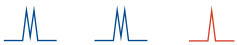
MN Appl. No. 211670

	a	b	c
Temperature:	145 °C	125 °C	145 °C
Resolution:	1.04	2.01	<0.5

δ-Undecalactone ($C_{11}H_{20}O_2$)

MN Appl. No. 211730

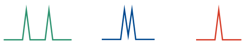
	a	b	c
Temperature:	170 °C	130 °C	155 °C
Resolution:	0.88	0.67	<0.5



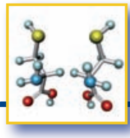
δ-Dodecalactone

MN Appl. No. 211760

	a	b	c
Temperature:	155 °C	140 °C	155 °C
Resolution:	1.25	1.11	<0.5



Courtesy of H. Casabianca, CNRS Service Central d'Analyse, Vernaison, France



Enantiomer separation of 2-hex-3-enyl methyl carbonate

MN Appl. No. 212310

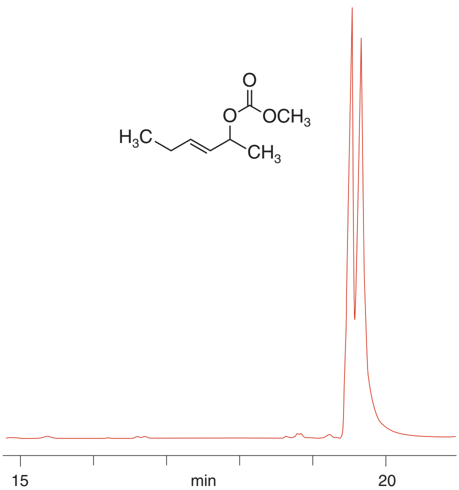
Column: FS-LIPODEX® G, 25 m x 0.25 mm ID, REF723379.25, max. temperature 220/240 °C

Carrier gas: 100 kPa H_2

Temperature: 50 °C (20 min) $\xrightarrow{10\ °C/min}$ 80 °C (5 min) $\xrightarrow{10\ °C/min}$ 120 °C (5 min)

Detector: FID

$C_8H_{14}O_3$



Courtesy of Mrs. Vermeeren, AK Prof. Gais, Inst. für Org. Chemie, RWTH Aachen, Germany

Enantiomer separation of 1-*t*-butyl-2-carboxymethyl aziridine

MN Appl. No. 202371

Column: FS-HYDRODEX β-PM, 50 m x 0.25 mm ID, REF 723370.50, max. temperature 230/250 °C

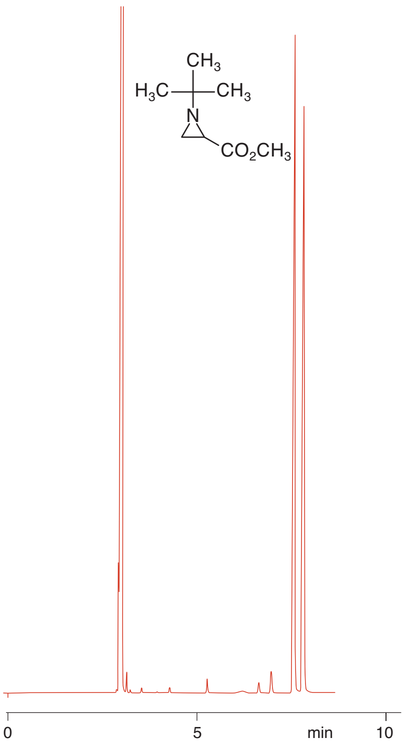
Injection: 0.1 µl (1 % in CH_2Cl_2) split 100 ml/min

Carrier gas: 120 kPa H_2 (1.7 ml/min)

Temperature: 130 °C

Detector: FID 250 °C

$C_8H_{15}NO_2$



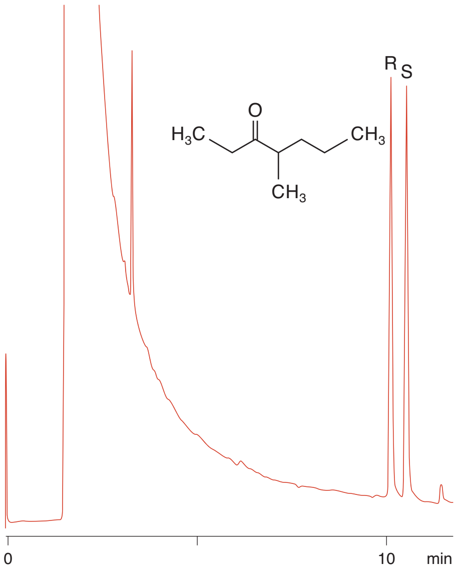
Chiral separations

Enantiomer separation of 4-methyl-3-heptanone (ant pheromone)

MN Appl. No. 201900

Column: LIPODEX® A, 50 m x 0.25 mm ID, REF 723360.50, max. temperature 200/220 °C
Carrier gas: H_2
Temperature: 85 °C
Detector: FID

$C_8H_{16}O$



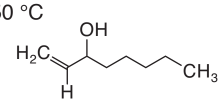
Courtesy of Prof. W.A. König, Hamburg, Germany

Enantiomer separation of 1-octen-3-ol

MN Appl. No. 211460

Columns: all 25 m x 0.25 mm ID:
a) FS-HYDRODEX β-6TBDM (REF 723381.25),
b) FS-LIPODEX® E (REF 723368.25),
c) FS-HYDRODEX β-PM (REF 723370.25)
Injection: 1 µl, split, 250 °C
Carrier gas: 1.1 ml/min He
Detector: FID 250 °C

$C_8H_{16}O$



	a	b	c
Temperature:	90 °C	60 °C	80 °C
Resolution:	<0.5	1.34	<0.5

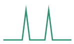
Courtesy of H. Casabianca, CNRS Service Central d'Analyse, Vernaison, France

1-octen-3-ol can also be separated on LIPODEX® A (see application 202761 at *www.mn-net.com*).

Enantiomer separation of 1-octen-3-ol (TFA)

MN Appl. No. 211470

Columns: FS-HYDRODEX β-6TBDM, 25 m x 0.25 mm ID, REF 723381.25
Injection: 1 µl, split, 250 °C
Carrier gas: 1.1 ml/min He
Temperature: 80 °C
Detector: FID 250 °C
Resolution: 1.49



Courtesy of H. Casabianca, CNRS Service Central d'Analyse, Vernaison, France

Enantiomer separation of 1-octen-3-ol and 2,2,2-trifluorophenylethanol

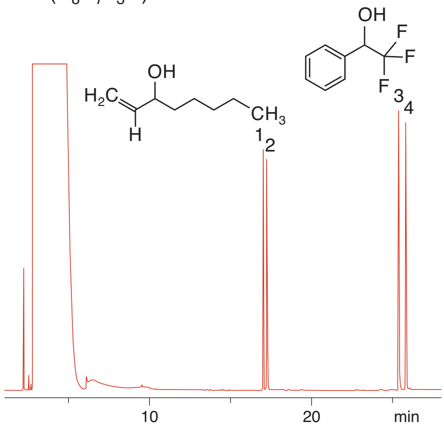
MN Appl. No. 212460

Column:	FS-HYDRODEX® β-TBDAc, 50 m x 0.25 mm ID, REF 723384.50, max. temperature 220/240 °C
Sample:	0.1 % in CH_2Cl_2
Carrier gas:	1.2 bar H_2
Temperature:	80 °C (5 min) $\xrightarrow{3\ °C/min}$ 140 °C (5 min)
Detector:	FID

Peaks:

1. (*S*)-1-Octen-3-ol ($C_8H_{16}O$)
2. (*R*)-1-Octen-3-ol

3./4. (*R*)/(*S*)-2,2,2-Trifluorophenylethanol ($C_8H_7F_3O$)

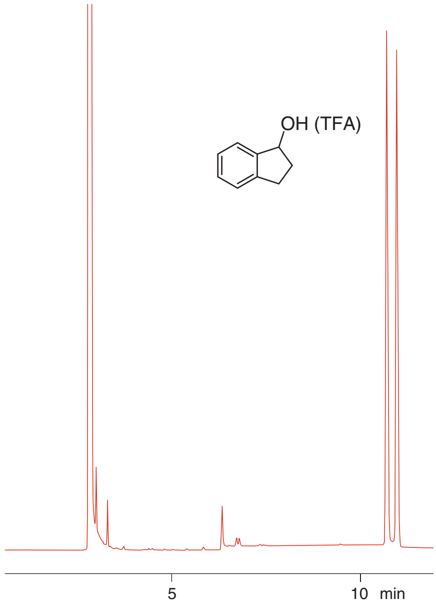


Enantiomer separation of 1-indanol (TFA)

MN Appl. No. 202781

Column:	FS-HYDRODEX β-PM, 50 m x 0.25 mm ID, REF 723370.50, max. temperature 230/250 °C
Injection:	1 μl (1 % in CH_2Cl_2) split 150 ml/min
Carrier gas:	120 kPa H_2 (1.7 ml/min)
Temperature:	130 °C
Detector:	FID 250 °C

$C_9H_{10}O$



1-indanol can also be separated on LIPODEX® A (see application 202771 at *www.mn-net.com*).

Chiral separations

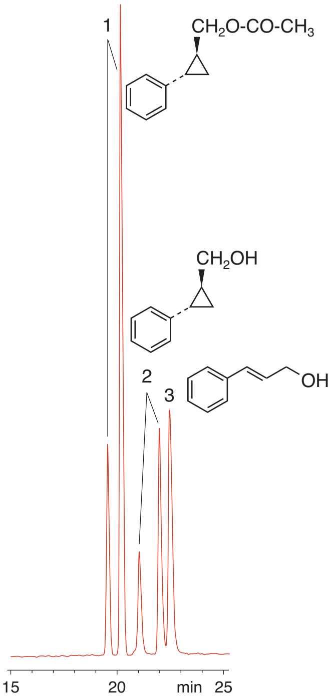
Enantiomer separation of phenylcyclopropylmethanol, phenylcyclopropylmethyl acetate and cinnamyl alcohol (TFA)

MN Appl. No. 212680

Column:	FS-HYDRODEX β-TBDAc, 25 m x 0.25 mm ID, REF 723384.25, max. temperature 220/240 °C
Injection:	1 *µ*l (0.1 % in methyl *t*-butyl ether), 220 °C, split 15 ml/min
Carrier gas:	0.6 bar H_2
Temperature:	130 °C
Detector:	FID 220 °C

Peaks:

1. (±)-trans-2-Phenylcyclopropylmethyl acetate ($C_{12}H_{14}O_2$)
2. (±)-trans-2-Phenylcyclopropylmethanol ($C_{10}H_{12}O$)
3. Cinnamyl alcohol ($C_9H_{10}O$)



Enantiomer separation of mandelic acid methyl ester

MN Appl. No. 213020

Column:	FS-HYDRODEX γ-TBDAc, 25 m x 0.25 mm ID, REF 723387.25, max. temperature 220/240 °C
Injection:	1 *µ*l, split 50 ml/min
Carrier gas:	0.6 bar H_2
Temperature:	170 °C
Detector:	FID

$C_9H_{10}O_3$

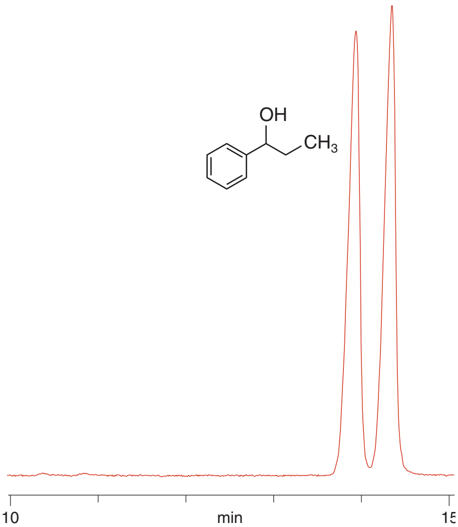
Mandelic acid methyl ester can also be separated on LIPODEX® A (application 202672) or LIPODEX® C (application 202682). See our application database at *www.mn-net.com*.

Enantiomer separation of 1-phenyl-propan-1-ol

MN Appl. No. 212320

Column: FS-LIPODEX® G, 25 m x 0.25 mm ID, REF723379.25, max. temperature 220/240 °C
Carrier gas: 100 kPa H_2
Temperature: 50 °C (5 min) $\xrightarrow{10\ °C/min}$ 80 °C (5 min)
Detector: FID

$C_9H_{12}O$



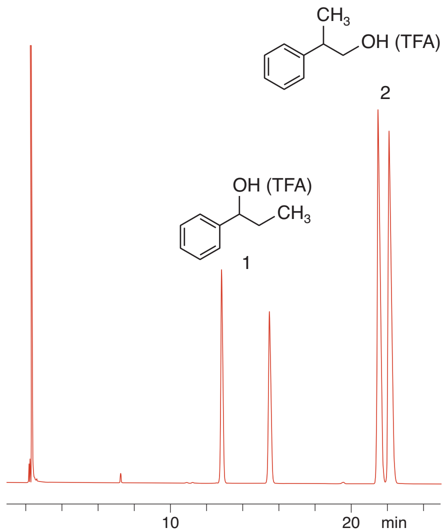
Courtesy of Mrs. Vermeeren, AK Prof. Gais, Inst. für Org. Chemie, RWTH Aachen, Germany

Enantiomer separation of phenylpropanols (TFA)

MN Appl. No. 212970

Column: FS-HYDRODEX γ-TBDAc, 50 m x 0.25 mm ID, REF723378.50, max. temperature 220/240 °C
Injection: 1 μl, split 50 ml/min
Carrier gas: 1.2 bar H_2
Temperature: 100 °C
Detector: FID

Peaks: ($C_9H_{12}O$)
1. 1-Phenylpropan-1-ol (TFA)
2. 2-Phenylpropan-1-ol (TFA)



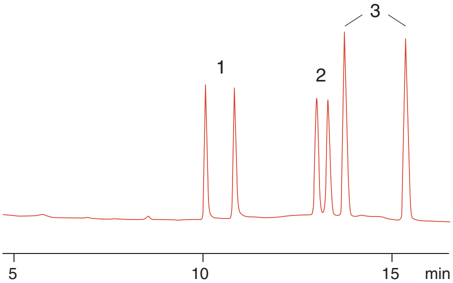
Chiral separations

Enantiomer separation of amphetamine, ephedrine and norephedrine (N,O-TFA)

MN Appl. No. 202310

Column:	LIPODEX® D, 50 m x 0.25 mm ID, REF 723366.50, max. temperature 200/220 °C
Carrier gas:	H_2
Temperature:	150 °C
Detector:	FID

Peaks:
1. Amphetamine
2. Ephedrine
3. Norephedrine



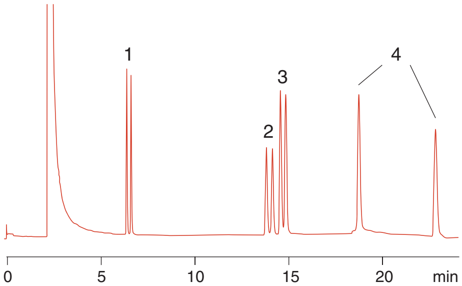
Courtesy of Prof. W.A. König, Hamburg, Germany

Enantiomer separation of sympathomimetic amines (N,O-TFA)

MN Appl. No. 202320

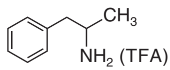
Column:	LIPODEX® D, 50 m x 0.25 mm ID, REF 723366.50, max. temperature 200/220 °C
Carrier gas:	1 bar H_2
Temperature:	175 °C
Detector:	FID

Peaks:
1. Amphetamine
2. Mexiletine
3. Pholedrine
4. Tranylcypromine

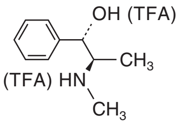


W.A. König, S. Lutz, G. Wenz, E. von der Bey, HRC **11** (1988) 506 – 509

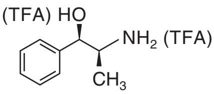
Amphetamine ($C_9H_{13}N$)



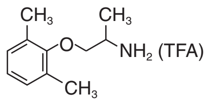
Ephedrine ($C_{10}H_{15}NO$)



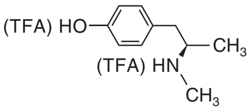
Norephedrine ($C_9H_{13}NO$)



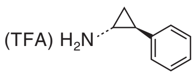
Mexiletine ($C_{11}H_{17}NO$)

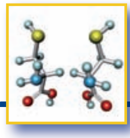


Pholedrine ($C_{10}H_{15}NO$)



Tranylcypromine ($C_9H_{11}N$)



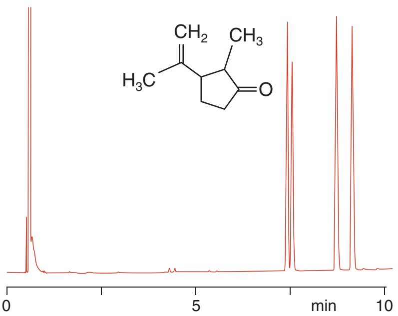


Enantiomer separation of 3-isopropenyl-2-methylcyclopentanone

MN Appl. No. 202070

Column:	FS-LIPODEX® E, 25 m x 0.25 mm ID, REF 723368.25, max. temperature 200/220 °C
Injection:	0.2 µl, split 80 ml/min
Carrier gas:	50 kPa H_2 (1.2 ml/min)
Temperature:	70 °C (3 min) $\xrightarrow{2\ °C/min}$ 110 °C
Detector:	FID 250 °C

$C_9H_{14}O$

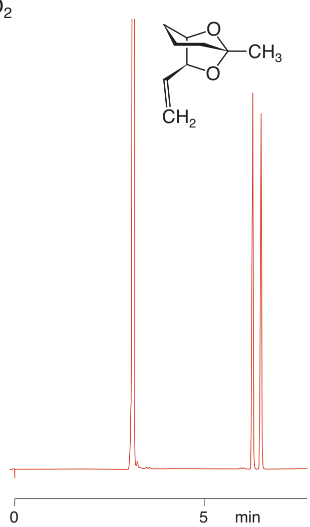


Enantiomer separation of vinyl-endo-brevicomin

MN Appl. No. 202130

Column:	FS-LIPODEX® E, 50 m x 0.25 mm ID, REF 723368.50, max. temperature 200/220 °C
Injection:	0.5 µl, split 180 ml/min
Carrier gas:	100 kPa H_2 (1.5 ml/min)
Temperature:	120 °C
Detector:	FID 250 °C

$C_9H_{14}O_2$



Vinyl-endo-brevicomin can also be separated on HYDRODEX β-PM (see application 202120 at *www.mn-net.com*).

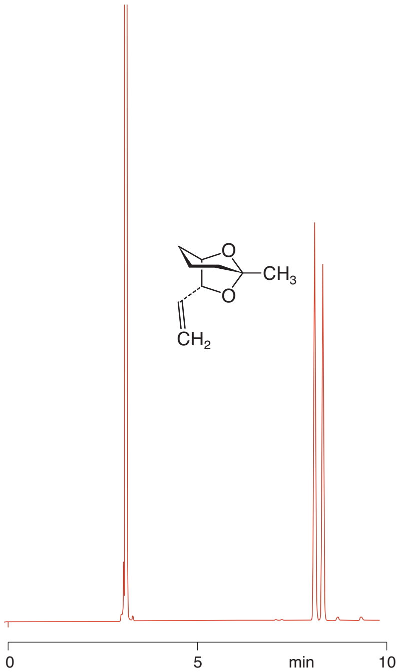
Chiral separations

Enantiomer separation of vinyl-exo-brevicomin

MN Appl. No. 202150

Column:	FS-LIPODEX® E, 50 m x 0.25 mm ID, REF 723368.50, max. temperature 200/220 °C
Injection:	0.5 *µ*l, split 180 ml/min
Carrier gas:	100 kPa H_2 (1.5 ml/min)
Temperature:	105 °C
Detector:	FID 250 °C

$C_9H_{14}O_2$



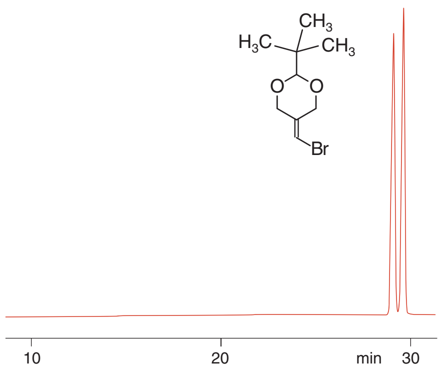
Vinyl-exo-brevicomin can also be separated on HYDRODEX β-PM (see application 202140 at *www.mn-net.com*).

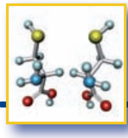
Enantiomer separation of 2-*t*-butyl-5-bromomethylene 1,3-dioxane

MN Appl. No. 202230

Column:	FS-LIPODEX® A, 50 m x 0.25 mm ID, REF 723360.50, max. temperature 200/220 °C
Injection:	0.5 *µ*l (2 % in CH_2Cl_2) split 92 ml/min
Carrier gas:	130 kPa H_2 (2.0 ml/min)
Temperature:	105 °C
Detector:	FID 250 °C

$C_9H_{15}BrO_2$

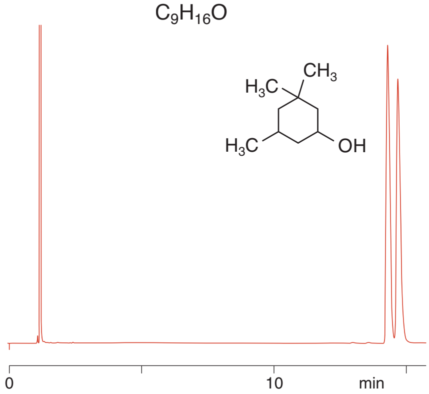




Enantiomer separation of *cis*-3,3,5-trimethylcyclohexanol
MN Appl. No. 201970

Column: FS-LIPODEX® E, 25 m x 0.25 mm ID, REF 723368.25, max. temperature 200/220 °C
Injection: 0.1 *µ*l (1 % in CH_2Cl_2) split 125 ml/min
Carrier gas: 60 kPa H_2 (1.6 ml/min)
Temperature: 80 °C
Detector: FID 250 °C

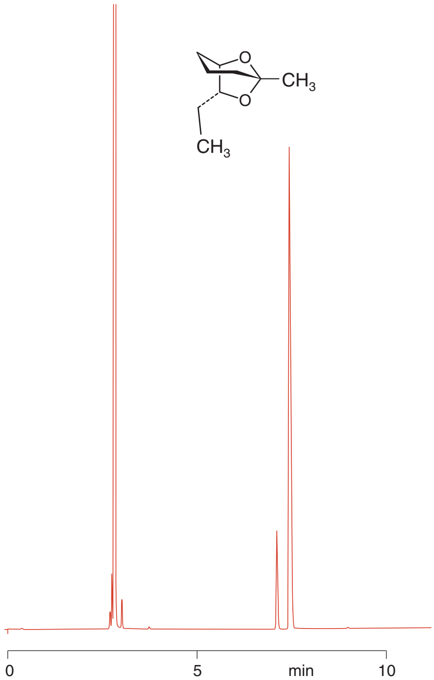
$C_9H_{16}O$



Enantiomer separation of (–)-exo-brevicomin
MN Appl. No. 202160

Column: FS-HYDRODEX β-PM, 50 m x 0.25 mm ID, REF 723370.50, max. temperature 230/250 °C
Injection: 0.1 *µ*l (1 % in CH_2Cl_2) split 150 ml/min
Carrier gas: 120 kPa H_2 (1.7 ml/min)
Temperature: 120 °C
Detector: FID 250 °C

$C_9H_{16}O_2$



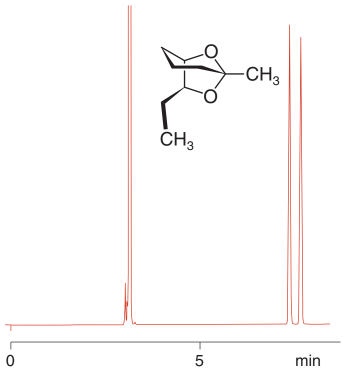
(–)-exo-brevicomin can also be separated on LIPODEX® E
(see application 202170 at *www.mn-net.com*).

Enantiomer separation of endo-brevicomin

MN Appl. No. 202180

Column: FS-LIPODEX® E, 50 m x 0.25 mm ID, REF 723368.50, max. temperature 200/220 °C
Injection: 0.5 μl, split 180 ml/min
Carrier gas: 100 kPa H_2 (1.5 ml/min)
Temperature: 110 °C
Detector: FID 250 °C

$C_9H_{16}O_2$

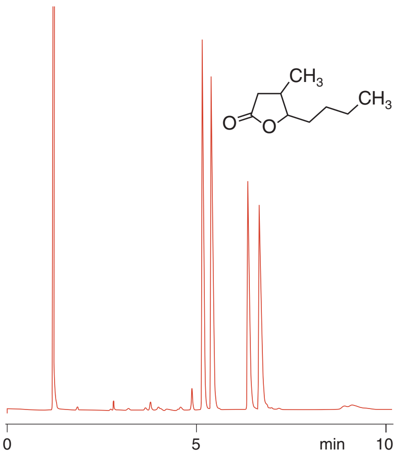


Enantiomer analysis of 4-butyl-3-methylbutyrolactone (Whisky lactone)

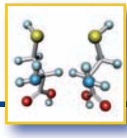
MN Appl. No. 202862

Column: FS-LIPODEX® E, 25 m x 0.25 mm ID, REF 723368.25, max. temperature 200/220 °C
Injection: 0.1 μl (1 % in CH_2Cl_2) split 95 ml/min
Carrier gas: 60 kPa H_2 (1.7 ml/min)
Temperature: 145 °C
Detector: FID 250 °C

$C_9H_{16}O_2$



Whisky lactone can also be separated on HYDRODEX β-PM (application 202882) or LIPODEX® A (application 202852). See our application database at *www.mn-net.com*.



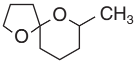
Enantiomer separation of spiroacetals

MN Appl. No. 202200

Column: LIPODEX® A, 50 m x 0.25 mm ID, REF 723360.50, max. temperature 200/ 220 °C
Temperature: 80 °C
Carrier gas: H_2
Detector: FID

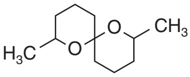
Peaks:

1. 7-Methyl-1,6-dioxaspiro[4,5]decane



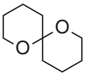
$C_9H_{16}O_2$

2. 2,8-Dimethyl-1,7-dioxaspiro[5,5]undecane



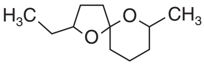
$C_{11}H_{20}O_2$

3. 1,7-Dioxaspiro[5,5]undecane

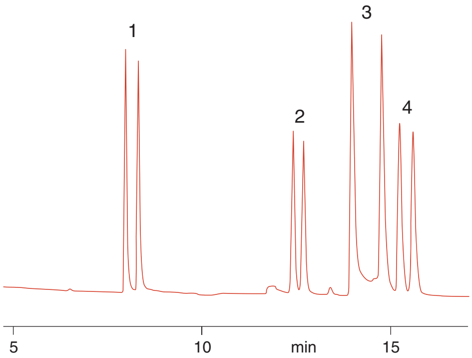


$C_9H_{16}O_2$

4. 2-Ethyl-7-methyl-1,6-dioxaspiro[4,5]decane



$C_{11}H_{20}O_2$



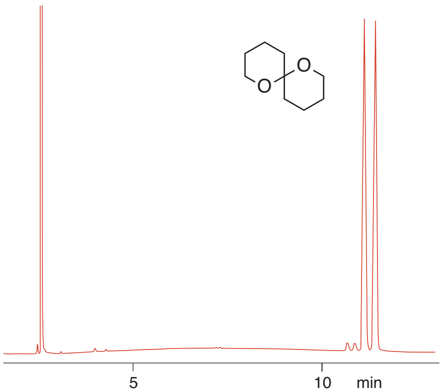
Courtesy of Prof. W.A. König, Hamburg, Germany

Enantiomer separation of 1,7-dioxaspiro[5,5]undecane

MN Appl. No. 202220

Column: FS-LIPODEX® A, 50 m x 0.25 mm ID, REF 723360.50, max. temperature 200/220 °C
Injection: 0.5 μl (1 % in CH_2Cl_2) split 320 ml/min
Carrier gas: 120 kPa H_2 (2.2 ml/min)
Temperature: 95 °C
Detector: FID 240 °C

$C_9H_{16}O_2$

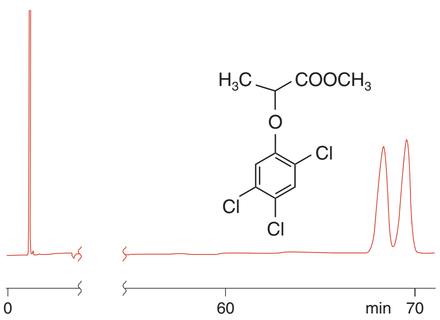


Enantiomers separation of fenoprop methyl ester

MN Appl. No. 202552

Column:	FS-HYDRODEX β-3P, 25 m x 0.25 mm ID, REF 723358.25, max. temperature 230/250 °C
Injection:	1 µl (1 % in CH_2Cl_2) split 130 ml/min
Carrier gas:	60 kPa H_2 (1.9 ml/min)
Temperature:	140 °C
Detector:	FID 250 °C

$C_{10}H_9Cl_3O_3$

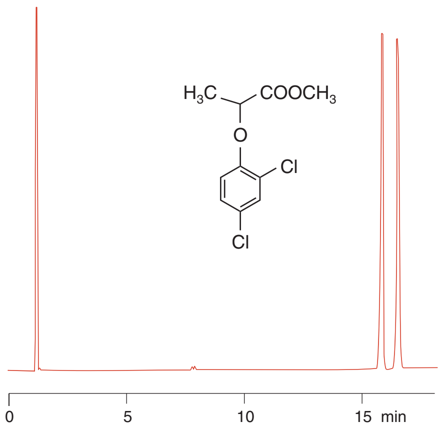


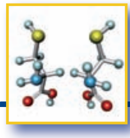
Enantiomer separation of dichlorprop methyl ester

MN Appl. No. 202542

Column:	FS-HYDRODEX β-3P, 25 m x 0.25 mm ID, REF 723358.25, max. temperature 230/250 °C
Injection:	0.1 µl (1 % in CH_2Cl_2) split 130 ml/min
Carrier gas:	60 kPa H_2 (1.9 ml/min)
Temperature:	160 °C
Detector:	FID 250 °C

$C_{10}H_{10}Cl_2O_3$





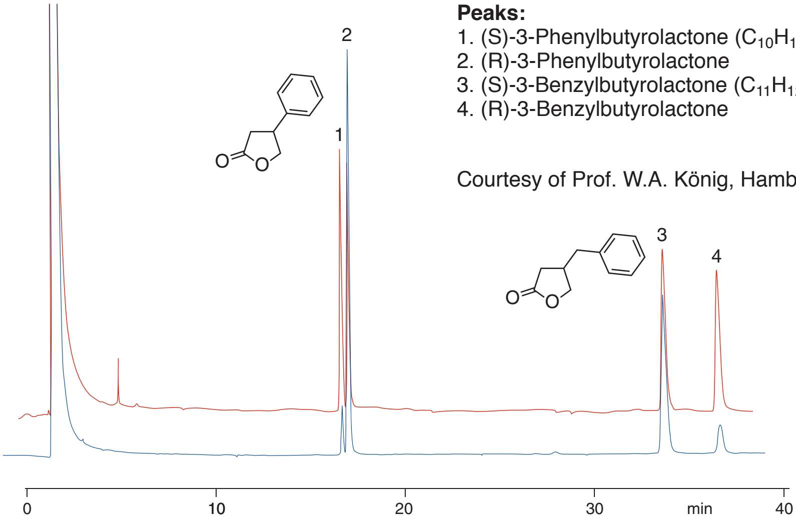
Enantiomer composition of 3-phenyl- and 3-benzylbutyrolactone

MN Appl. No. 202932

Column: LIPODEX® B, 50 m x 0.25 mm ID, REF 723362.50, max. temperature 200/220 °C
Carrier gas: H_2
Temperature: 175 °C
Detector: FID

Peaks:
1. (S)-3-Phenylbutyrolactone ($C_{10}H_{10}O_2$)
2. (R)-3-Phenylbutyrolactone
3. (S)-3-Benzylbutyrolactone ($C_{11}H_{12}O_2$)
4. (R)-3-Benzylbutyrolactone

Courtesy of Prof. W.A. König, Hamburg, Germany

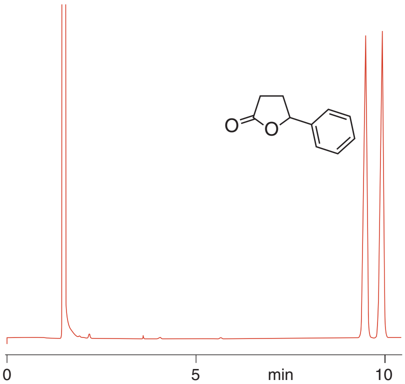


Enantiomer analysis of γ-phenylbutyrolactone

MN Appl. No. 202942

Column: FS-LIPODEX® E, 25 m x 0.25 mm ID, REF 723368.25, max. temperature 200/220 °C
Injection: 0.5 μl, split 1:100
Carrier gas: 60 kPa H_2
Temperature: 170 °C
Detector: FID 250 °C

$C_{10}H_{10}O_2$

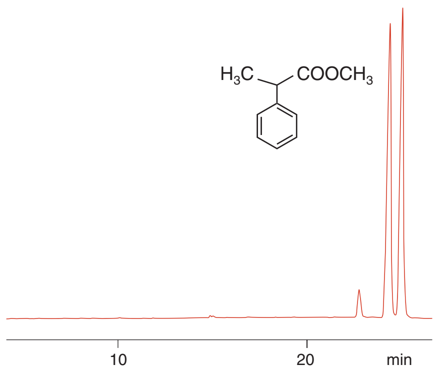


γ-phenylbutyrolactone can also be separated on HYDRODEX β-PM (see application 202952 at *www.mn-net.com*).

Chiral separations

Enantiomer separation of 2-phenylpropionic acid (hydratropic acid) methyl ester
MN Appl. No. 202572

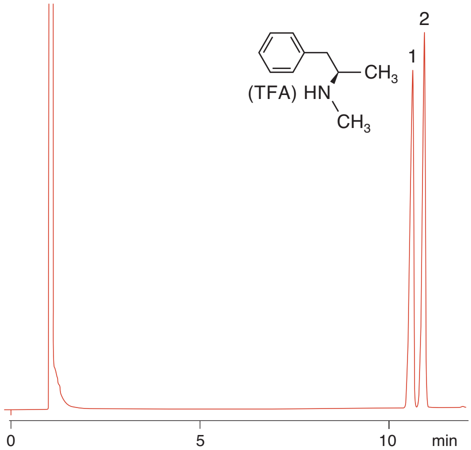
Column: FS-LIPODEX® E, 25 m x 0.25 mm ID, REF 723368.25, max. temperature 200/220 °C
Injection: 0.1 *µ*l (0.1 % in CH_2Cl_2) split 100 ml/min
Carrier gas: 60 kPa H_2
Temperature: 80 °C
Detector: FID 250 °C
$C_{10}H_{12}O_2$



Enantiomer separation of desoxyephedrine (TFA)
MN Appl. No. 202330

Column: FS-LIPODEX® E, 25 m x 0.25 mm ID, REF 723368.25, max. temperature 200/220 °C
Injection: 0.5 *µ*l (1 % in CH_2Cl_2) split 70 ml/min
Carrier gas: 60 kPa H_2 (1.3 ml/min)
Temperature: 130 °C
Detector: FID 250 °C

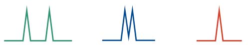
Peaks:
1. D-Desoxyephedrine (TFA) $C_{10}H_{15}N$
2. L-Desoxyephedrine (TFA)

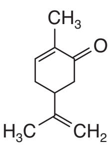


Enantiomer separation of carvone
MN Appl. No. 211500

Columns: all 25 m x 0.25 mm ID: a) FS-HYDRODEX β-6TBDM (REF 723381.25), b) FS-LIPODEX® E (REF 723368.25), c) FS-HYDRODEX β-PM (REF 723370.25)
Injection: 1 *µ*l, split, 250 °C
Carrier gas: 1.1 ml/min He
Detector: FID 250 °C
$C_{10}H_{14}O_2$

	a	b	c
Temperature:	105 °C	90 °C	110 °C
Resolution:	1.22	1.02	<0.5





Courtesy of H. Casabianca, CNRS Service Central d'Analyse, Vernaison, France

Carvone can also be separated on LIPODEX® A (see applications 202110 and 211940 at *www.mn-net.com*).

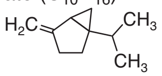
Chiral constituents of peppermint oil

MN Appl. No. 250410

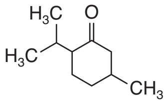
Column: FS-LIPODEX® G, 25 m x 0.25 mm ID, max. temp. 220/240 °C, REF 723379.25
Carrier gas: 50 kPa H_2
Temperature: 75 °C, isothermal
Detector: FID

Peaks:

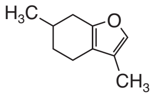
1. (+)-*trans*-Sabinene hydrate ($C_{10}H_{16}$)



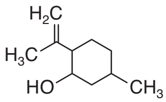
2. (+)-Menthone
3. (+)-Isomenthone
4. (–)-Menthone
5. (–)-Isomenthone
($C_{10}H_{18}O$)



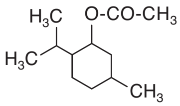
6. (+)-Menthofuran ($C_{10}H_{14}O$)



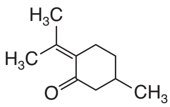
7. (–)-Isopulegol ($C_{10}H_{18}O$)



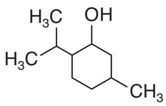
8. (–)-Menthyl acetate ($C_{12}H_{22}O_2$)



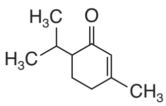
9. (+)-Pulegone ($C_{10}H_{16}O$)



10. (+)-Neomenthol
11. (–)-Neomenthol
12. (+)-Neoisomenthol
13. (+)-Menthol
14. (–)-Neoisomenthol

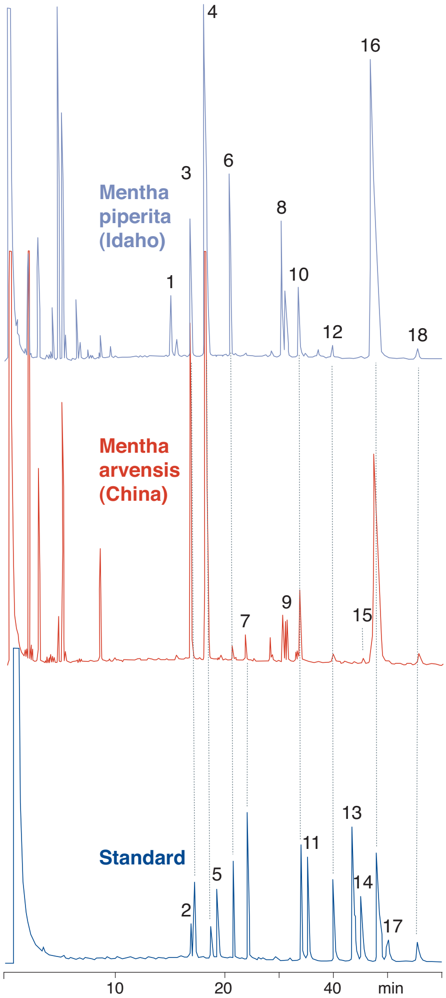


15. (+)-Piperitone ($C_{10}H_{16}O$)



16. (–)-Menthol
17. (+)-Isomenthol
18. (–)-Isomenthol

($C_{10}H_{20}O$) structure see above



W. A. König et al., High Resol. Chromatogr. **20** (1997) 55 – 61

Chiral separations

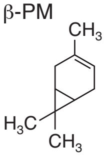
Enantiomer separation of Δ3-carene

MN Appl. No. 211530

Columns: all 25 m x 0.25 mm ID:
a) FS-HYDRODEX β-6TBDM (REF 723381.25),
b) FS-LIPODEX® E (REF 723368.25),
c) FS-HYDRODEX β-PM (REF 723370.25)

Injection: 1 μl, split, 250 °C
Carrier gas: 1.1 ml/min He
Detector: FID 250 °C

$C_{10}H_{16}$



	a	b	c
Temperature:	75 °C	50 °C	70 °C
Resolution:	3.01	8.65	2.41

Courtesy of H. Casabianca, CNRS Service Central d'Analyse, Vernaison, France

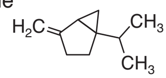
Enantiomer separation of sabinene

MN Appl. No. 211540

Columns: all 25 m x 0.25 mm ID:
a) FS-HYDRODEX β-6TBDM (REF 723381.25),
b) FS-LIPODEX® E (REF 723368.25),
c) FS-HYDRODEX β-PM (REF 723370.25)

Injection: 1 μl, split, 250 °C
Carrier gas: 1.1 ml/min He
Detector: FID 250 °C

$C_{10}H_{16}$



	a	b	c
Temperature:	75 °C	50 °C	gradient
Resolution:	5.19	2.1	1.29

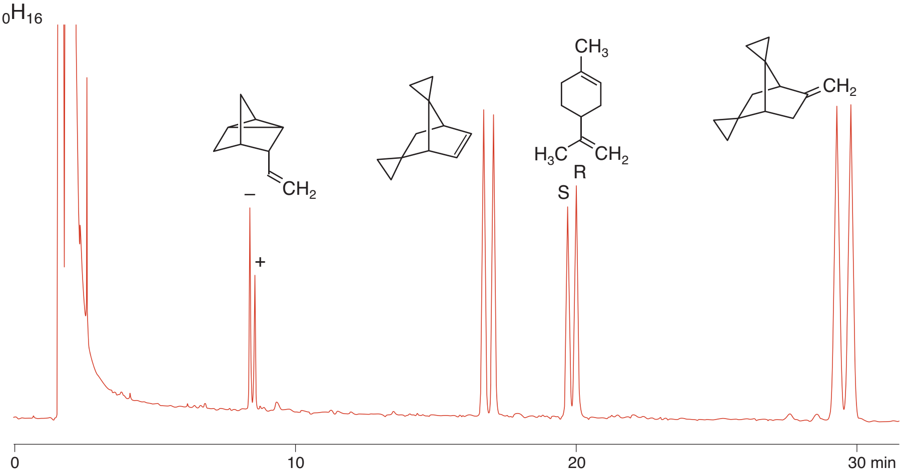
Courtesy of H. Casabianca, CNRS Service Central d'Analyse, Vernaison, France

Enantiomer separation of cyclic olefins including limonene

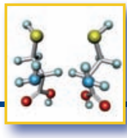
MN Appl. No. 201830

Column: LIPODEX® C, 50 m x 0.25 mm ID, REF 723364.50, max. temperature 200/220 °C
Carrier gas: 1 bar H_2
Temperature: 70 °C
Detector: FID

$C_{10}H_{16}$



W.A. König et al., HRC **12** (1989) 35 – 39

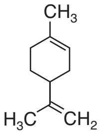


Enantiomer separation of limonene

MN Appl. No. 211550

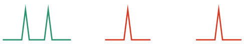
Columns: all 25 m x 0.25 mm ID:
a) FS-HYDRODEX β-6TBDM (REF 723381.25),
b) FS-LIPODEX® E (REF 723368.25),
c) FS-HYDRODEX β-PM (REF 723370.25)

Injection: 1 μl, split, 250 °C
Carrier gas: 1.1 ml/min He
Detector: FID 250 °C



$C_{10}H_{16}$

	a	b	c
Temperature:	80 °C	55 °C	70 °C
Resolution:	6.48	<0.5	0.55



Courtesy of H. Casabianca, CNRS Service Central d'Analyse, Vernaison, France

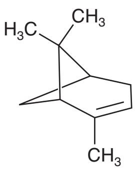
Limonene can also be separated on HYDRODEX β-3P (see application 201850 at *www.mn-net.com*).

Enantiomer separation of α-pinene

MN Appl. No. 211510

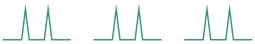
Columns: all 25 m x 0.25 mm ID:
a) FS-HYDRODEX β-6TBDM (REF 723381.25),
b) FS-LIPODEX® E (REF 723368.25),
c) FS-HYDRODEX β-PM (REF 723370.25)

Injection: 1 μl, split, 250 °C
Carrier gas: 1.1 ml/min He
Detector: FID 250 °C



$C_{10}H_{16}$

	a	b	c
Temperature:	68 °C	40 °C	60 °C
Resolution:	1.79	1.66	3.33



Courtesy of H. Casabianca, CNRS Service Central d'Analyse, Vernaison, France

Enantiomer separation of β-pinene

MN Appl. No. 211520

Columns: all 25 m x 0.25 mm ID:
a) FS-HYDRODEX β-6TBDM (REF 723381.25),
b) FS-LIPODEX® E (REF 723368.25),
c) FS-HYDRODEX β-PM (REF 723370.25)

Injection: 1 μl, split, 250 °C
Carrier gas: 1.1 ml/min He
Detector: FID 250 °C

$C_{10}H_{16}$	a	b	c
Temperature:	75 °C	50 °C	70 °C
Resolution:	3.23	4.26	1.23

Courtesy of H. Casabianca, CNRS Service Central d'Analyse, Vernaison, France

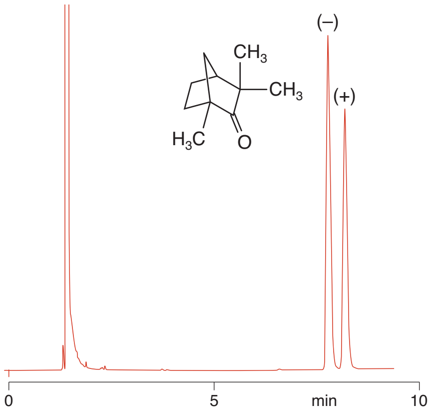
Enantiomer separation of fenchone

MN Appl. No. 202090

Column: FS-LIPODEX® E, 25 m x 0.25 mm ID, REF 723368.25, max. temperature 200/220 °C

Injection: 0.5 μl, split 1:100
Carrier gas: 60 kPa H_2
Temperature: 90 °C
Detector: FID 250 °C

$C_{10}H_{16}O$



Chiral separations

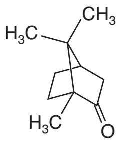
Enantiomer separation of camphor

MN Appl. No. 211560

Columns: all 25 m x 0.25 mm ID:
a) FS-HYDRODEX β-6TBDM (REF 723381.25),
b) FS-LIPODEX® E (REF 723368.25),
c) FS-HYDRODEX β-PM (REF 723370.25)

Injection: 1 μl, split, 250 °C
Carrier gas: 1.1 ml/min He
Detector: FID 250 °C

$C_{10}H_{16}O$



	a	b	c
Temperature:	100 °C	90 °C	100 °C
Resolution:	2.11	6.66	<0.5

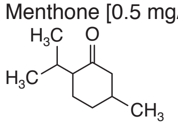
Courtesy of H. Casabianca, CNRS Service Central d'Analyse, Vernaison, France

Separation of essential oils

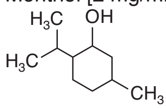
MN Appl. No. 212980 / 212990 / 213000

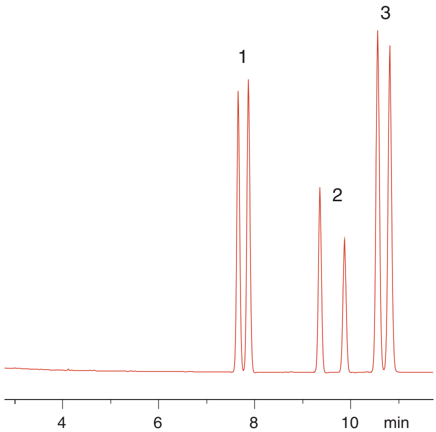
Column: FS-HYDRODEX γ-TBDAc, 50 m x 0.25 mm ID, max. temp. 220/240 °C, REF 723387.50
Injector: 220 °C
Carrier gas: 1.2 bar H_2
Temperature: 125 °C
Detector: FID 220 °C

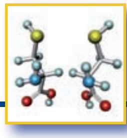
Peaks:
1. Fenchone [1.5 mg/ml] ($C_{10}H_{16}O$)
2. Menthone [0.5 mg/ml] ($C_{10}H_{18}O$)



3. Menthol [2 mg/ml] ($C_{10}H_{20}O$)





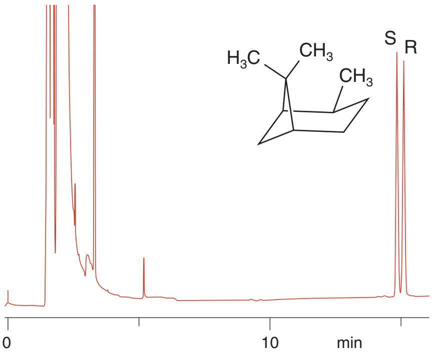


Enantiomer separation of *cis*-pinane

MN Appl. No. 201810

Column: LIPODEX® C, 50 m x 0.25 mm ID, REF 723364.50, max. temperature 200/220 °C
Carrier gas: H_2
Temperature: 70 °C
Detector: FID

$C_{10}H_{18}$



Courtesy of Prof. W.A. König, Hamburg, Germany

Enantiomer separation of terpinen-4-ol

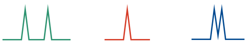
MN Appl. No. 211630

Columns: all 25 m x 0.25 mm ID:
a) FS-HYDRODEX β-6TBDM (REF 723381.25),
b) FS-LIPODEX® E (REF 723368.25),
c) FS-HYDRODEX β-PM (REF 723370.25)

Injection: 1 µl, split, 250 °C
Carrier gas: 1.1 ml/min He
Detector: FID 250 °C

$C_{10}H_{18}O$

	a	b	c
Temperature:	110 °C	75 °C	70 °C
Resolution:	2.1	<0.5	0.65



Courtesy of H. Casabianca, CNRS Service Central d'Analyse, Vernaison, France

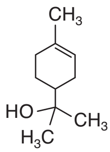
Enantiomer separation of α-terpineol

MN Appl. No. 211640

Columns: all 25 m x 0.25 mm ID:
a) FS-HYDRODEX β-6TBDM (REF 723381.25),
b) FS-LIPODEX® E (REF 723368.25),
c) FS-HYDRODEX β-PM (REF 723370.25)

Injection: 1 µl, split, 250 °C
Carrier gas: 1.1 ml/min He
Detector: FID 250 °C

$C_{10}H_{18}O$



	a	b	c
Temperature:	115 °C	80 °C	110 °C
Resolution:	4.29	1.26	1.75

Courtesy of H. Casabianca, CNRS Service Central d'Analyse, Vernaison, France

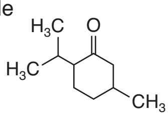
Enantiomer separation of menthone

MN Appl. No. 211600

Columns: all 25 m x 0.25 mm ID:
a) FS-HYDRODEX β-6TBDM (REF 723381.25),
b) FS-LIPODEX® E (REF 723368.25),
c) FS-HYDRODEX β-PM (REF 723370.25)

Injection: 1 µl, split, 250 °C
Carrier gas: 1.1 ml/min He
Detector: FID 250 °C

$C_{10}H_{18}O$



	a	b	c
Temperature:	100 °C	80 °C	90 °C
Resolution:	1.88	11.45	<0.5

Courtesy of H. Casabianca, CNRS Service Central d'Analyse, Vernaison, France

Chiral separations

Enantiomer separation of isomenthone

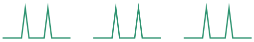
MN Appl. No. 211610

Columns: all 25 m x 0.25 mm ID:
a) FS-HYDRODEX β-6TBDM (REF 723381.25),
b) FS-LIPODEX® E (REF 723368.25),
c) FS-HYDRODEX β-PM (REF 723370.25)

Injection: 1 µl, split, 250 °C
Carrier gas: 1.1 ml/min He
Detector: FID 250 °C

$C_{10}H_{18}O$

	a	b	c
Temperature:	100 °C	90 °C	90 °C
Resolution:	10.01	10.11	2.04



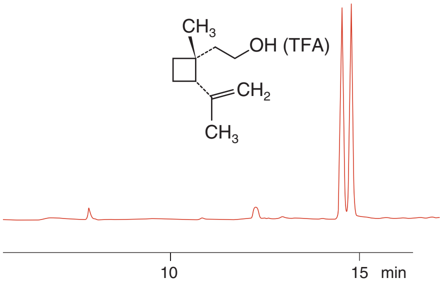
Courtesy of H. Casabianca, CNRS Service Central d'Analyse, Vernaison, France

Enantiomer separation of grandisol (TFA)

MN Appl. No. 202811

Column:
LIPODEX® C,
50 m x 0.25 mm ID,
REF 723364.50,
max. temperature 200/220 °C
Carrier gas: 1 bar H_2
Temperature: 90 °C
Detector: FID

$C_{10}H_{18}O$



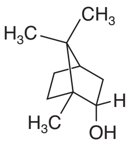
W.A. König et al., HRC **12** (1989) 35 – 39

Enantiomer separation of borneol

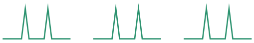
MN Appl. No. 211570

Columns: all 25 m x 0.25 mm ID:
a) FS-HYDRODEX β-6TBDM (REF 723381.25),
b) FS-LIPODEX® E (REF 723368.25),
c) FS-HYDRODEX β-PM (REF 723370.25)

Injection: 1 µl, split, 250 °C
Carrier gas: 1.1 ml/min He
Detector: FID 250 °C
$C_{10}H_{18}O$



	a	b	c
Temperature:	115 °C	80 °C	110 °C
Resolution:	4.99	1.77	2.95

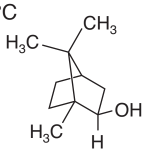


Enantiomer separation of isoborneol

MN Appl. No. 211580

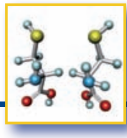
Columns: all 25 m x 0.25 mm ID:
a) FS-HYDRODEX β-6TBDM (REF 723381.25),
b) FS-LIPODEX® E (REF 723368.25),
c) FS-HYDRODEX β-PM (REF 723370.25)

Injection: 1 µl, split, 250 °C
Carrier gas: 1.1 ml/min He
Detector: FID 250 °C
$C_{10}H_{18}O$



	a	b	c
Temperature:	115 °C	90 °C	110 °C
Resolution:	3.07	1.36	1.25

Courtesy of H. Casabianca, CNRS Service Central d'Analyse, Vernaison, France

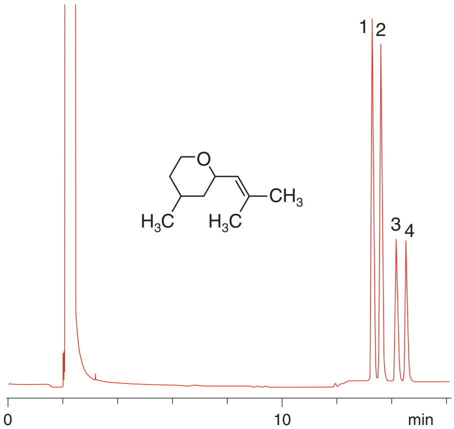


Enantiomer separation of rose oxide

MN Appl. No. 212430

Column:	FS-HYDRODEX® β-TBDAc, 50 m x 0.25 mm ID, REF 723384.50, max. temperature 220/240 °C
Sample:	0.1 % in hexane
Carrier gas:	1.4 bar H_2
Temperature:	90 °C
Detector:	FID

Peaks: ($C_{10}H_{18}O$)
1. (+)-*cis*-Rose oxide
2. (–)-*cis*-Rose oxide
3. (–)-*trans*-Rose oxide
4. (+)-*trans*-Rose oxide



MN Appl. No. 211620

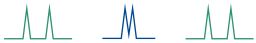
Columns:	all 25 m x 0.25 mm ID: a) FS-HYDRODEX β-6TBDM (REF 723381.25), b) FS-LIPODEX® E (REF 723368.25)	
Carrier gas:	1.1 ml/min He	
Detector:	FID 250 °C	
	a	b
Temperature:	90 °C	60 °C
Resolution:	1.41	<0.5

Courtesy of H. Casabianca, CNRS Service Central d'Analyse, Vernaison, France

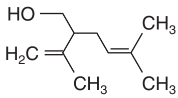
Enantiomer separation of lavandulol

MN Appl. No. 211590

Columns:	all 25 m x 0.25 mm ID: a) FS-HYDRODEX β-6TBDM (REF 723381.25), b) FS-LIPODEX® E (REF 723368.25), c) FS-HYDRODEX β-PM (REF 723370.25)		
Injection:	1 μl, split, 250 °C		
Carrier gas:	1.1 ml/min He		
Detector:	FID 250 °C		
	a	b	c
Temperature:	110 °C	80 °C	100 °C
Resolution:	6	0.95	2.82



Courtesy of H. Casabianca, CNRS Service Central d'Analyse, Vernaison, France

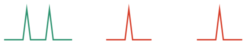


Lavandulol $C_{10}H_{18}O$

Enantiomer separation of lavandulyl acetate

MN Appl. No. 211740

Columns:	all 25 m x 0.25 mm ID: a) FS-HYDRODEX β-6TBDM (REF 723381.25), b) FS-LIPODEX® E (REF 723368.25), c) FS-HYDRODEX β-PM (REF 723370.25)		
Injection:	1 μl, split, 250 °C		
Carrier gas:	1.1 ml/min He		
Detector:	FID 250 °C		
	a	b	c
Temperature:	105 °C	85 °C	100 °C
Resolution:	1.9	<0.5	0.54



Courtesy of H. Casabianca, CNRS Service Central d'Analyse, Vernaison, France

Chiral separations

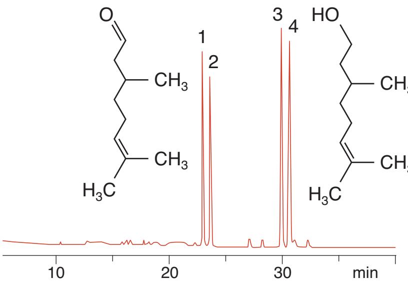
Enantiomer separation of citronellal and citronellol

MN Appl. No. 212440

Column:	FS-HYDRODEX® β-TBDAc, 50 m x 0.25 mm ID, REF 723384.50, max. temperature 220/240 °C
Sample:	0.1 % in CH_2Cl_2
Carrier gas:	H_2, 1.5 bar
Temperature:	100 °C
Detector:	FID

Peaks:

1. (*R*)/(*S*)-Citronellal ($C_{10}H_{18}O$)
2. (*S*)/(*R*)-Citronellal
3. (*S*)-Citronellol ($C_{10}H_{20}O$)
4. (*R*)-Citronellol



Also see application 211680 at *www.mn-net.com*

Enantiomer separation of citronellol (TFA)

MN Appl. No. 211690

Columns:	all 25 m x 0.25 mm ID: a) FS-HYDRODEX β-6TBDM (REF 723381.25), b) FS-LIPODEX® E (REF 723368.25)	
Carrier gas:	1.1 ml/min He	
Detector:	FID 250 °C	
	a	b
Temperature:	95 °C	85 °C
Resolution:	0.67	1.75

Courtesy of H. Casabianca, CNRS Service Central d'Analyse, Vernaison, France

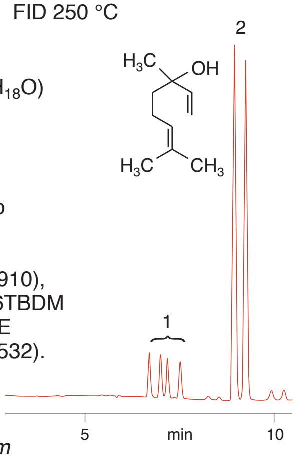
Enantiomer separation of linalool

MN Appl. No. 201920

Column:	FS-HYDRODEX β-3P, 25 m x 0.25 mm ID, REF 723358.25, max. temperature 230/250 °C
Injection:	0.1 μl (1 % in CH_2Cl_2) split 130 ml/min
Carrier gas:	60 kPa H_2 (1.9 ml/min)
Temperature:	120 °C
Detector:	FID 250 °C

Peaks:

1. Linalool oxide
2. Linalool ($C_{10}H_{18}O$)



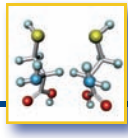
Linalool can also be separated on LIPODEX® C (application 201910), HXDRODEX β-6TBDM and LIPODEX® E (application 210532). See our application database at *www.mn-net.com*

Enantiomer separation of linalool oxide

MN Appl. No. 210533

Columns:	all 25 m x 0.25 mm ID: a) FS-HYDRODEX β-6TBDM (REF 723381.25), b) FS-LIPODEX® E (REF 723368.25), c) FS-HYDRODEX β-PM (REF 723370.25)		
Injection:	1 μl, split, 250 °C		
Carrier gas:	1.1 ml/min He		
Detector:	FID 250 °C		
$C_{10}H_{18}O_2$	a	b	c
Temperature:	90 °C	65 °C	85 °C
Resolution:	6.12	3.18	1.54

Courtesy of H. Casabianca, CNRS Service Central d'Analyse, Vernaison, France



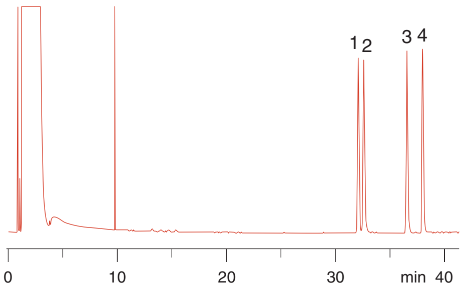
Enantiomer separation of linalool and linalyl acetate

MN Appl. No. 212410

Column: FS-HYDRODEX® β-TBDAc, 25 m x 0.25 mm ID, REF 723384.25, max. temperature 220/240 °C
Sample: 0.1 % in CH_2Cl_2
Carrier gas: 0.8 bar H_2
Temperature: 75 °C (20 min) $\xrightarrow{1\ °C/min}$ 110 °C (5 min)
Detector: FID

Peaks:

1. (*R*)-Linalyl acetate ($C_{12}H_{20}O_2$)
2. (*S*)-Linalyl acetate
3. (*R*)-Linalool ($C_{10}H_{18}O$)
4. (*S*)-Linalool



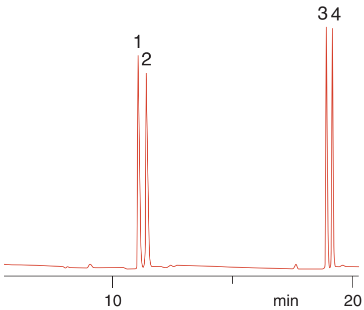
Enantiomer separation of δ-decalactone and δ-dodecalactone

MN Appl. No. 212420

Column: FS-HYDRODEX® β-TBDAc, 25 m x 0.25 mm ID, REF 723384.25, max. temperature 220/240 °C
Sample: 0.1 % in hexane
Carrier gas: H_2, 0.8 bar
Temperature: 160 °C (12 min) $\xrightarrow{4\ °C/min}$ 200 °C (10 min)
Detector: FID

Peaks:

1. (*S*)-δ-Decalactone ($C_{10}H_{18}O_2$)
2. (*R*)-δ-Decalactone
3. (*S*)-δ-Dodecalactone ($C_{12}H_{18}O_2$)
4. (*R*)-δ-Dodecalactone



Chiral separations

Enantiomer separation of menthol

MN Appl. No. 211700

Columns: all 25 m x 0.25 mm ID:
a) FS-HYDRODEX β-6TBDM (REF 723381.25),
b) FS-LIPODEX® E (REF 723368.25),
c) FS-HYDRODEX β-PM (REF 723370.25)
Injection: 1 μl, split, 250 °C
Carrier gas: 1.1 ml/min He
Detector: FID 250 °C

$C_{10}H_{20}O$

	a	b	c
Temperature:	115 °C	85 °C	105 °C
Resolution:	1.5	2.34	1.46

Courtesy of H. Casabianca, CNRS Service Central d'Analyse, Vernaison, France

Menthol can also be separated on LIPODEX® A (see application 210090 at *www.mn-net.com*).

Enantiomer separation of menthol (TFA)

MN Appl. No. 211710

Columns: FS-HYDRODEX β-6TBDM, 25 m x 0.25 mm ID, REF 723381.25
Injection: 1 μl, split, 250 °C
Carrier gas: 1.1 ml/min He
Temperature: 85 °C
Detector: FID 250 °C
Resolution: 2.52

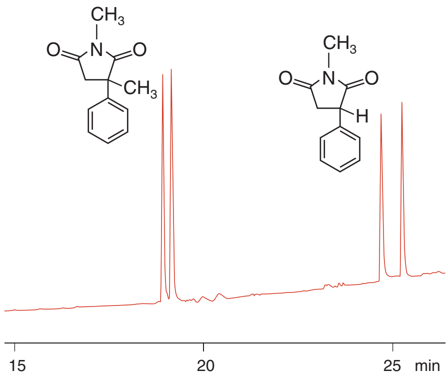
Courtesy of H. Casabianca, CNRS Service Central d'Analyse, Vernaison, France

Enantiomer separation of antiepileptic drugs mesuximide and phensuximide

MN Appl. No. 202381

Column: LIPODEX® B, 50 m x 0.25 mm ID, REF 723362.50, max. temperature 200/220 °C
Carrier gas: 1 bar H_2
Temperature: 135 °C $\xrightarrow{3\ °C/min}$ 200 °C
Detector: FID

Peaks:
1. Mesuximide ($C_{12}H_{13}NO_2$)
2. Phensuximide ($C_{11}H_{11}NO_2$)



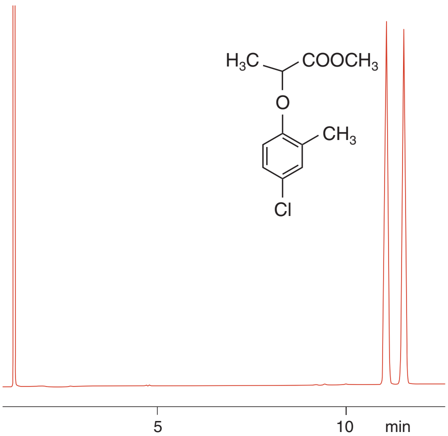
W.A. König et al., HRC **11** (1988) 621 – 625

Enantiomer separation of mecoprop methyl ester

MN Appl. No. 202562

Column:	FS-HYDRODEX β-3P, 25 m x 0.25 mm ID, REF 723358.25, max. temperature 230/250 °C
Injection:	0.1 μl (1 % in CH_2Cl_2) split 130 ml/min
Carrier gas:	60 kPa H_2 (1.9 ml/min)
Temperature:	160 °C
Detector:	FID 250 °C

$C_{11}H_{13}ClO_3$

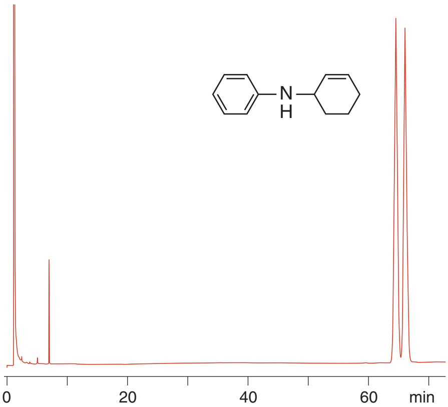


Enantiomer separation of *N*-phenyl-cyclohex-2-enamine

MN Appl. No. 212250

Column:	FS-LIPODEX® E, 25 m x 0.25 mm ID, REF 723368.25, max. temperature 200/220 °C
Sample:	10 μl in 3 ml CH_2Cl_2
Carrier gas:	0.6 bar H_2
Temperature:	110 °C
Detector:	FID

$C_{12}H_{15}N$



Courtesy of Mrs. Eschmann, Institut für Brennstoffchemie, RWTH Aachen, Germany

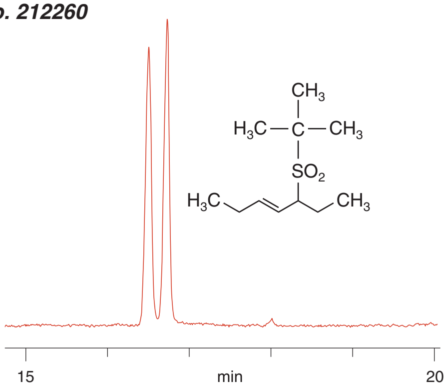
Enantiomer separation of 5-(2-methyl-propan-2-sulphonyl)-hept-3-ene

MN Appl. No. 212260

Column:	FS-LIPODEX® G, 25 m x 0.25 mm ID, REF 723379.25, max. temperature 220/240 °C
Carrier gas:	100 kPa H_2
Temperature:	60 °C (15 min) $\xrightarrow{10\ °C/min}$ 100 °C (5 min)
Detector:	FID

$C_{11}H_{22}O_2S$

Courtesy of Mrs. Vermeeren, AK Prof. Gais, Inst. für Org. Chemie, RWTH Aachen, Germany



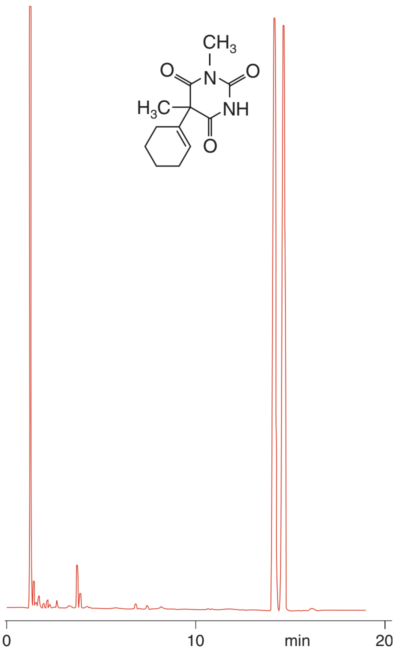
Chiral separations

Enantiomer separation of hexobarbital (TFA)

MN Appl. No. 202401

Column: FS-HYDRODEX β-3P, 25 m x 0.25 mm ID, REF 723358.25, max. temperature 230/250 °C
Injection: 0.1 μl, split 130 ml/min
Carrier gas: 60 kPa H_2 (1.9 ml/min)
Temperature: 210 °C
Detector: FID 250 °C

$C_{12}H_{16}N_2O_3$

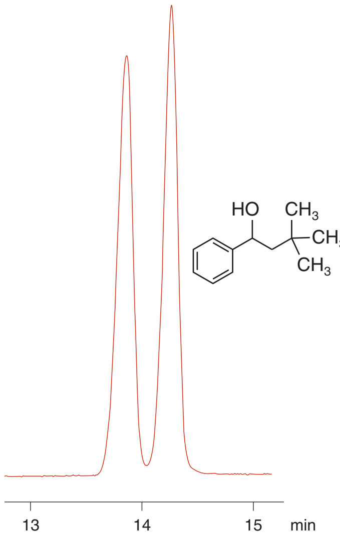


Enantiomer separation of 3,3-dimethyl-1-phenyl-butan-1-ol

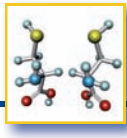
MN Appl. No. 212350

Column: FS-LIPODEX® G, 25 m x 0.25 mm ID, REF 723379.25, max. temperature 200/220 °C
Carrier gas: 100 kPa H_2
Temperature: 100 °C (5 min) $\xrightarrow{10\ °C/min}$ 120 °C (5 min) $\xrightarrow{10\ °C/min}$ 140 °C (5 min) $\xrightarrow{10\ °C/min}$ 170 °C (45 min)
Detector: FID

$C_{12}H_{18}O$



Courtesy of Mrs. Vermeeren, AK Prof. Gais, Inst. für Org. Chemie, RWTH Aachen, Germany

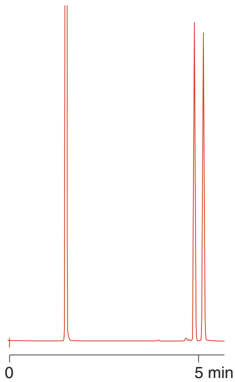


Enantiomer separation of menthyl acetate

MN Appl. No. 202010

Column:	FS-HYDRODEX β-3P, 25 m x 0.25 mm ID, REF 723358.25, max. temperature 230/250 °C
Injection:	0.1 *µ*l (1 % in CH_2Cl_2) split 130 ml/min
Carrier gas:	60 kPa H_2 (1.9 ml/min)
Temperature:	150 °C
Detector:	FID 250 °C

$C_{12}H_{22}O_2$



Menthyl acetate can also be separated on HYDRODEX β-PM (see application 202000 at *www.mn-net.com*).

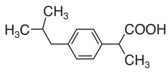
Separation of isomeric antiinflammatory drugs

MN Appl. No. 210150

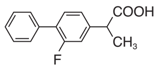
Column:	FS-HYDRODEX β-6TBDM, 25 m x 0.25 mm ID, max. temperature 250 °C, REF 723381.25
Carrier gas:	H_2
Temperature:	135 °C —1 °C/min→ 200 °C
Detector:	FID

Peaks:

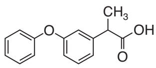
1. Ibuprofen $C_{13}H_{18}O_2$



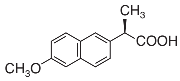
2. Flurbiprofen $C_{15}H_{13}FO_2$



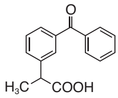
3. Fenoprofen $C_{15}H_{14}O_3$

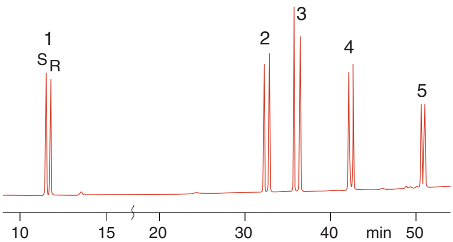


4. Naproxen $C_{14}H_{14}O_3$



5. Ketoprofen $C_{16}H_{14}O_3$





Courtesy of Prof. W.A. König, Hamburg, Germany

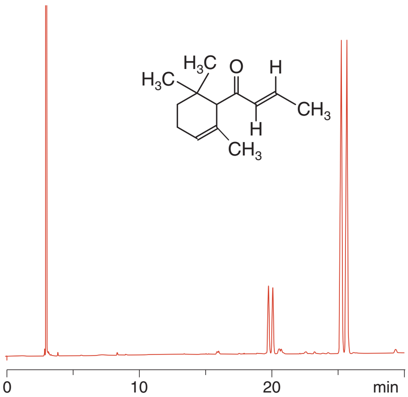
Chiral separations

Enantiomer separation of α-damascone

MN Appl. No. 202030

Column:	FS-HYDRODEX β-PM, 50 m x 0.25 mm ID, REF 723370.50, max. temperature 230/250 °C
Injection:	0.1 µl (1 % in CH_2Cl_2) split 150 ml/min
Carrier gas:	120 kPa H_2 (1.7 ml/min)
Temperature:	130 °C
Detector:	FID 250 °C

$C_{13}H_{20}O$

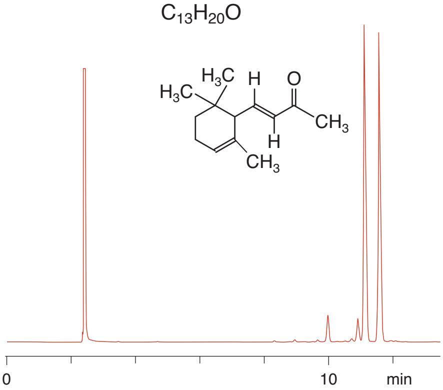


Enantiomer separation of α-ionone

MN Appl. No. 213010

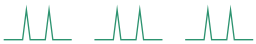
Column:	FS-HYDRODEX γ-TBDAc, 50 m x 0.25 mm ID, REF 723370.50, max. temperature 230/250 °C
Injection:	0.5 µl, split 5 0 ml/min
Carrier gas:	1.2 bar H_2
Temperature:	155 °C
Detector:	FID

$C_{13}H_{20}O$



MN Appl. No. 211770

Columns:	all 25 m x 0.25 mm ID: a) FS-HYDRODEX β-6TBDM (REF 723381.25), b) FS-LIPODEX® E (REF 723368.25), c) FS-HYDRODEX β-PM (REF 723370.25)		
Injection:	1 µl, split, 250 °C		
Carrier gas:	1.1 ml/min He		
Detector:	FID 250 °C		
	a	b	c
Temperature:	125 °C	105 °C	120 °C
Resolution:	7.42	3.89	3.19



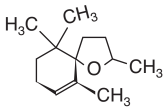
Courtesy of H. Casabianca, CNRS Service Central d'Analyse, Vernaison, France

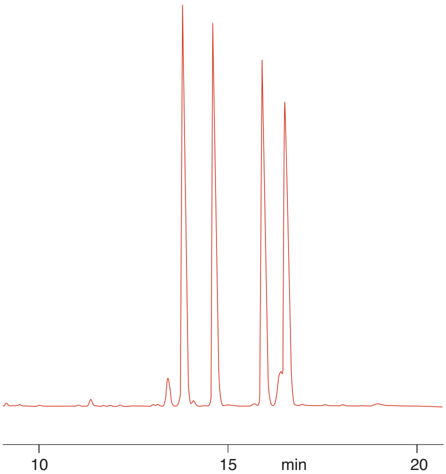
Enantiomer separation of theaspiran

MN Appl. No. 202210

Column:	FS-HYDRODEX β-PM, 50 m x 0.25 mm ID, REF 723370.50, max. temperature 230/250 °C
Injection:	0.5 µl (1 % in CH_2Cl_2) split 1:100
Carrier gas:	200 kPa H_2
Temperature:	120 °C
Detector:	FID 250 °C

$C_{13}H_{22}O$



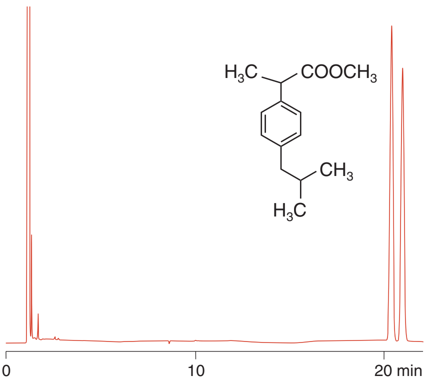


Enantiomer separation of ibuprofen methyl ester

MN Appl. No. 202582

Column:	FS-HYDRODEX β-3P, 25 m x 0.25 mm ID, REF 723358.25, max. temperature 230/250 °C
Injection:	0.5 µl (1 % in CH_2Cl_2) split 130 ml/min
Carrier gas:	60 kPa H_2 (1.9 ml/min)
Temperature:	140 °C
Detector:	FID 250 °C

$C_{14}H_{20}O_2$



Chiral separations

Separation of isomeric sesquiterpenes

MN Appl. No. 250170

Column: FS-HYDRODEX β-6TBDM, 15 m x 0.25 mm ID, max. temperature 230/250 °C

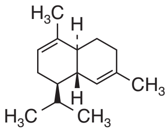
Carrier gas: H_2

Temperature: 100 °C $\xrightarrow{2\ °C/min}$ 200 °C

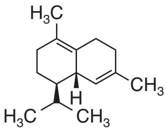
Detector: FID

Peaks: ($C_{15}H_{24}$)

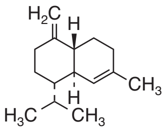
1. (–)-γ-Cadinene
2. (–)-δ-Cadinene
3. (–)-α-Cadinene
4. (+)-γ-Cadinene
5. (+)-α-Cadinene
6. (+)-δ-Cadinene
7. (+)-Cadina-1,4-diene
8. (–)-Cadina-1,4-diene



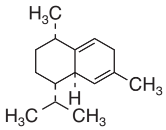
α-Cadinene



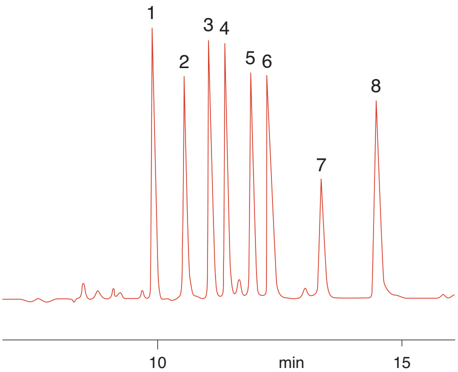
δ-Cadinene



γ-Cadinene



Cadina-1,4-diene



Courtesy of Prof. W.A. König, Hamburg, Germany

Enantiomer separation of fluoxetine and norfluoxetine

MN Appl. No. 212220

Column: FS-HYDRODEX β-6TBDM, 25 m x 0.25 mm ID, REF 723358.25, max. temperature 230/250 °C

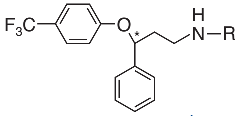
Temperature: 170 °C $\xrightarrow{1\ °C/min}$ 200 °C

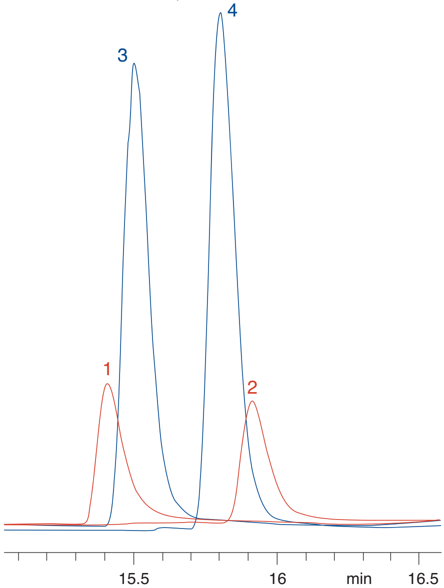
Carrier gas: 1.1 ml/min H_2

Detector: PND 300 °C

Peaks:

1. (*S*)-Norfluoxetine (R= H)
2. (*R*)-Norfluoxetine
3. (*S*)-Fluoxetine (R = CH_3)
4. (*R*)-Fluoxetine





S. Ulrich, J. Chromatography B, **783** (2003) 481 – 490

Separation of isomeric paracyclophanes

MN Appl. No. 250190

Column: FS-HYDRODEX β-6TBDM, 25 m x 0.25 mm ID, REF 723381.25
max. temperature 230/250 °C

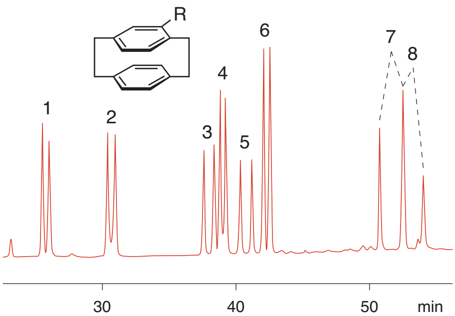
Carrier gas: H_2

Temperature: 135 °C $\xrightarrow{1\ °C/min}$ 200 °C

Detector: FID

Peaks:

1. 4-Methyl-[2.2]-paracyclophane ($C_{17}H_{18}$, R = $-CH_3$)
2. 4-Ethinyl-[2.2]-paracyclophane ($C_{18}H_{16}$, R = -C≡CH)
3. 4-Allyloxy-[2.2]-paracyclophane ($C_{19}H_{20}O$, R = $-O-CH_2-CH=CH_2$)
4. 4-Acetyl-[2.2]-paracyclophane ($C_{18}H_{18}O$, R = $-CO-CH_3$)
5. 4-Formyl-[2.2]-paracyclophane ($C_{17}H_{16}O$, R = -CHO)
6. 4-Cyano-[2.2]-paracyclophane ($C_{17}H_{15}N$, R = -CN)
7. 4-Hydroxymethyl-[2.2]-paracyclophane ($C_{17}H_{18}O$, R = $-CH_2OH$)
8. 4-Hydroxy-[2.2]-paracyclophane ($C_{16}H_{16}O$, R = -OH)



Courtesy of Prof. W.A. König, Hamburg, Germany

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MACHEREY-NAGEL products shall in any event be used wearing adequate PROTECTIVE CLOTHING. For detailed information please refer to the respective Material Safety Data Sheet of the product !

MACHEREY-NAGEL products shall exclusively be used in an ADEQUATE TEST ENVIRONMENT.

MACHEREY-NAGEL does not assume any responsibility for damages due to improper application of our products in other fields of application.

APPLICATION ON THE HUMAN BODY IS STRICTLY FORBIDDEN. The respective user is liable for any and all damages resulting from such application.

The user has to ensure that the products used are suitable for the intended application.

MACHEREY-NAGEL does not warrant the reproducibility of published applications.

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