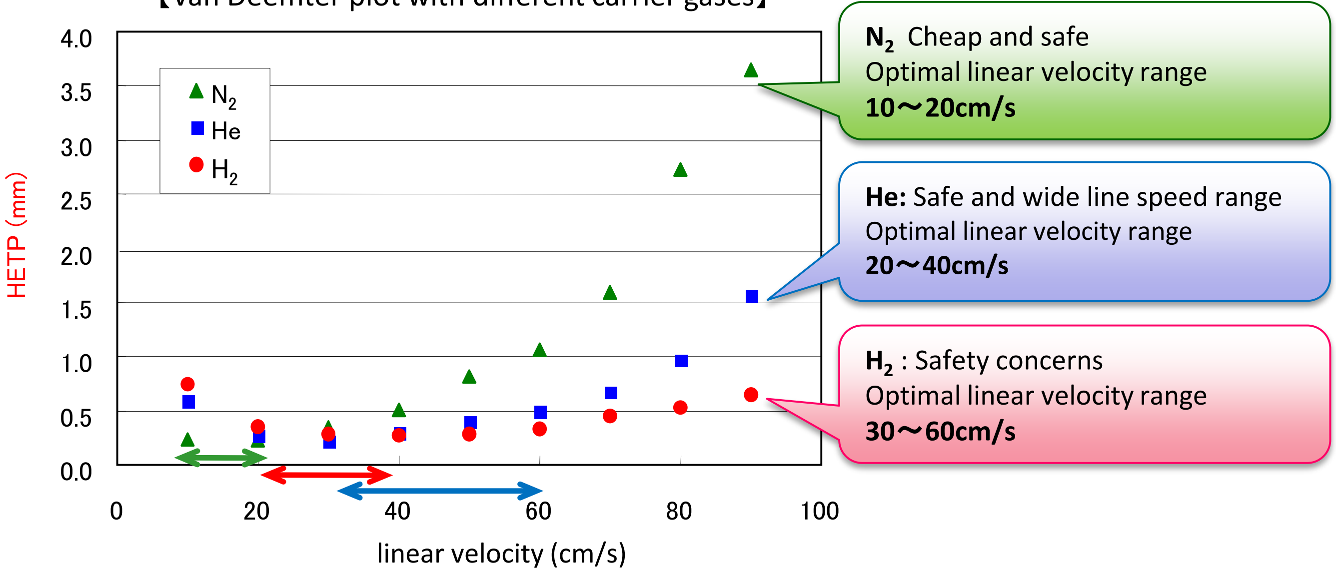
Proposal of Helium Alternative Carrier in GC Analysis

Helium (He) is often used as a carrier gas in gas chromatography, but in recent years, the global depletion problem has continued, and it is still difficult to obtain. Therefore, the demand for nitrogen (N2) and hydrogen (H2) as alternative gases is increasing. This time, we will introduce the points to note when changing gas, along with an analysis example using a safe and inexpensive nitrogen carrier.

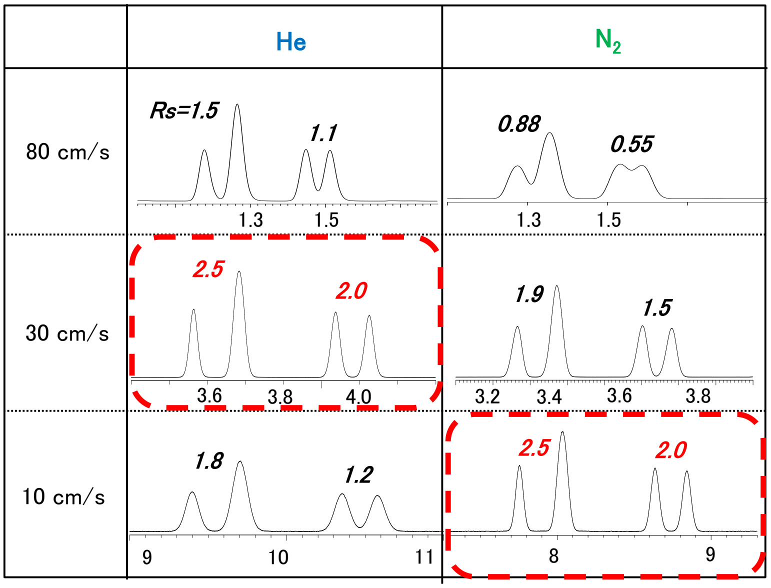
Precautions When Changing Carrier Gas − Linear Velocity −

The linear velocity of the carrier gas is an important factor in the analysis. The faster the linear velocity, the faster the analysis time, but in order to obtain good separation, it is necessary to analyze at the optimum linear velocity. The optimum linear velocity varies depending on the type of carrier gas and the inner diameter of the column. **The graph below is a Van Deemter plot by carrier gas type, showing that the smaller the HETP (theoretical stage equivalent height), the higher the separation capacity.** The line speed at which HETP is minimized is the optimum linear velocity.

【Van Deemter plot with different carrier gases】



When changing the carrier gas, sufficient separation may not be obtained if the original conditions are applied as they are. In such a case, perform analysis in the optimum linear velocity range of the carrier gas to be used.



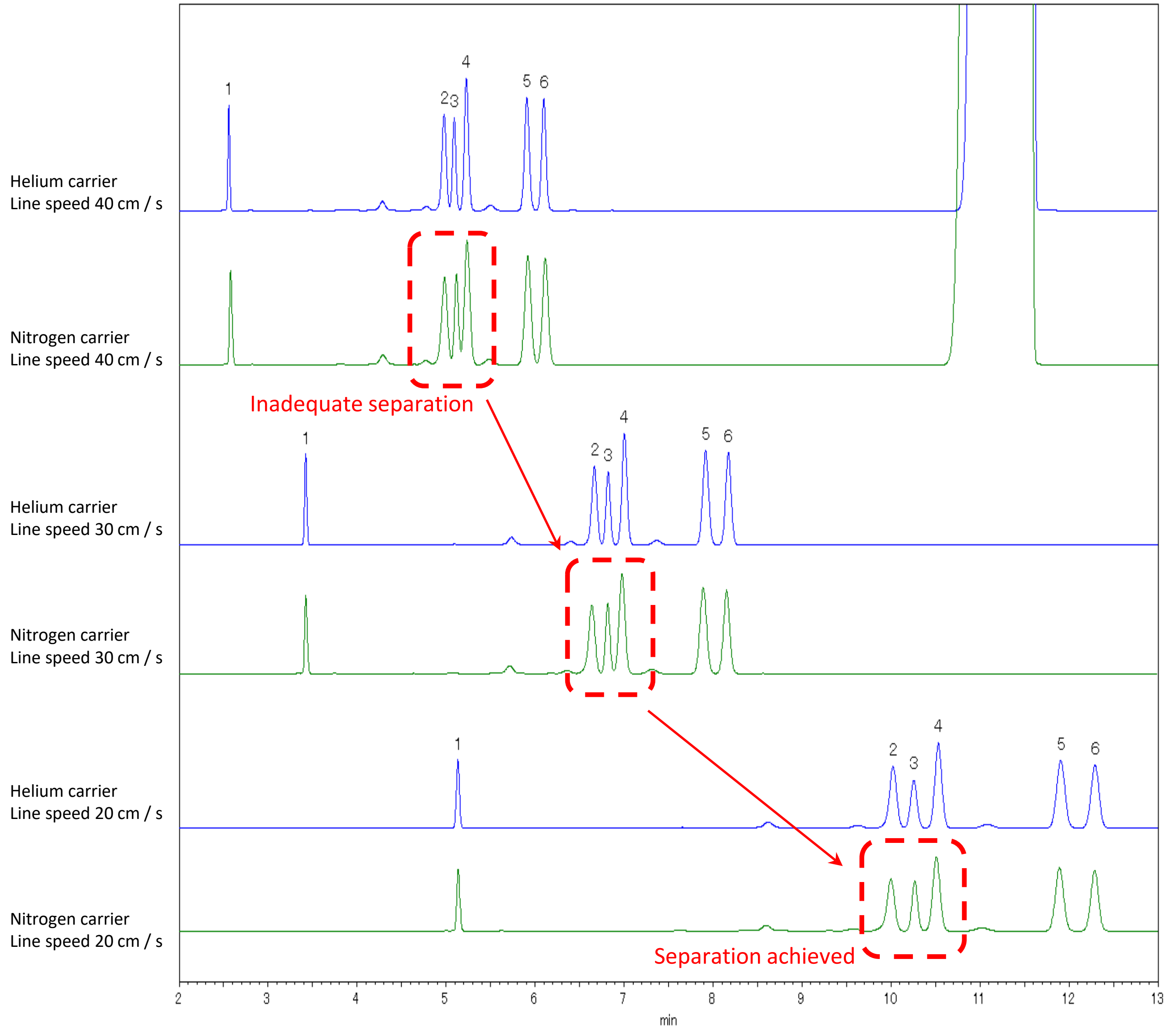
(Reference)
Column flow conversion formula

$$F = u \times 60 \times r^2 \times \pi$$

F: Column flow rate (mL / min)
u: Average linear velocity (cm / s)
r: Column radius (cm)

Precautions When Changing Carrier Gas-Comparison of Separation Patterns-

The following is an example of analysis under the same conditions of the capillary FID regarding the expected effect on the analysis results when the carrier gas is changed from helium to nitrogen.
* The column flow rate is adjusted according to the linear velocity of each carrier gas type.



<u>Conditions</u>

System :	GC4000 Plus type-A
Column :	InertCap Pure-WAX
	0.53 mmI.D. × 60 m df = 1.0 µm
Col.Temp. :	45 ℃
Carrier Gas :	He or N_2 3 - 8 mL/min
Detection :	FID Auto Range , 200℃
Injection :	Split 15:1 , 200 ℃
Sample Size :	1 µL

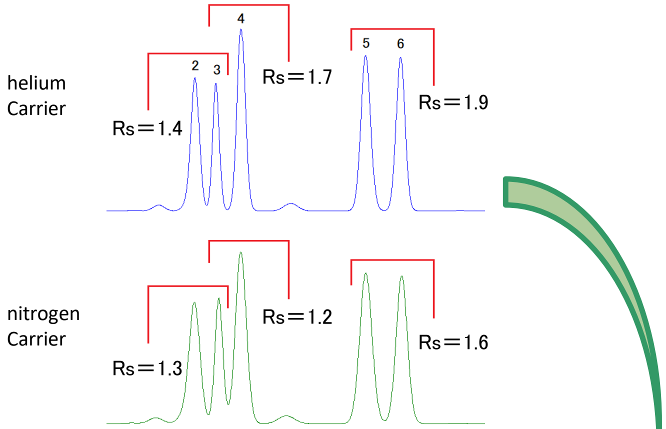
<u>Samples:</u>

1. n-Hexane
2. Ethyl acetate
3. Methanol
4. 2-Butanone (MEK)
5. 2-Propanol (IPA)
6. Ethanol

(each 0.2 % in Toluene)

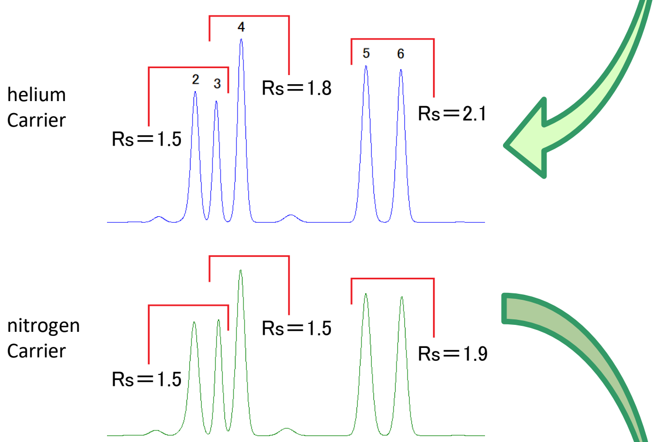
Precautions When Changing Carrier Gas-Peak Separation Comparison-

In the solvent analysis example on the previous page, even if the carrier gas was changed to nitrogen, there was no significant difference in the separation pattern and detection sensitivity, but the optimum linear velocity range was different for each carrier gas, so the linear velocity was changed. By doing so, a difference was seen in the peak separation.



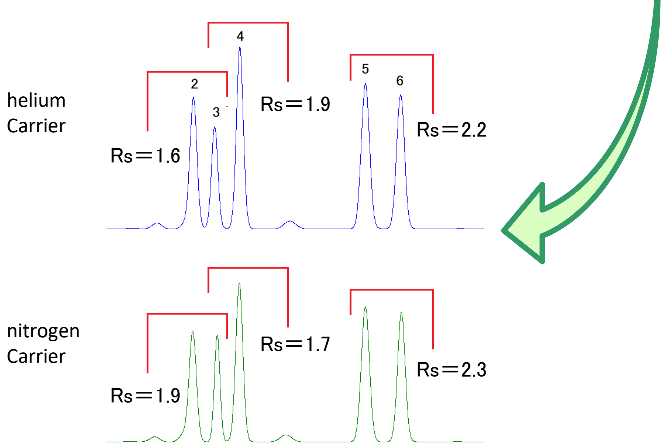
Line speed 40 cm / s

When the carrier gas is changed from helium to nitrogen, it can be seen that the peak resolution after changing the carrier gas visually decreases at linear velocities around 40 cm/s. When changing the carrier gas, compare the degree of peak separation under the analysis conditions in which the linear velocity is set to be gradually decreased as shown below.



Line speed 30 cm / s

Changing the linear velocity from 40 cm / s to 30 cm / s improves the peak separation for both helium and nitrogen, but the difference is smaller, so changing from helium 40 cm / s to nitrogen 30 cm / s , Can be considered as an analysis condition suitable for the purpose of using alternative carrier gas.

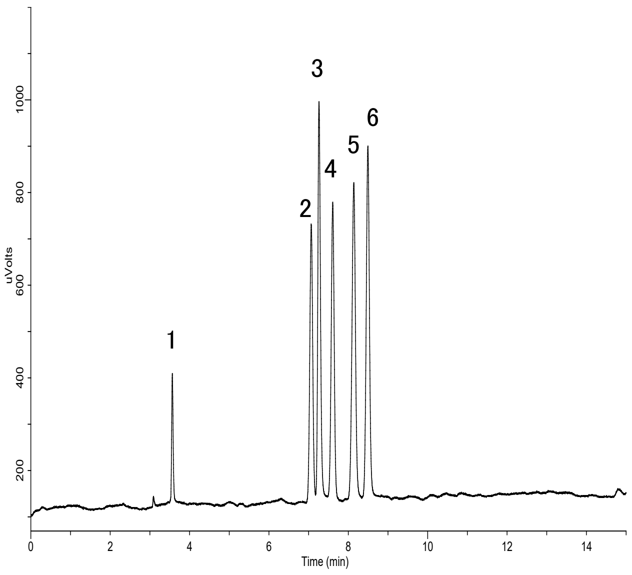


Line speed 20 cm / s

Further changes in the linear velocity from 30 cm / s to 20 cm / s approach the optimum linear velocity range of nitrogen, which is better than the peak separation when using helium. However, changing the linear velocity from 40 cm / s to 20 cm / s will almost double the peak retention time, so it is necessary to consider it as an analysis condition that balances with the analysis efficiency.

Precautions When Changing Carrier Gas (1) ~ TCD ~

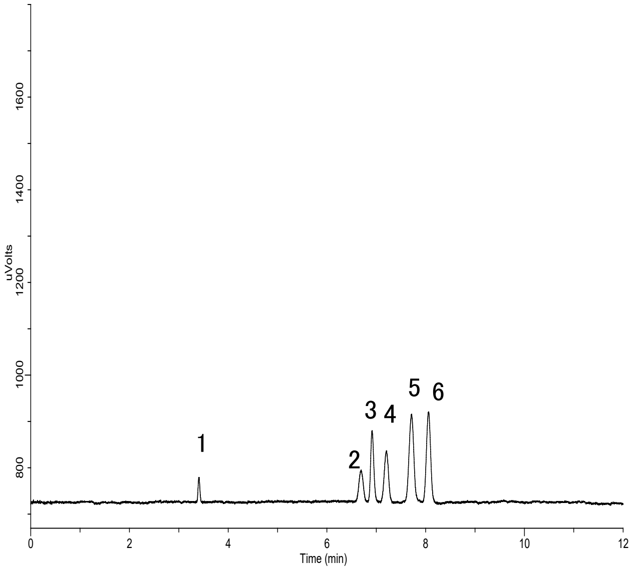
TCD detectors may experience desensitization when the carrier gas is changed from helium to nitrogen.
Below is an example of analysis under the same conditions.
* The TCD current value is adjusted according to the carrier gas type.



Conditions
System: GC4000 Plus type-A (DSTF)
Column: InertCap WAX
0.32 mmI.D. × 60 m df = 1.0 µm
Col.Temp.: 65 ℃
Carrier Gas: He 3 mL/min
Detector: TCD 100 mA (Temp.: 120℃)
Det.Gain: Low
Injection: split 1 : 10 (Temp.: 200 ℃)
Sample Size: 1 µL

	Samples	Area
1	n-Hexane	738
2	Ethyl acetate	3091
3	Methanol	4096
4	Methyl Ethyl Ketone	3475
5	2-Propanol	4230
6	Ethanol	4299

Difference in area value due to carrier gas change

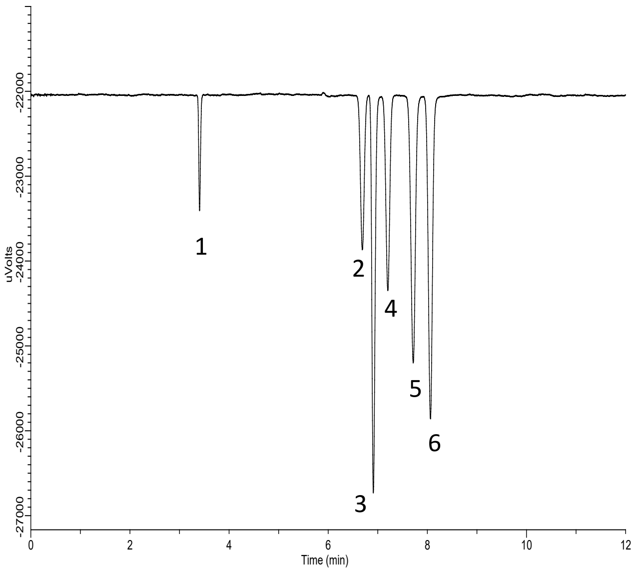


Conditions
Carrier Gas: N_2 3 mL/min
Detector: TCD 60 mA (Temp.: 120℃)
* Other conditions are the same as for He carrier analysis.

	Samples	Area
1	n-Hexane	151
2	Ethyl acetate	393
3	Methanol	698
4	Methyl Ethyl Ketone	678
5	2-Propanol	1218
6	Ethanol	1168

Precautions When Changing Carrier Gas (2) ~ TCD ~

TCD detectors have compounds whose peaks are inverted when the carrier gas is changed from helium to nitrogen. In this case, it is possible to detect the inverted peak in the positive direction by changing the polarity.

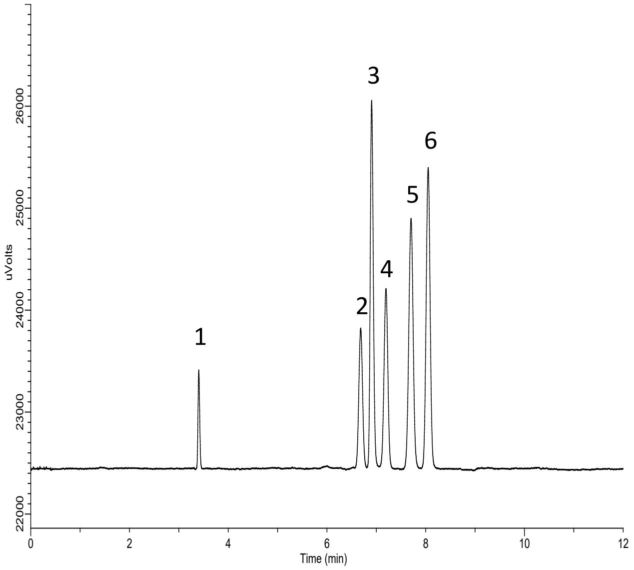


Samples:
1. n-Hexane
2. Ethyl acetate
3. Methanol
4. Methyl Ethyl Ketone
5. 2-Propanol
6. Ethanol

Conditions

System :	GC4000 Plus type-A（DSTF）
Column :	InertCap WAX
	0.32 mmI.D. × 60 m df=1.0 µm
Col.Temp. :	65 ℃
Carrier Gas :	**N_2 3 mL/min**
Detector :	TCD 60 mA（Temp. : 120℃）
Det.Gain :	Low
Polarity :	**+**
Injection :	split 1 : 10（Temp. : 200 ℃）
Sample Size :	1 µL

Detects a peak in the positive direction by changing the polarity

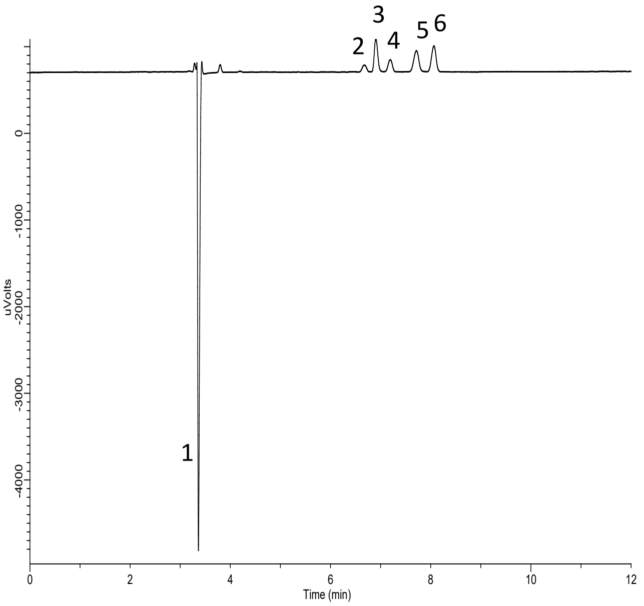


Conditions

System :	GC4000 Plus type-A（DSTF）
Column :	InertCap WAX
	0.32 mmI.D. × 60 m df=1.0 µm
Col.Temp. :	65 ℃
Carrier Gas :	**N_2 3 mL/min**
Detector :	TCD 60 mA（Temp. : 120℃）
Det.Gain :	Low
Polarity :	**-**
Injection :	split 1 : 10（Temp. : 200 ℃）
Sample Size :	1 µL

Precautions When Changing Carrier Gas (3) ~ TCD ~

If some peaks are inverted, it is possible to change the polarity during the analysis.

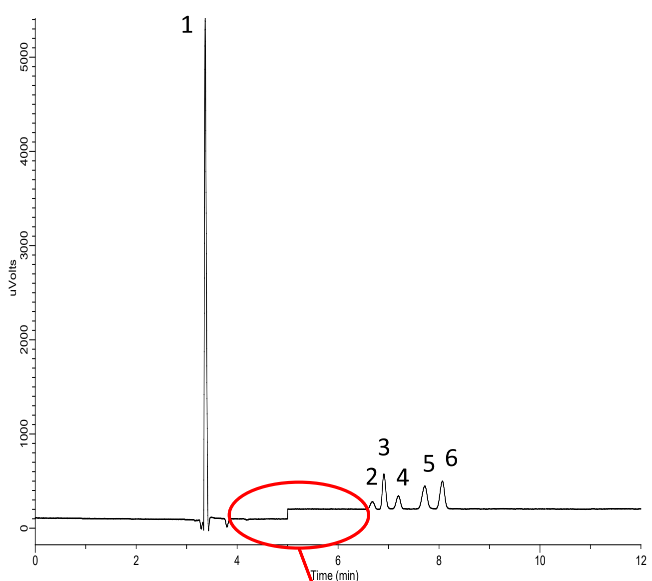


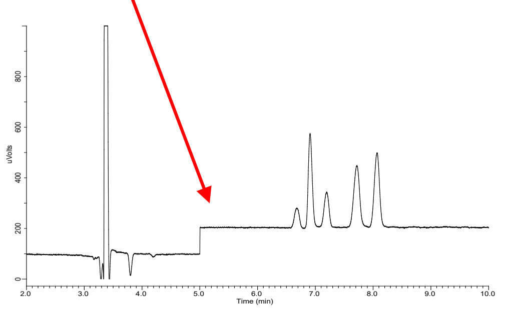
Samples:
1. n-Hexane
2. Ethyl acetate
3. Methanol
4. Methyl Ethyl Ketone
5. 2-Propanol
6. Ethanol

Conditions

System :	GC4000 Plus type-A（DSTF）
Column :	InertCap WAX
	0.32 mmI.D. × 60 m df=1.0 µm
Col.Temp. :	65 ℃
Carrier Gas :	**N_2 3 mL/min**
Detector :	TCD 60 mA（Temp. : 120℃）
Det.Gain :	Low
Polarity :	**+**
Injection :	split 1 : 10（Temp. : 200 ℃）
Sample Size :	1 µL

Polarity at the start of analysis is positive (+)
Change polarity to minus (-) after 5 minutes





The baseline may be disturbed when the polarity changes, but if it does not overlap with the peak, there is no problem with the analysis.

Introducing Gas Purification Filters for GC and GC / MS

It is possible to obtain purified gas equivalent to 99.9999% purity by using a super clean gas filter. This cartridge type super gas screen filter has a special structure built into a dedicated base plate that stops gas, so outside air does not get mixed in when replacing the filter. Since it can be removed without tools, it can be easily replaced. It also comes with an indicator that lets you know when to replace the filter at a glance.

•Super Clean Gas Filters

Base plate

No tools required

Products

Product	Product Description	Cat.No.
Moisture Filter, with Indicating	It is a filter that removes water that requires special attention due to impurities in the carrier gas. We recommend installing a moisture filter on all carrier gas lines.	3001-18350
Oxygen Filter, with Indicating	A filter that removes oxygen in the carrier gas. Prevents damage to the column due to oxygen.	3001-18351
Hydrocarbon Filter	It is a filter for removing organic impurities. When using a moisture filter and a hydrocarbon filter together, you can also remove the water in the hydrocarbon filter by connecting a moisture chart wrap later.	3001-18352
Moisture/Hydrocarbon Filter	It is an integrated type of moisture filter and hydrocarbon filter. Ideal as a purification filter for FID combustion gas.	3001-18353
Super Clean Base GC Base Plate	1position 1/8in. Connection	3001-18300

Kit Product

Product	Substances that can be removed			Cat.No.
	Moisture	Oxygen	Hydrocarbon	
Oxygen/Moisture/Hydrocarbon Filter Kit 1pc	●	●	●	3001-18313
Oxygen/Moisture/Hydrocarbon Filter Kit 1pc (purged with He)	●	●	●	3001-18314
GC-FID Burner gas filter kit Moisture/Hydrocarbon Filter 2pcs	●		●	3001-18315
GC-FID3 filter kit Moisture/Hydrocarbon Filter 2pcs; Oxygen/Moisture/Hydrocarbon Filter 1pc	●	●	●	3001-18318
GC-FID4 filter kit Moisture Filter 1pc; Oxygen Filter 1pc; Hydrocarbon Filter 2pcs	●	●	●	3001-18319

GL Sciences Inc. Japan
22-1 Nishishinjuku 6-chome
Shinjuku-ku, Tokyo
163-1130, Japan

Phone: +81-3-5323-6620
Fax: +81-3-5323-6621
Email: world@gls.co.jp
Web: www.glsciences.com

GL Sciences Inc. USA
4733 Torrance Blvd. Suite 255
Torrance, CA 90503
USA

Phone: +1-310-265-4424
Fax: +1-310-265-4425
Email: info@glsciencesinc.com
Web: www.glsciencesinc.com

GL Sciences B.V.
Dillenburgstraat 7C
5652AM, Eindhoven
The Netherlands

Phone: +31-40-254-9531
Email: info@glsciences.eu
Web: www.glsciences.eu

GL Sciences (Shanghai) Limited
Tower B, Room 2003
Far East International Plaza
No.317 Xianxia Road, Changning District
Shanghai, China 200051

Phone: +86-21-62782272
Email: contact@glsciences.com.cn
Web: www.glsciences.com.cn

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