



FlexFire

for HPLC / UHPLC column

FlexFire C18

FlexFire AQ C18

FlexFire C30

FlexFire C8

FlexFire C1

FlexFire HILIC

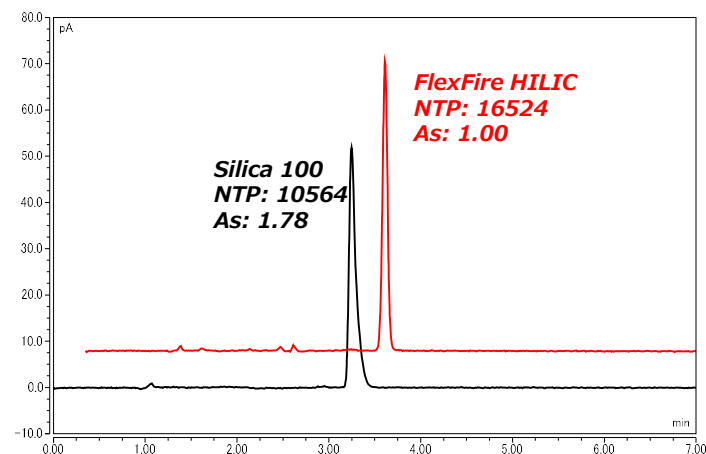
What's FlexFire ?

The FlexFire series is a new product released by Nomura Chemical in 2019.

FlexFire's Flex expresses Flexible, and Fire expresses the strength of fire. The logo was created with the motif of the phoenix as a symbol of the fire. The outer frame was linked to the column appearance and the simplest chemical structure.

And there is no normal size that has been used in this series. All of them are unified with a semi-micro column with an inner diameter of 2.0 mm, and method transfer is facilitated with particle sizes of 5 μm , 2.6 μm and 1.6 μm .

A major point of the FlexFire series is based on silica gel, which is different from the conventional one. This new silica gel succeeded in increasing mechanical strength and reducing impurities.



Analytical conditions;

Column: Develosil FlexFir HILIC, 3 μm (4.6x150mm)
 Develosil Silica 100-3, 3 μm (4.6x150mm)
 Mobile phase: Acetonitrile/Water=90/10
 Flow rate: 1.0mL/min
 Temperature: 40°C
 Detection: CAD
 Sample: Allantoin
 Injection volume: 1.0 μL

System: Thermo Fisher SCIENTIFIC UltiMate 3000

Fig.1 Comparison of materials

Allantoin was analyzed using a column packed with unmodified silica gel. In this analysis, the new silica gel gives good results without using a buffer. The new silica gel provides the best performance.

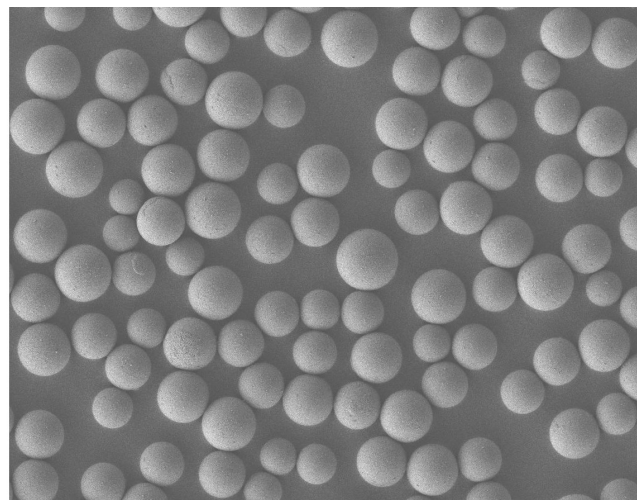


Fig.2 TEM image of silica gel for FlexFire

Flexibility

The Flexfire series also has a new chemistry update that summarizes the history. As of January 2020, six types of chemistry are available as reversed-phase columns and HILIC columns. We also have plans to release wide pores and special functional groups.

In this way, the FlexFire series provides a great deal of flexibility for analysis by making many functional groups and particle sizes a family. (The Lineup is shown in Table.1)

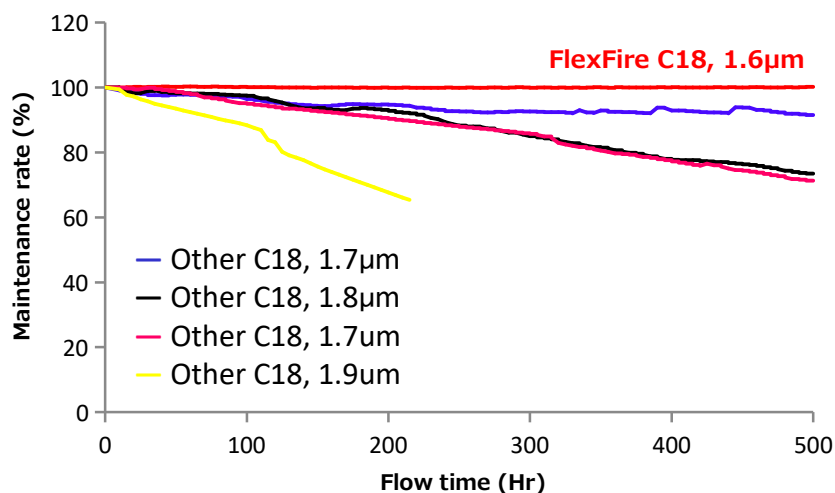
Durability

This greatly improved pressure and pH durability. The FlexFire series lineup from HPLC to UHPLC can be used to the limit of the system used, and the pH can be used in the range of pH 1-10 on average. Sometimes aqueous ammonia or triethylamine can also be added to the mobile phase. This made it possible to improve the peak shape and change the separation pattern.

(The durability is show in Fig.3)

Table.1 FlexFire series line up and properties

	FlexFire C18	FlexFire AQ C18	FlexFire C30	FlexFire C8	FlexFire C1	FlexFire HILIC
Particle size	1.6µm, 2.6µm, 5µm	1.6µm, 2.6µm, 5µm	1.6µm, 2.6µm, 5µm	1.6µm, 2.6µm, 5µm	1.6µm, 2.6µm, 5µm	1.6µm, 2.6µm, 5µm
Chemistry	Octadecyl	Octadecyl	Triacontyl	Octyl	Trimethyl	—
Surface area	340m ² /g	340m ² /g	340m ² /g	340m ² /g	340m ² /g	340m ² /g
Pore volume	1.0mL/g	1.0mL/g	1.0mL/g	1.0mL/g	1.0mL/g	1.0mL/g
Pore diameter	11nm	11nm	11nm	11nm	11nm	11nm
Carbon	22%	8.5%	11%	12%	5.5%	—
End-cap	あり	あり	あり	あり	あり	なし
pH	pH1-10	pH1-9	pH1-10	pH1-10	pH1-9	pH1-5
Temperature	~60°C	~60°C	~60°C	~60°C	~60°C	~60°C
Pressure range	1.6µm: 800bar (=80Mpa=11,603psi)					
	2.6µm: 600bar(=60Mpa=8,702psi)					
	5µm: 300bar (=30Mpa=4,351psi)					



Conditions;
 Column: Develsil FlexFire C18, 1.6µm
 Size: 2.0x50mm
 Mobile phase: Acetonitrile/10mM NH₄OH, pH10.5=60/40
 Flow rate: 0.5mL/min
 Temperature: 40°C
 Detection: UV254nm
 Sample: 1.Uracil (0.01mg/mL)
 2.Naphthalene (0.1mg/mL)
 Injection volume 0.16µL

We compared the durability of FlexFire C18 and competitor C18 columns under alkaline conditions. With FlexFire C18, the retention time did not change even after 500 hours. Columns that cannot withstand liquidity decrease with retention time.

Fig.3 Retention time maintenance rate with respect to liquid flow time

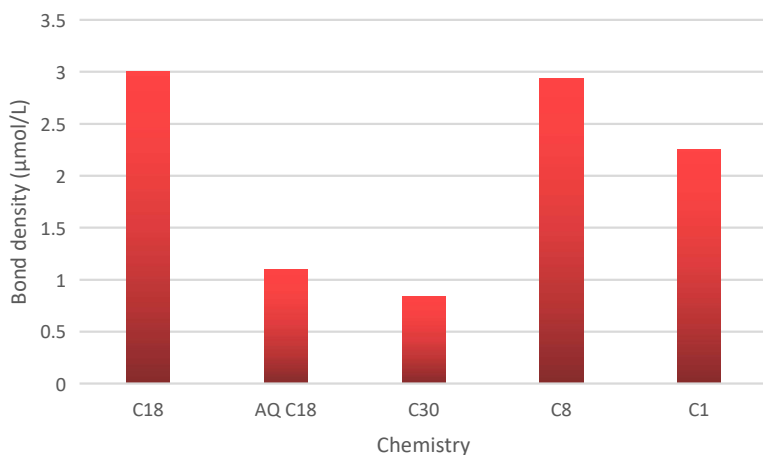


Fig.4 Bond density of each chemistry

Column selection from bond density

Fig.4 shows the bond density of the FlexFire series. From this graph, since AQ C18 and C30 have low bond density, analysis in a 100% aqueous mobile phase becomes possible.

C18 and C8 are highly versatile columns that engage in hydrophobic interaction, which is the basis of chromatography.

C1 has middle hydrophobicity and can be used in 100% aqueous mobile phase.

UHPLC Method Transfer

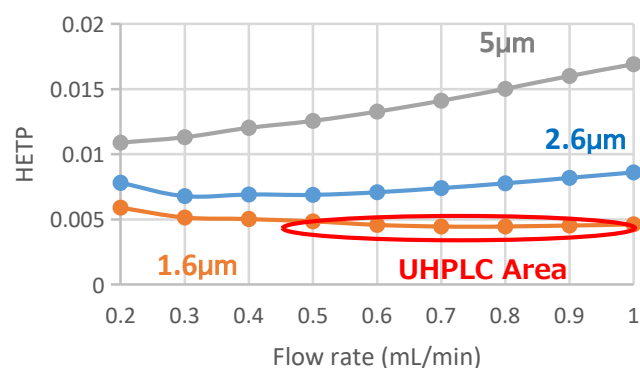
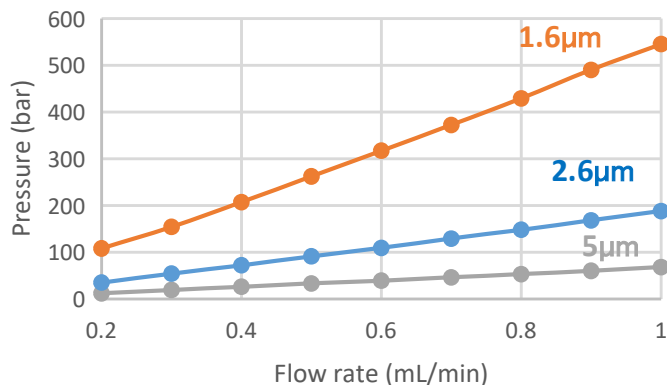
The FlexFire series is available in particle sizes of 1.6 μ m, 2.6 μ m and 5 μ m. The particle size can be selected according to the system. And method transfer from 5 μ m to 1.6 μ m can be performed easily.

For example, research and development require rapid results. In such a case, by selecting a particle size of 1.6 μ m, the purpose can be achieved with a time reduction of more than half the planned time.

After that, the method can be transferred to 5 μ m in the quality control department, and perfect inspection can be performed at low cost.

And why does FlexFire only have 2.0mm ID columns? The answer is very simple. Moreover, since it is possible to reduce the injection amount, a valuable sample can be used meaningfully.

Today, it is an era when consideration for the environment is questioned. The theme is to release products that consider not only analysis but also before and after.



Conditions;

Column: Develosil FlexFire C18 (2.0x50mm)
 Mobile phase: Acetonitrile/Water=60/40
 Flow rate: 0.2mL/min~1.0mL/min
 Temperature: 40°C
 Detection: UV254nm
 Sample: Naphthalene
 Injection volume: 0.16 μ L

Fig.5 Pressure and HETP vs Flow Rate for FlexFire C18

To the best of our knowledge, the transfer conditions can be easily determined using the software provided by the system manufacturer.

However, since the concept of the transfer method is different, it is necessary to decide a certain amount of rules.

And most importantly, the FlexFire series has the same physical properties of silica gel, so you won't betray it!

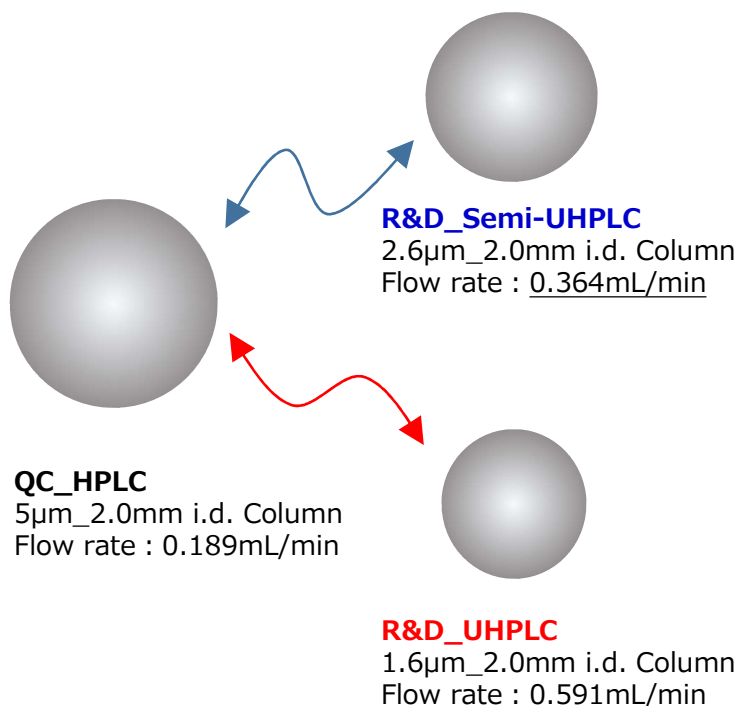
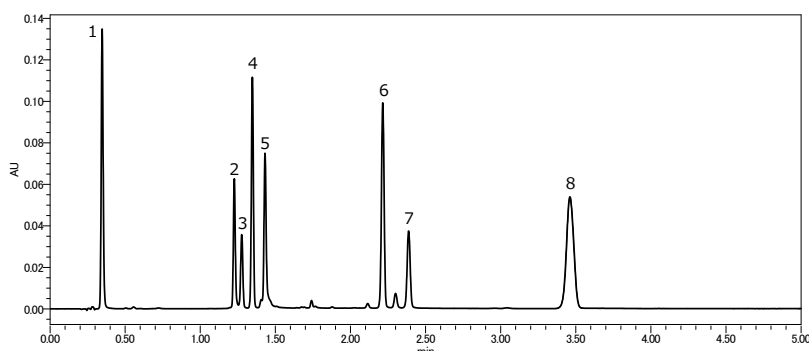


Fig.6 Image model of method transfer



FlexFire C18 has the ability to support various applications. In this analysis example, very simple analysis conditions are constructed only by adding formic acid. By selecting a particle size of 1.6 μ m, polyphenol analysis, which has required a lot of time, was completed in just 4 minutes.

Fig.7 Analysis of Polyphenols with FlexFire C18, 1.6 μ m

Conditions;

Column: Develosil FlexFire C18, 1.6 μ m

Size: 2.0x50mm

Mobile phase: A) Water + 0.1% HCOOH

B) Acetonitrile + 0.1% HCOOH

min	mL/min	%A	%B	Curve
0.00	0.5	80	20	6
1.28	0.5	45	55	6
3.60	0.5	45	55	6
3.61	0.5	80	20	6

Temperature: 40°C

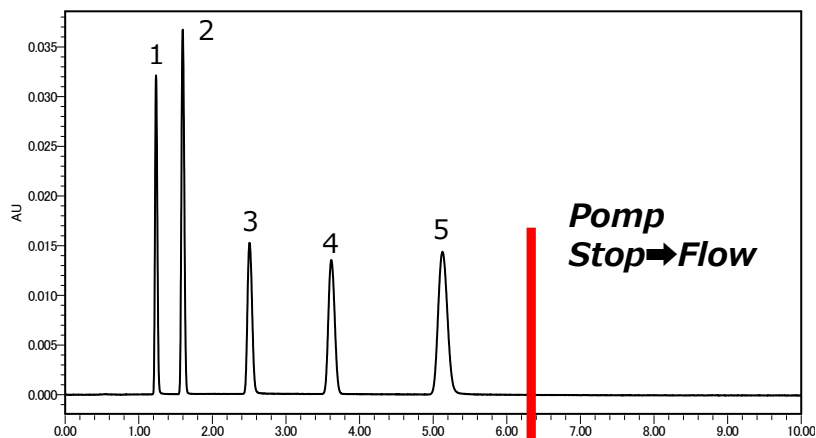
Detection: UV260nm

Sample: 1.Puerarin 2.Baicalin 3.Resveratrol

4.Daidsein 5.Quercetin 6.Biochanin A

7.Curcmin 8.Ipriflavone

Injection volume: 0.2 μ L



Conditions:

Column: Develosil FlexFire AQ C18, 2.6 μ m

Size: 2.0x100mm, Stainless

Mobile Phase: 10mM HCOONH₄

Flow rate: 0.3mL/min

Temperature: 40°C

Detection: UV260nm

Sample: 1.Cytosine (53 μ g/mL)

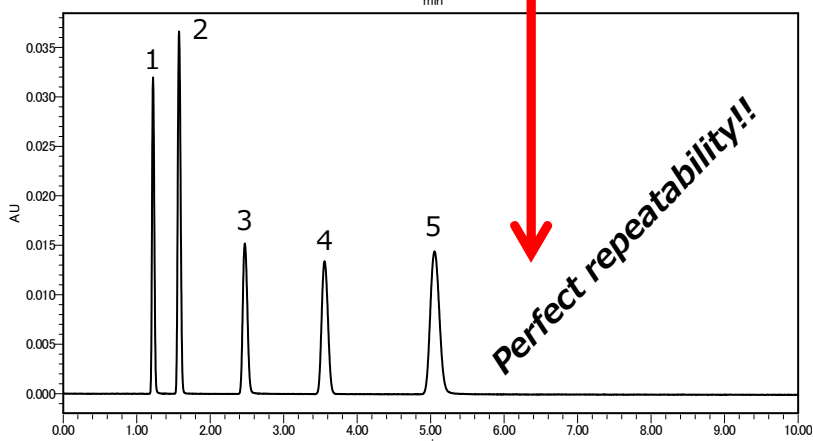
2.Uracil (50 μ g/mL)

3.Guanine (52 μ g/mL)

4.Thymine (50 μ g/mL)

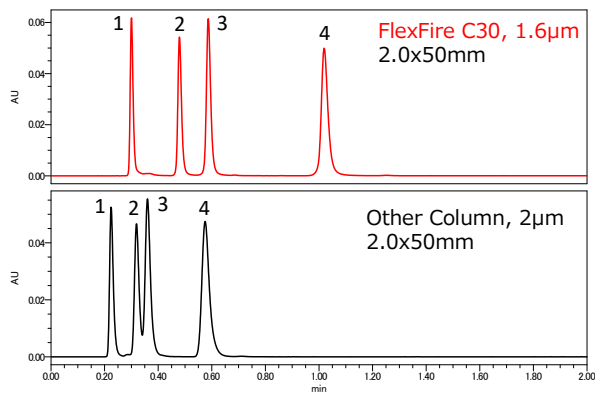
5.Adenine (50 μ g/mL)

Injection volume: 0.2 μ L



Reproducibility is paramount when using 100% aqueous mobile phase. When the pump is stopped, the mobile phase in the pores will escape. And once again, the compound will not be retained. However, FlexFire AQ C18 can achieve reproducibility by repeating this operation. This is because FlexFire AQ C18 controls the bond density so that this phenomenon does not occur.

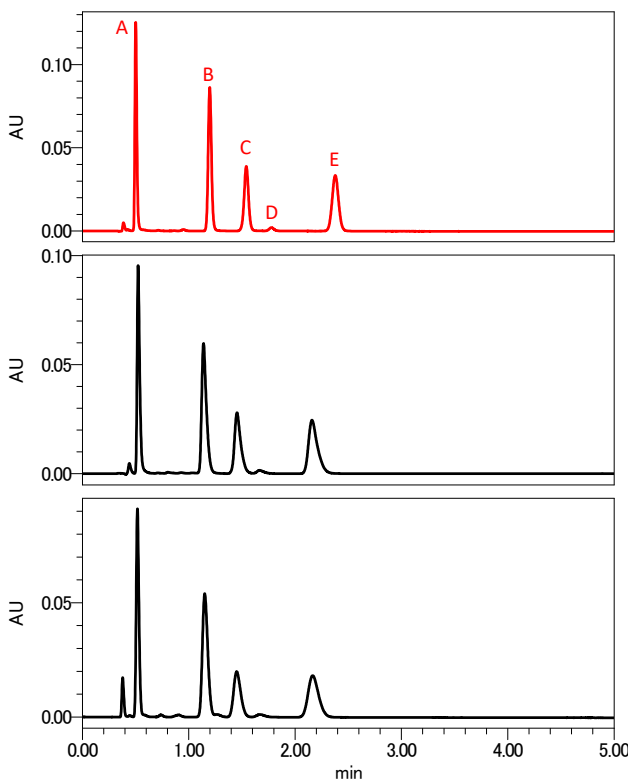
Fig.8 Stop-flow test under 100% aqueous mobile phase conditions



Conditions;
 Column: Develosil FlexFire C30, 1.6µm (2.0x50mm)
 Other column, 2µm (2.0x50mm)
 ※Columns for analysis of highly polar compounds
 Mobile phase: 25mM Ammonium phosphate, pH7.0
 Flow rate: 0.5mL/min
 Temperature: 40°C
 Detection: UV260nm
 Sample: 1.dCTP 2.dTTP 3.dGTP 4.dATP
 Injection volume: 0.2µL

FlexFire C30 can be used with 100% aqueous mobile phase, just like FlexFire AQ C18. FlexFire C30 has an unparalleled separation potential. C18 is a very effective column selection when the goal cannot be achieved. In Fig. 9, it is compared with other company's C30 column. Even with the same C30, FlexFire c30 is very good at retaining and separating highly polar compounds.

Fig.9 Analysis of dNTP with 100% aqueous mobile phase



Conditions;
 Column: Develosil FlexFire C8, 2.6µm (2.0x50mm)
 Develosil C8-UG, 3µm (2.0x50mm)
 Other C8, 3µm (2.0x50mm)
 Mobile phase: Acetonitrile/0.1%H3PO4=45/55
 Flow rate: 0.3mL/min
 Temperature: 40°C
 Detection: UV254nm
 Injection volume: 0.2µL

Fig.10 Comparison of C8 columns (with pesticides)

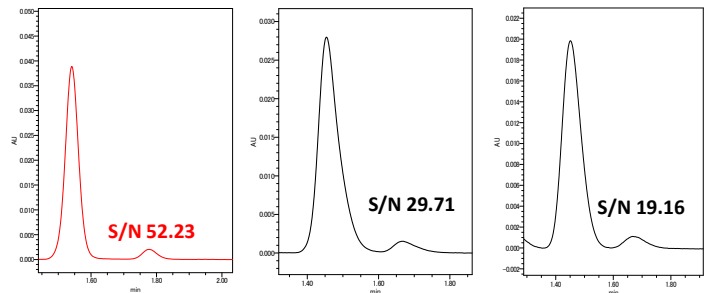


Fig.11 S/N comparison of pesticide D

FlexFire C8 has an ideal update compared to the previous C8. As Fig.11 shows, FlexFire C8 produces a sharp peak in pesticide analysis. As a result, Fig. 11 shows that S / N is also advantageous.

C8 is often used to save time instead of C18. However, FlexFire C8 is as versatile as C18 and can be a tool as a main column. In particular, FlexFire C8 will be very effective as a transfer from C18 column in LC / MS.

The time savings will have a significant effect on C1 in the next section.

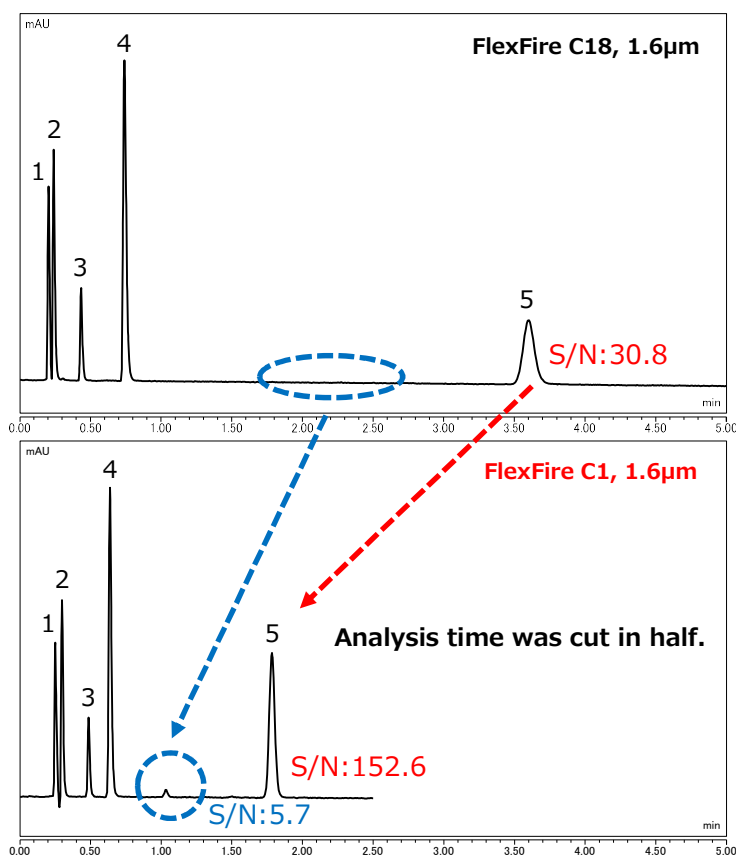
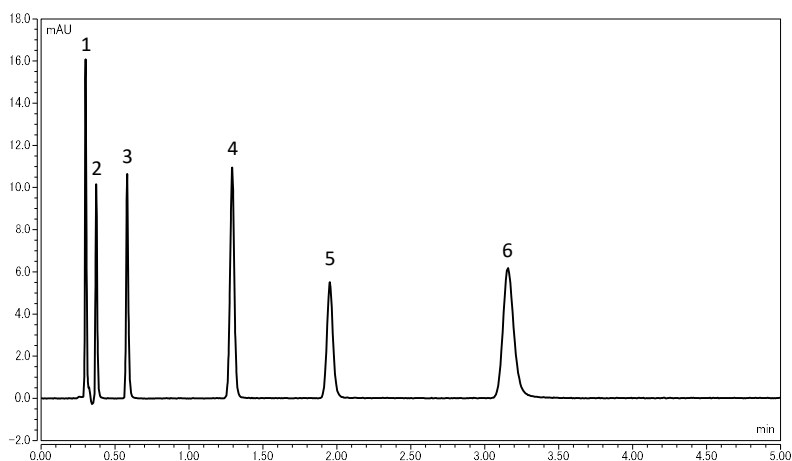


Fig.12 S/N comparison (C18vs C1)

The "C1" column will not be well recognized. We have done a lot of research on the C1 column. As a result, the idea that "the C1 column has a short retention" was changed to the recognition that "the adsorptivity was low". Naturally, the retention capacity is small, but there are compounds that can be seen. For example, as shown in Fig. 11, S / N is higher than that of C18 column. In addition, peaks that were not visible at C18 can be clearly seen at C1. This is very effective for the analysis of impurities and metabolites using LC / MS.

Sample: 1.Uracil 2.Caffeine 3.Phenol
4.Amitriptyline 5.Naphthalene

Analysis conditions are described in the CoA report.



Analytical conditions:

Column: Develosil FlexFire HILIC, 1.6µm (2.0x50mm)
 Mobile phase: Acetonitrile/10mM HCOONH₄, pH3.0=90/10
 Flow rate: 0.5mL/min
 Temperature: 40°C (ForcedAir)
 Detection: UV254nm
 Acquisition rate: 20Hz
 Sample:
 1.Acetoaminophen (0.9µg/mL)
 2.Uracil (8.0µg/mL)
 3.Bromhexine (48µg/mL)
 4.Paroxetine (0.5mg/mL)
 5.Phenylephrine (1.1mg/mL)
 6.Metformin (0.24mg/mL)

Injection volume: 0.08µL

FlexFire HILIC has no linking group. That is, the silica gel carrier is directly involved in the separation. Mainly suitable for analyzing basic compounds under acidic conditions. Useful when reverse phase columns cannot be analyzed well or when you want to retain highly polar compounds. Moreover, FlexFire HILIC can be used as a normal phase column. This makes it possible to analyze compounds and oils with high fat solubility using UHPLC.

Fig.13 Analysis of basic compounds using FlexFire HILIC



Category	Product Name	Code
UHPLC	FlexFire C18 2.0x35mm, 1.6µm	301-I20035W
UHPLC	FlexFire C18 2.0x50mm, 1.6µm	301-I20050W
UHPLC	FlexFire C18 2.0x75mm, 1.6µm	301-I20075W
UHPLC	FlexFire C18 2.0x100mm, 1.6µm	301-I20100W
UHPLC	FlexFire C18 2.0x150mm, 1.6µm	301-I20150W
HPLC	FlexFire C18 2.0x35mm, 2.6µm	301-L20035W
HPLC	FlexFire C18 2.0x50mm, 2.6µm	301-L20050W
HPLC	FlexFire C18 2.0x75mm, 2.6µm	301-L20075W
HPLC	FlexFire C18 2.0x100mm, 2.6µm	301-L20100W
HPLC	FlexFire C18 2.0x150mm, 2.6µm	301-L20150W
HPLC	FlexFire C18 2.0x250mm, 2.6µm	301-L20250W
HPLC	FlexFire C18 2.0x35mm, 5µm	301-520035W
HPLC	FlexFire C18 2.0x50mm, 5µm	301-520050W
HPLC	FlexFire C18 2.0x75mm, 5µm	301-520075W
HPLC	FlexFire C18 2.0x100mm, 5µm	301-520100W
HPLC	FlexFire C18 2.0x150mm, 5µm	301-520150W
HPLC	FlexFire C18 2.0x250mm, 5µm	301-520250W
UHPLC	FlexFire AQ C18 2.0x35mm, 1.6µm	306-I20035W
UHPLC	FlexFire AQ C18 2.0x50mm, 1.6µm	306-I20050W
UHPLC	FlexFire AQ C18 2.0x75mm, 1.6µm	306-I20075W
UHPLC	FlexFire AQ C18 2.0x100mm, 1.6µm	306-I20100W
UHPLC	FlexFire AQ C18 2.0x150mm, 1.6µm	306-I20150W
HPLC	FlexFire AQ C18 2.0x35mm, 2.6µm	306-L20035W
HPLC	FlexFire AQ C18 2.0x50mm, 2.6µm	306-L20050W
HPLC	FlexFire AQ C18 2.0x75mm, 2.6µm	306-L20075W
HPLC	FlexFire AQ C18 2.0x100mm, 2.6µm	306-L20100W
HPLC	FlexFire AQ C18 2.0x150mm, 2.6µm	306-L20150W
HPLC	FlexFire AQ C18 2.0x250mm, 2.6µm	306-L20250W
HPLC	FlexFire AQ C18 2.0x35mm, 5µm	306-520035W
HPLC	FlexFire AQ C18 2.0x50mm, 5µm	306-520050W
HPLC	FlexFire AQ C18 2.0x75mm, 5µm	306-520075W
HPLC	FlexFire AQ C18 2.0x100mm, 5µm	306-520100W
HPLC	FlexFire AQ C18 2.0x150mm, 5µm	306-520150W
HPLC	FlexFire AQ C18 2.0x250mm, 5µm	306-520250W
UHPLC	FlexFire C30 2.0x35mm, 1.6µm	302-I20035W
UHPLC	FlexFire C30 2.0x50mm, 1.6µm	302-I20050W
UHPLC	FlexFire C30 2.0x75mm, 1.6µm	302-I20075W
UHPLC	FlexFire C30 2.0x100mm, 1.6µm	302-I20100W
UHPLC	FlexFire C30 2.0x150mm, 1.6µm	302-I20150W
HPLC	FlexFire C30 2.0x35mm, 2.6µm	302-L20035W
HPLC	FlexFire C30 2.0x50mm, 2.6µm	302-L20050W
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HPLC	FlexFire C30 2.0x100mm, 5µm	302-520100W
HPLC	FlexFire C30 2.0x150mm, 5µm	302-520150W
HPLC	FlexFire C30 2.0x250mm, 5µm	302-520250W

Category	Product Name	Code
UHPLC	FlexFire C8 2.0x35mm, 1.6µm	303-I20035W
UHPLC	FlexFire C8 2.0x50mm, 1.6µm	303-I20050W
UHPLC	FlexFire C8 2.0x75mm, 1.6µm	303-I20075W
UHPLC	FlexFire C8 2.0x100mm, 1.6µm	303-I20100W
UHPLC	FlexFire C8 2.0x150mm, 1.6µm	303-I20150W
HPLC	FlexFire C8 2.0x35mm, 2.6µm	303-L20035W
HPLC	FlexFire C8 2.0x50mm, 2.6µm	303-L20050W
HPLC	FlexFire C8 2.0x75mm, 2.6µm	303-L20075W
HPLC	FlexFire C8 2.0x100mm, 2.6µm	303-L20100W
HPLC	FlexFire C8 2.0x150mm, 2.6µm	303-L20150W
HPLC	FlexFire C8 2.0x250mm, 2.6µm	303-L20250W
HPLC	FlexFire C8 2.0x35mm, 5µm	303-520035W
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HPLC	FlexFire C8 2.0x250mm, 5µm	303-520250W
UHPLC	FlexFire C1 2.0x35mm, 1.6µm	304-I20035W
UHPLC	FlexFire C1 2.0x50mm, 1.6µm	304-I20050W
UHPLC	FlexFire C1 2.0x75mm, 1.6µm	304-I20075W
UHPLC	FlexFire C1 2.0x100mm, 1.6µm	304-I20100W
UHPLC	FlexFire C1 2.0x150mm, 1.6µm	304-I20150W
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HPLC	FlexFire C1 2.0x50mm, 2.6µm	304-L20050W
HPLC	FlexFire C1 2.0x75mm, 2.6µm	304-L20075W
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HPLC	FlexFire C1 2.0x100mm, 5µm	304-520100W
HPLC	FlexFire C1 2.0x150mm, 5µm	304-520150W
HPLC	FlexFire C1 2.0x250mm, 5µm	304-520250W
UHPLC	FlexFire HILIC 2.0x35mm, 1.6µm	305-I20035W
UHPLC	FlexFire HILIC 2.0x50mm, 1.6µm	305-I20050W
UHPLC	FlexFire HILIC 2.0x75mm, 1.6µm	305-I20075W
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HPLC	FlexFire HILIC 2.0x75mm, 5µm	305-520075W
HPLC	FlexFire HILIC 2.0x100mm, 5µm	305-520100W
HPLC	FlexFire HILIC 2.0x150mm, 5µm	305-520150W
HPLC	FlexFire HILIC 2.0x250mm, 5µm	305-520250W



Nomura Chemical Co., Ltd.
 15, Hinode-cho, Seto, 489-0004, Japan
 Tel: +81-561-48-1853 Fax: +81-561-48-1434
 e-mail: info@develosil.net