ChromaNik Technologies Inc.

C18, C18-HT, RP-AQUA, C8, PhE, Biphenyl

HPLC column

Sunniest

ChromaNik Technologies Inc.

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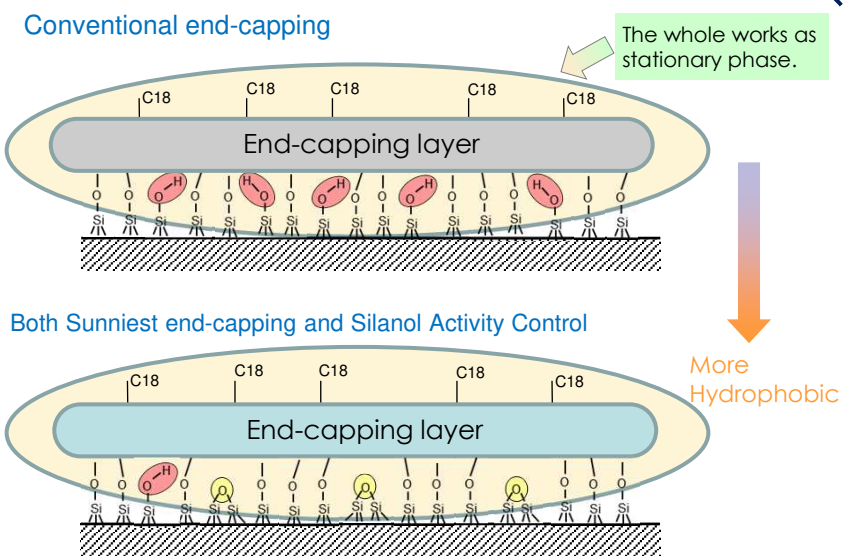
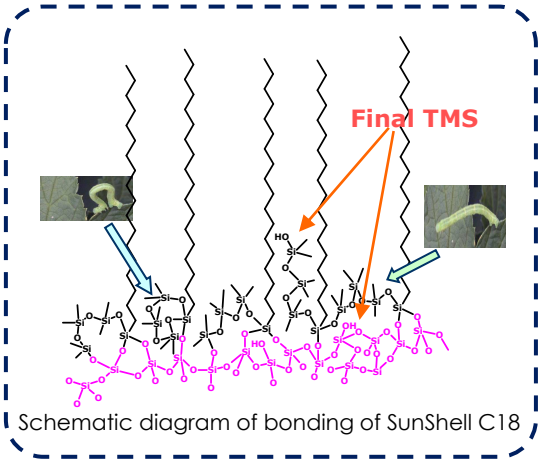
Sunniest C18, C18-HT, RP-AQUA, C8, PhE, Biphenyl, PFP, PFP&C18, Cyano, Silica

Unique end-capping by new concept

This figure shows comparison of hydrophobicity between two C18 stationary phases. We developed silanol activity control technique which was a reaction at extremely high temperature. This technique makes residual silanol groups change to siloxane bond. The upper one is a C18 phase with conventional end-capping and the lower one is a C18 phase with both Sunniest end-capping and silanol activity control. A residual silanol group contributes as a polar site and makes hydrophobicity of stationary phase decrease. On the other hand siloxane bond in the lower one doesn't make hydrophobicity decrease. Consequently the lower one is more hydrophobic than the upper one.



State of stationary phase with unique end-capping and comparison of hydrophobicity



Schematic diagram of bonding of SunShell C18

An end-capping of hexamethyltrisiloxane works as an arm. This arm moves like a Geometrid caterpillar, so that a functional group on the tip of the arm can bond with a silanol group which is located anywhere. Finally TMS reagent is bonded to a remaining silanol group.

Features

★ Little residual silanol groups by an unique bonding technique

★ Excellent stability, especially under acidic pH conditions

★ Sharp peak shape for acidic, basic and chelating compounds

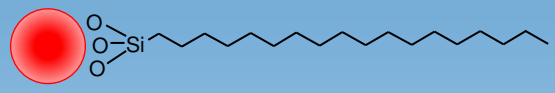
★ RP-AQUA with C30 bonding and Biphenyl offer Performance in 100% aqueous conditions, and shows enhanced retention of polar compounds.

SUNNIEST

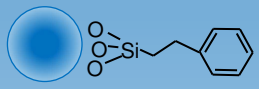
STATIONARY PHASE

Reversed phase

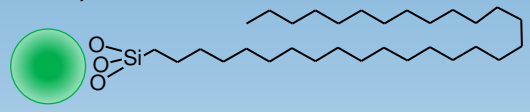
C18, C18-HT



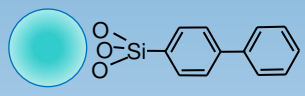
PhE



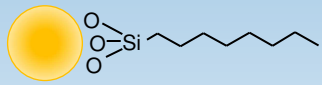
RP-AQUA, C30



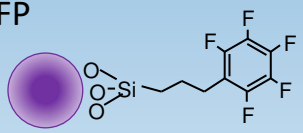
Biphenyl



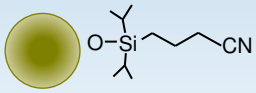
C8,



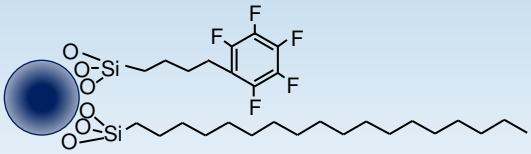
PFP



Cyano

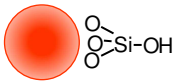


PFP&C18



Normal phase & HILIC

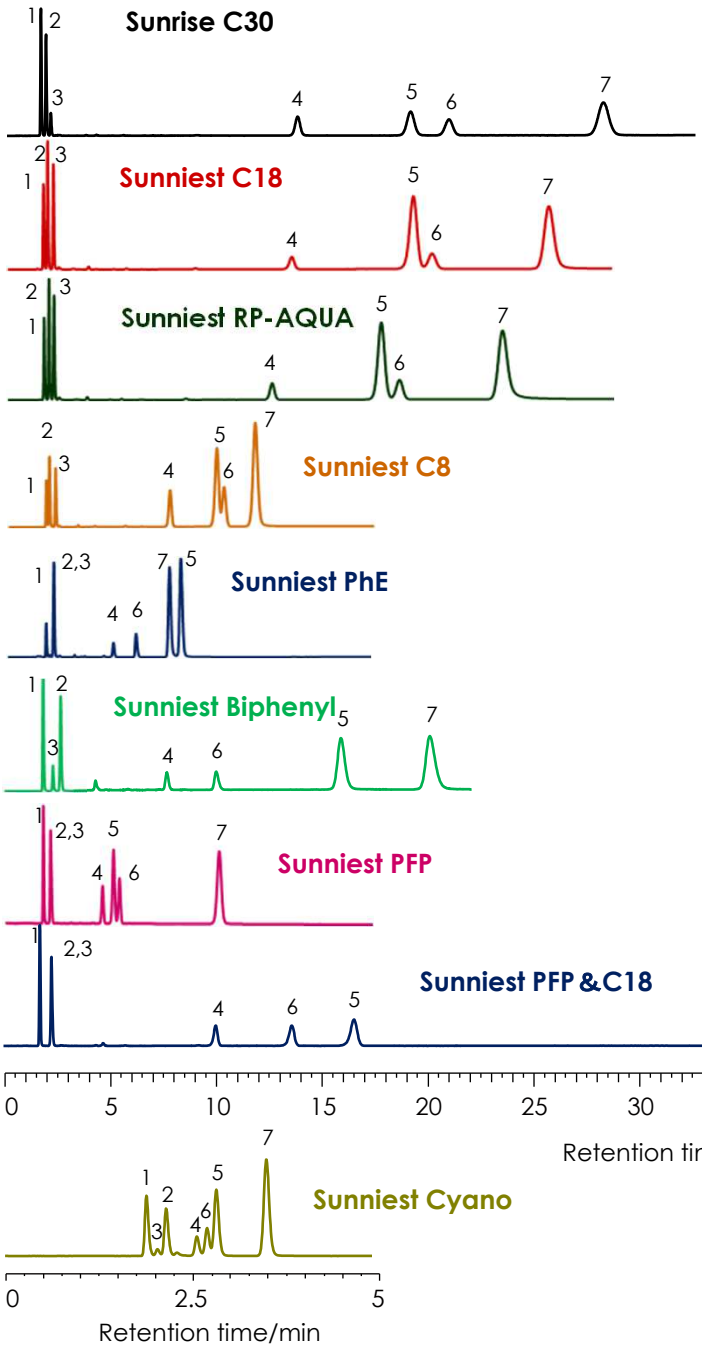
Silica



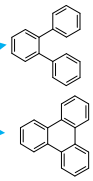
Characteristics of Sunniest

	Particle size (μm)	Pore diameter (nm)	Specific surface area (m^2/g)	Carbon content (%)	Bonded phase	End-capping	pH range	USP L line
Sunniest C18	1.8, 3 and 5	12	340	16	C18	Sunniest end-capping	1.5 - 10	L1
Sunniest C18-HT	2	10	340	16	C18	Sunniest end-capping	1.5 - 10	L1
Sunniest RP-AQUA	3 and 5	12	340	16	C30	Sunniest end-capping	2 - 8	L62
Sunniest C8	3 and 5	12	340	10	C8	Sunniest end-capping	1.5 - 9	L7
Sunniest PhE	3 and 5	12	340	10	Phenylethyl	Sunniest end-capping	1.5 - 8	L11
Sunniest Biphenyl	5	12	340	11	Biphenyl	Sunniest end-capping	1.5 -9	L11
Sunniest PFP	5	12	340	10	Pentafluorophenyl	TMS end-capping	2 - 8	L43
Sunniest PFP&C18	5	12	340	14	PFP + C18	TMS end-capping	2 - 8	L43
Sunniest Cyano	5	12	340	5.5	Diisopropylcyanopropyl	No	2 - 8	L10
Sunniest Silica	3 and 5	12	340	0	Bare silica	No	1 - 5	L3

◆ Separation of standard samples



Column: Sunrise C30,
Sunniest C18, RP-AQUA, C8, PhE,
Biphenyl, PFP, PFP&C18, Cyano
5 μm, 150 x 4.6 mm
Mobile phase: CH_3OH/H_2O=75/25
Flow rate: 1.0 mL/min
Temperature: 40 °C
Sample: 1 = Uracil,
2 = Caffeine,
3 = Phenol,
4 = Butylbenzene,
5 = o-Terphenyl,
6 = Amylbenzene,
7 = Triphenylene.

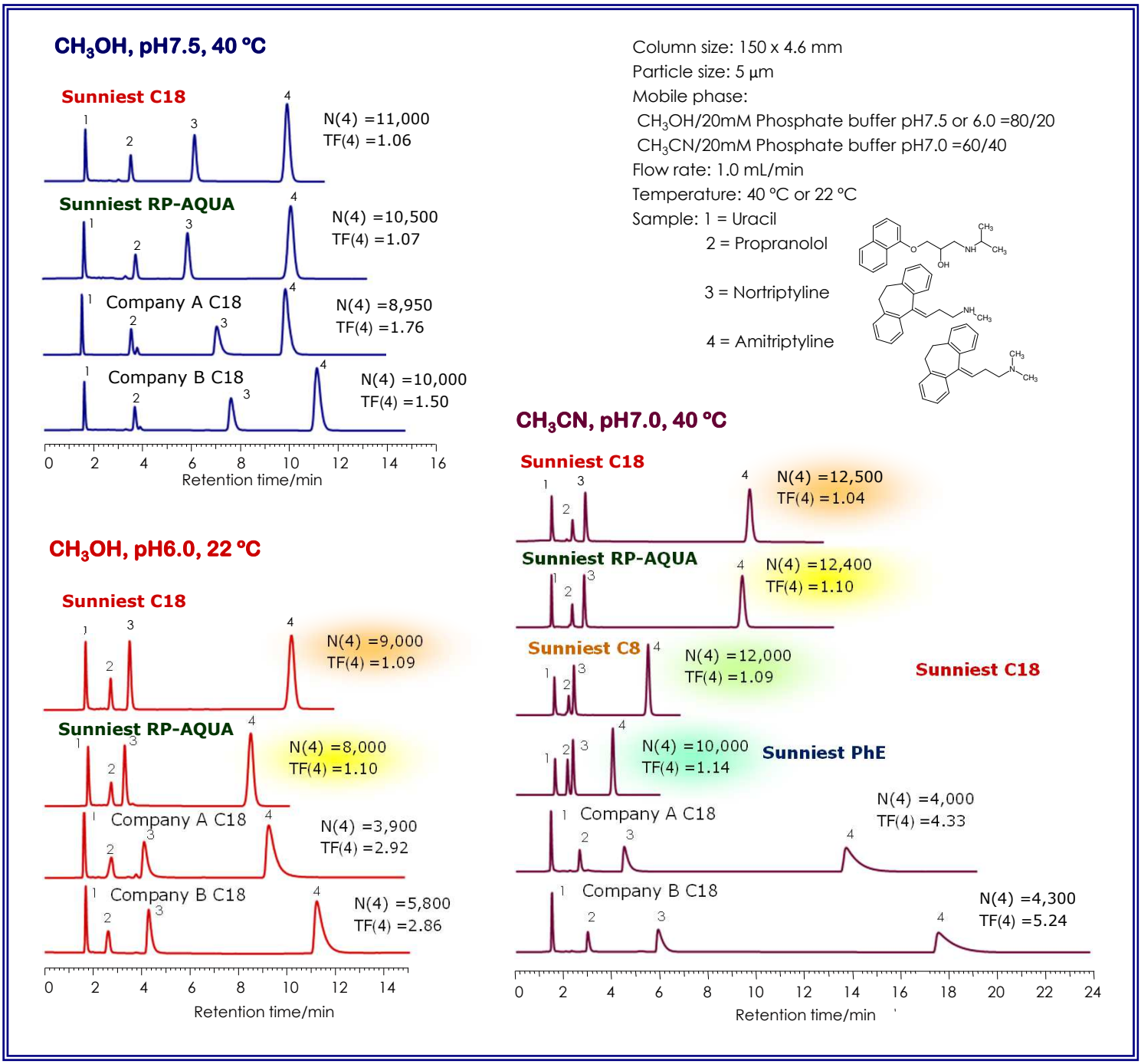


	Hydrogen bond (Caffeine/ Phenol)	Hydrophobicity (Amylbenzene/ Butylbenzene)	Steric selectivity (Triphenylene/ o-Terphenyl)
C30	0.51	1.59	1.52
C18	0.43	1.56	1.37
RP-QUA	0.49	1.56	1.37
C8	0.33	1.43	1.23
PhE	1.00	1.34	0.92
Biphenyl	1.77	1.41	1.30
PFP	1.00	1.29	2.51
PFP&C18	1.00	1.43	2.66
Cyano	1.76	1.21	1.70

Nine types of stationary phases were compared hydrogen-bonding α (Caffeine / Phenol), hydrophobic α (Amylbenzene / Butylbenzene), and steric selectivity α (Triphenylene / o-Terphenyl). The hydrogen bonding expressed by the separation factor of caffeine and phenol was lower in the alkyl group stationary phase with high temperature end-capping, but slightly higher in PhE (phenethyl group), PFP (pentafluorophenyl group), and PFP & C18. The elution times of caffeine and phenol were the same, and the separation factor was 1. Biphenyl was subjected to high-temperature end-capping and was almost unaffected by residual silanol groups, but the hydrogen-bonding value was 1.77, showing high hydrogen-bonding. This is a characteristic of Biphenyl, and it is thought that it has a large hydrogen bond property due to the bonding of two benzene rings. Cyano was not end-capped, and it is thought that the hydrogen bonding was increased due to the influence of the residual silanol groups. Hydrophobicity is higher in the stationary phase with higher carbon content. The phenyl-based stationary phase is lower than the alkyl-based stationary phase. PFP & C18 is a stationary phase with increased hydrophobicity of PFP, and both stationary phases have the same hydrogen bonding property and steric selectivity, but only the hydrophobicity is changed. The steric selectivity tends to increase as the alkyl group becomes longer, but PFP and PFP & C18 have extremely large values. And it is expected to show specific separation. The elution order is different between the alkyl group stationary phase and the phenyl group stationary phase, and there is a large difference in separation selectivity.

◆ Evaluation of End-capping

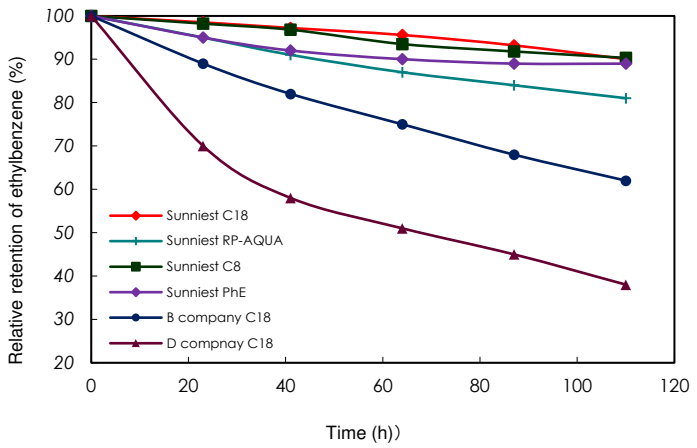
Comparison of plates number (N) and USP tailing factor (TF) of amitriptyline



Amitriptyline is widely used to evaluate residual silanol groups on the C18 stationary phase. Peak shape of Amitriptyline was compared under 3 kinds of conditions such as methanol/phosphate buffer/40 ºC, methanol/phosphate buffer/22 ºC and acetonitrile/phosphate buffer/40 ºC. Majority of the HPLC columns offered good peak shapes under methanol/phosphate buffer/40 ºC conditions. However using Mobile phase of acetonitrile/phosphate buffer/40 ºC, most of the columns (Refer column A and B) offered high extent of tailing unlike Sunniest columns offering a symmetrical peak.

Sunniest C18, RP-AQUA and C8 columns allow to use a wide range of mobile phase without peak tailing because of extremely low content of residual silanol groups on the stationary phase.

◆Stability under acidic and basic pH conditions

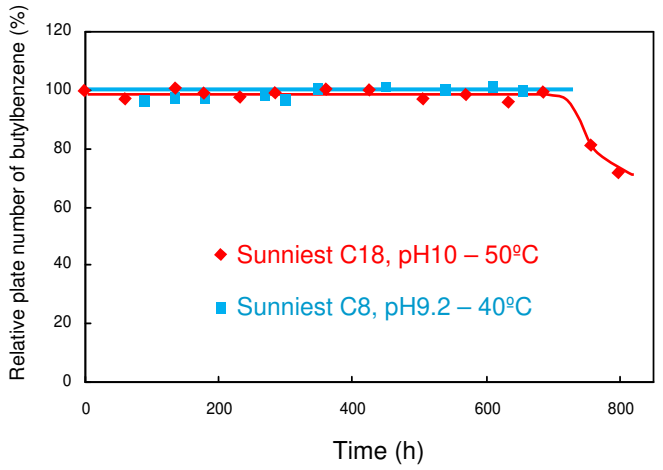


Durable test condition

Column size: 150 x 4.6 mm
Mobile phase: CH_3CN/1.0% TFA (pH1) = 10/90
Flow rate: 1.0 mL/min
Temperature: 80 °C

Measurement condition

Column size: 150 x 4.6 mm
Mobile phase: CH_3CN/H_2O=60/40
Flow rate: 1.0 mL/min
Temperature: 40 °C
Sample: 1 = Uracil
2 = Ethylbenzene



Durable test condition

Column: Sunniest C18, C8, 5 µm 150 x 4.6 mm
Mobile phase:
C18: CH_3OH/20mM Sodium borate/10mM NaOH=30/21/49 (pH10)
C8: CH_3OH/20mM Sodium borate (pH9.2) =30/70
Flow rate: 1.0 mL/min
Temperature: C18 - 50 °C, C8 - 40 °C

Measurement condition

Column: Sunniest C18, C8, 5µm 150 x 4.6 mm
Mobile phase: CH_3OH/H_2O=75/25
Flow rate: 1.0 mL/min
Temperature: 40 °C
Sample: 1 = Butylbenzene

Stability under acidic pH conditions was evaluated at 80 ºC using acetonitrile/1% trifluoroacetic acid solution (10:90) as mobile phase. 100% aqueous mobile phase expels from the pore of packing materials by capillarity and packing materials don't deteriorate. 10% acetonitrile in a mobile phase allows an accurate evaluation.[1-3)]

★Sunniest C18 has kept 90% retention for 100 hours under severe conditions of acetonitrile /1% trifluoroacetic acid solution (pH 1)at 80 deg C.

Our Unique bonding technique offers significant enhancement of column life,

Considering the Sunniest RP-AQUA C30 ligand length the Sunniest RP-AQUA is less stable than Sunniest C18. However, Sunniest RP-AQUA C30 column with high temparature bonding along with end capping offers longer column life in comparison to other RP Aqua columns.

Stability under basic pH conditions was evaluated at 50 ºC using methanol/Sodium borate buffer pH 10 (30:70) as a mobile phase. Sodium borate is used as a alkaline standard solution for pH meter, so that its buffer capacity is high.

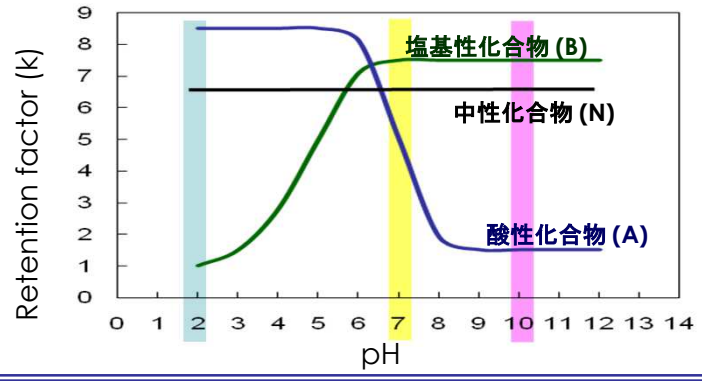
Elevated temperature of 10 ºC makes column life be one third. When Sunniest C18 column is used at 40 ºC, column life becomes 2,000 hours. Most of the HPLC columns stability data is offered at ambient room temperature alternate 25 ºC at pH 1-10 units. At temperature of 25 ºC, the column life is sixteen times longer than that at 50 ºC.

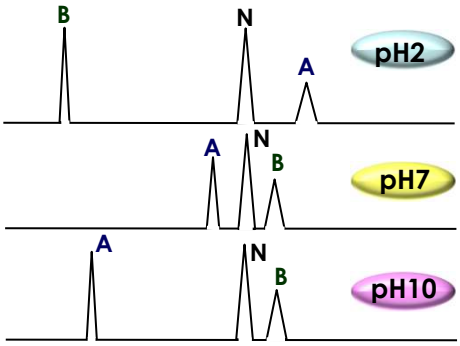
★ Sunniest C18 offers performance at elevated pH and temperature. Regarding stability under basic pH condition, there are very few C18 column like Sunniest C18 & Hybrid type C18 which can sustain and offer performance under such challenging conditions of high temperature and pH. It is considered that our double end-capping & base deactivation technique leads higher stability.

★ Sunniest C18 has operational pH Range from 1.5 to 10. Sunniest C8,Phenyl has operational pH Range 1.5 to 9 and Sunniest RP-Aqua and Pentafluorophenyl (PFP) at pH 2-8..

1) N. Nagae, T. Enami and S. Doshi, LC/GC North America October 2002.
2) T. Enami and N. Nagae, American Laboratory October 2004.
3) T. Enami and N. Nagae, BUNSEKI KAGAKU, 53 (2004) 1309.

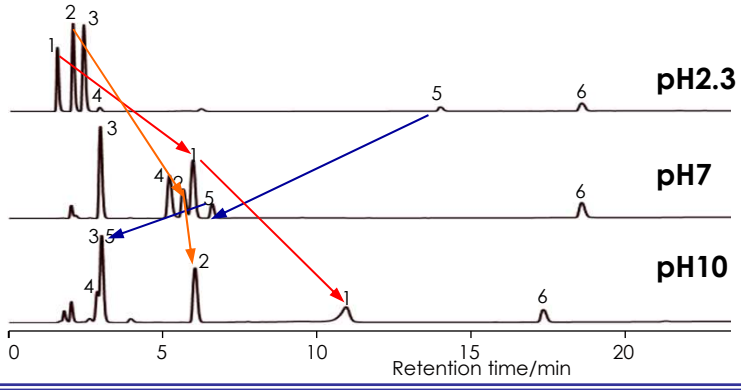
◆ Relationship between pH and retention of Acidic, Basic and Neutral compounds





Ionic compounds are promoted or suppressed in ionization by the mobile phase pH. The higher the pH of the mobile phase for acidic compounds and the lower the pH of the mobile phase for basic compounds, the more ionization is promoted and the higher the polarity, so the retention is smaller.

◆ pH selectivity

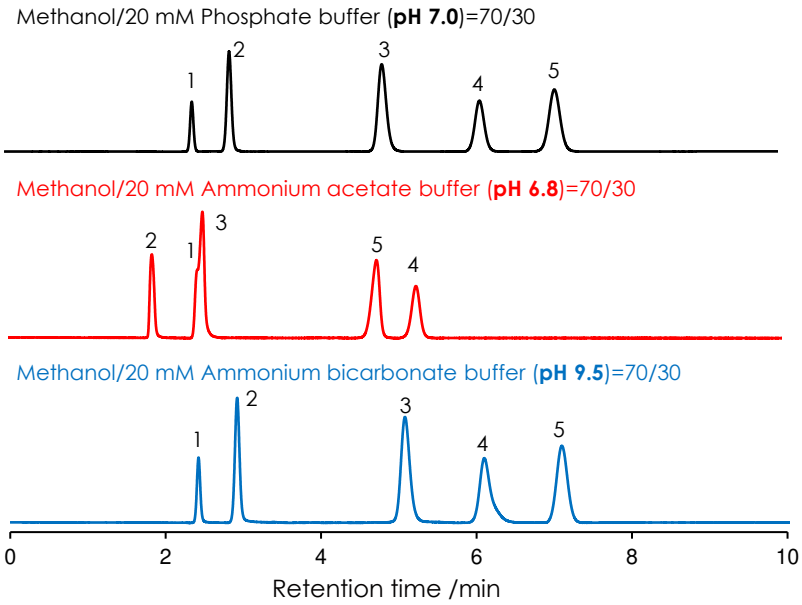


Column: Sunniest C18, 5 µm, 150 x 4.6 mm
Mobile phase: A1) 20 mM Phosphoric acid pH 2.3
A2) 20 mM Phosphate buffer pH 7
A3) 20 mM Phosphate buffer pH 10
B) Acetonitrile

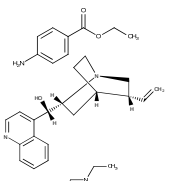
Time (min)	0	30
%B (%)	2	26

Flow rate: 1.0 mL/min, Temperature: 40 °C, Detection: UV@250 nm, Sample: 1= Thiamine HCl Vitamin B_1, 2 = Nicotinamide, 3 = Nicotinic acid, 4 = Pyridoxine HCl Vitamin B_6, 5 = Folic acid, 6 = Riboflavin Vitamin B_2

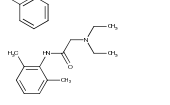
◆ Separation of local anesthetic and effect by pH of mobilr phase



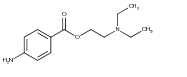
Column: Sunniest C18 5 µm, 150 x 4.6 mm
Mobile phase: Shown in the figure
Flow rate : 1.0 mL/min
Pressure : 10.4 MPa
Temperature : 40 °C
Detection : UV@250nm
Injection volume : 1 µL
Sample : 1 = Benzocaine,



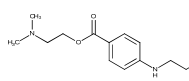
2 = Procaine,



3 = Cinchonine,



4 = Lidocaine,



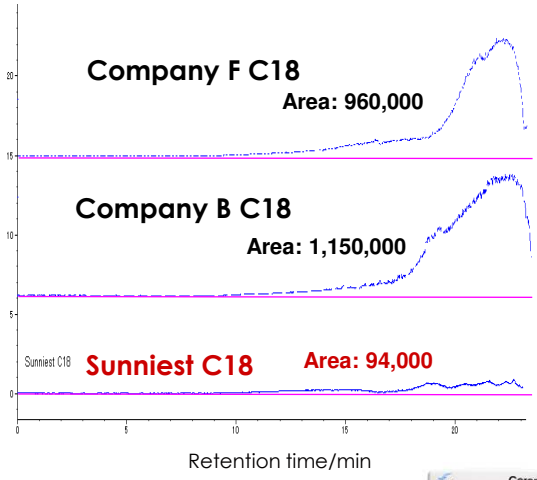
5 = Tetracaine

Separation using a neutral phosphate buffer may not be reproducible if changed to ammonium acetate salt for LC / MS, but separation can be improved by adjusting to alkaline with ammonium bicarbonate buffer. This is the case for the above separation of local anesthetics.

In the analysis of ionic compounds, pH can significantly change the separation selectivity. Since the Sunniest C18 column has highly stable under basic pH condition and can use an alkaline mobile phase with a pH of 10, the mobile phase conditions can be changed significantly from acidic to alkaline, and the optimum analytical method can be established.

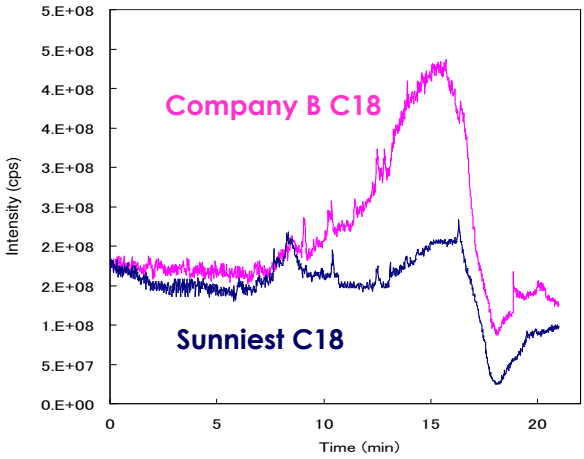
◆ Comparison data: Bleeding from column

《Comparison using Corona CAD》



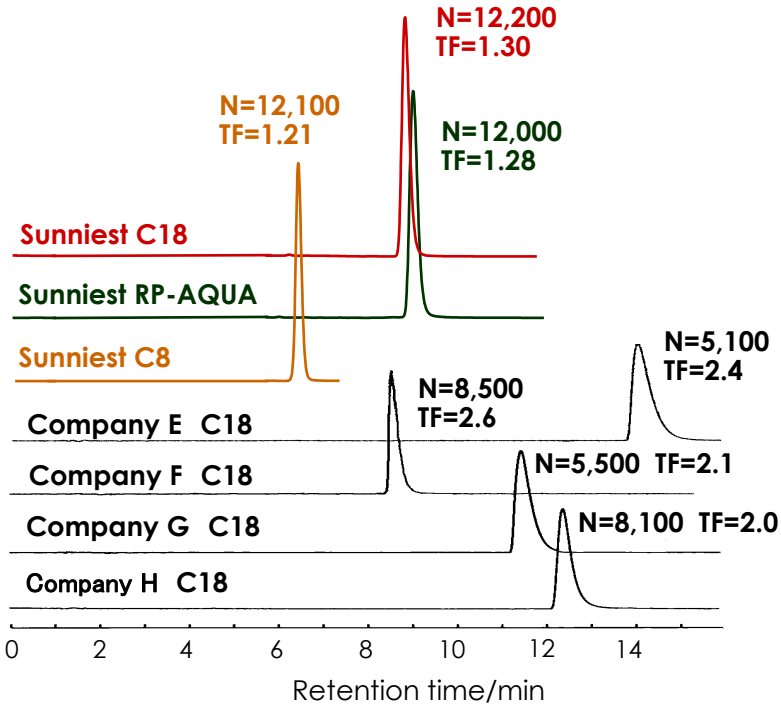
Column size: 150 x 2.0 mm
Mobile phase:
A) 0.1% acetic acid
B) CH_3CN
Gradient: Time: 0min 3min 14.4min 18min 19min
%B: 5% 5% 100% 100% 5%
Flow rate: 0.2 mL/min
Temperature: 40 °C
Detection: Corona CAD

《Comparison using MS》

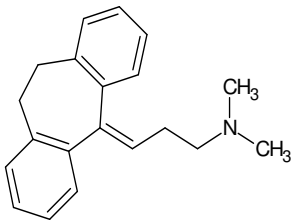


Column size: 150 x 2.0 mm
Mobile phase:
A) 0.1% acetic acid
B) CH_3CN
Gradient: Time: 0min 3min 14.4min 18min 19min
%B: 5% 5% 100% 100% 5%
Flow rate: 0.2 mL/min
Temperature: 40 °C
MS: ABI API-4000
Ionization: Turboionspray (cation)
Measurement mode: Q1 Scan m/z 100-1000

◆ Separation of antidepressants using Acetonitrile and Ammonium acetate for LC/MS



Column size: 150 x 4.6 mm
Particle size: 5 µm
Mobile phase: CH_3CN/10mM
Ammonium acetate pH6.8=40/60
Flow rate: 1.0 mL/min
Temperature: 40 °C
Sample: Amitriptyline



◆ Reproducibility of retention under 100% aqueous conditions

★ C18 and C8 reversed phases exhibit decreased and poorly reproducible retention under more than 98% aqueous conditions as shown in Fig. 1. This problem traditionally has been explained as being the result of ligand collapse or a matting effect. Nagae[1-3] ascertained , however , that the mobile phase was being expelled from the pores of the packing material under 100% aqueous mobile phase conditions, as Fig. 2 shows.

★ When the surface of packing materials isn't wet by water, water used as a mobile phase expels from the pore of the packing material by capillarity. This is a reason why reproducibility in retention is low under 100% aqueous conditions. Reversely pressure around the packing material makes water permeate into the pore of the packing material to overcome a force worked by capillarity.

In other words, the surface of a reversed phase like C18 isn't wet by water anytime even if water permeates into the pore of the packing material or not. So it is wrong that we say " dewetting" when water expel from the pore. Saying " Depermeatiing" is more appropriate.

★ Sunniest RP-AQUA /C30 is a reversed stationary phase, so that it is not wet with water. However the contact angle of water on the surface of Sunniest RP-AQUA /C30 is less than that of a conventional C18. Expelling force (pressure) acted by capillarity on Sunniest RP-AQUA /C30 is less than atmospheric pressure. So, Sunniest RP-AQUA /C30 shows reproducible retention under 100% aqueous conditions.

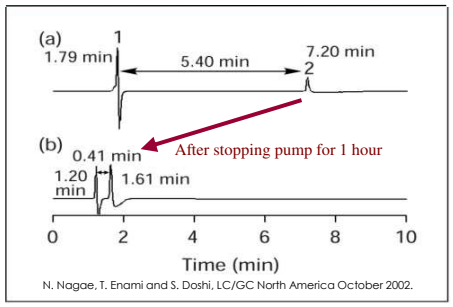


Fig. 1 Retention behavior of a C18 column under 100% aqueous mobile phase conditions

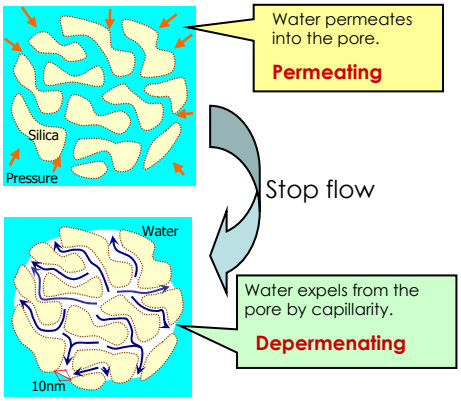
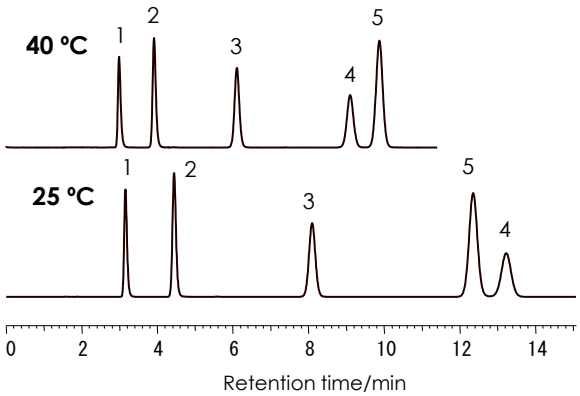


Fig. 2 Schematic diagram of C18 particle

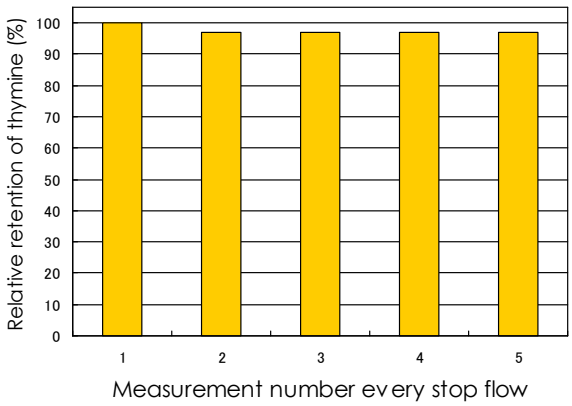
1) N. Nagae, T. Enami and S. Doshi, LC/GC North America October 2002.
2) T. Enami and N. Nagae, American Laboratory October 2004.
3) T. Enami and N. Nagae, BUNSEKI KAGAKU, 53 (2004) 1309.

◆ Separation of nucleic acid bases



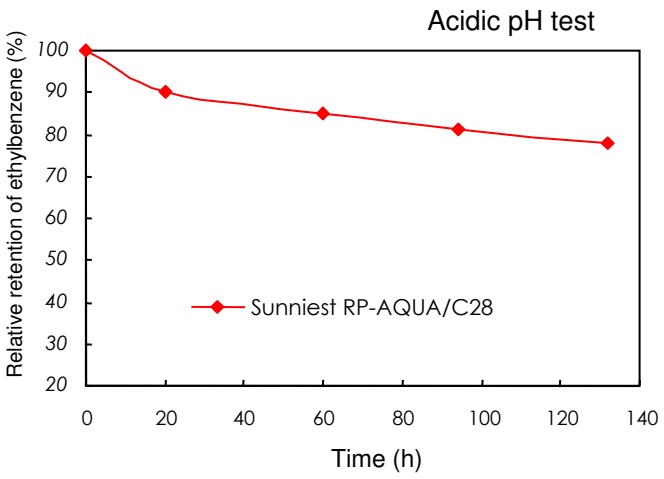
Column: Sunniest RP-AQUA,/C28 5µm 150 x 4.6 mm
Mobile phase: 10 mM Phosphate buffer pH 7.0
Flow rate: 1.0 mL/min
Temperature: 40 °C and 25°C
Sample: 1 = Cytosine 2 = Uracil
3 = Thymidine 4 = Uridine
5 = Thymine

Change of retention of thymine at 40 °C (measurement every stop flow for 1 hour)



Sunniest RP-AQUA/C30 showed more than 97% of reproducibility in retention using 100% aqueous buffer as a mobile phase.

◆ Stability of Sunniest RP-AQUA/ C30 under 100% aqueous conditions

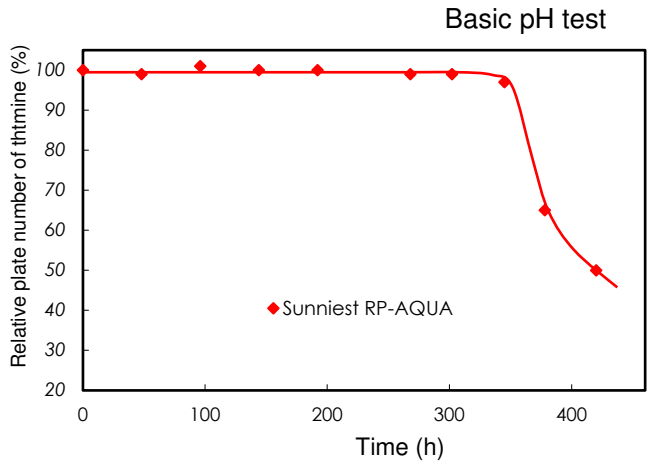


Durable test conditions

Column: Sunniest RP-AQUA, 5µm 150 x 4.6 mm
Mobile phase: 0.5% TFA
Flow rate: 1.0 mL/min
Temperature: 60 °C

Measurement conditions

Column: Sunniest RP-AQUA, 5µm 150 x 4.6 mm
Mobile phase: CH_3OH/H_2O=75/25
Flow rate: 1.0 mL/min
Temperature: 40 °C
Sample: 1 = Uracil
2 = Amylbenzene



Durable test conditions

Column: Sunniest RP-AQUA, 5µm 150 x 4.6 mm
Mobile phase: 20mM Phosphate buffer pH8.0
Flow rate: 1.0 mL/min
Temperature: 40 °C

Measurement conditions

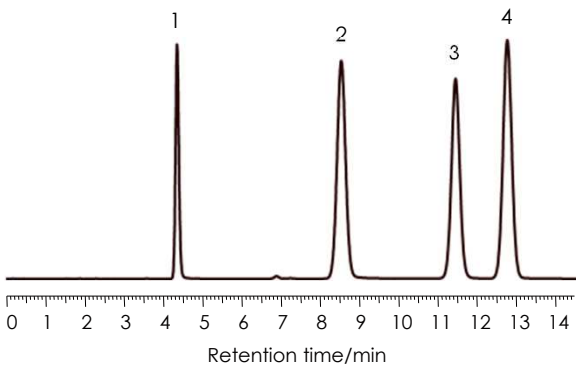
Column: Sunniest RP-AQUA, 5µm 150 x 4.6 mm
Mobile phase: 10mM Phosphate buffer pH7.0
Flow rate: 1.0 mL/min
Temperature: 40 °C
Sample: 1 = Thymine

It is important that stability is evaluated for RP-AQUA columns under 100% aqueous conditions because RP-AQUA column life becomes longer with incremental contents of organic solvent in a mobile phase. Sunniest RP-AQUA/C30 column can be used under 100% aqueous conditions from pH 2 to pH 8.

★Sunniest RP-AQUA/C30 column can be used under 100% aqueous conditions from pH 2 to pH 8. Sunniest RP-AQUA/C30 is one of the most stable aqua type column.

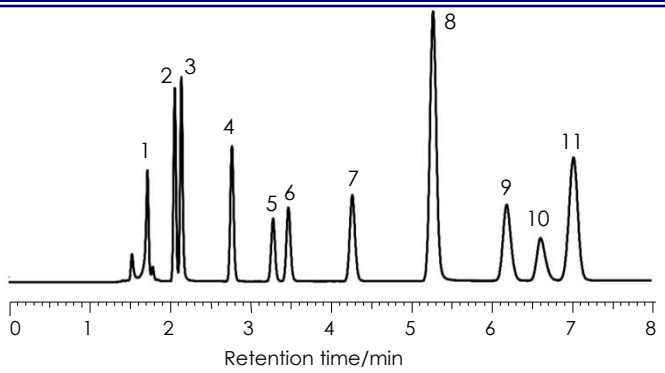
★ Sunniest RP-AQUA/C30 column with high temperature bonding along with end capping offers longer column life in comparison to other RP Aqua columns

◆ Separation of water-soluble vitamins



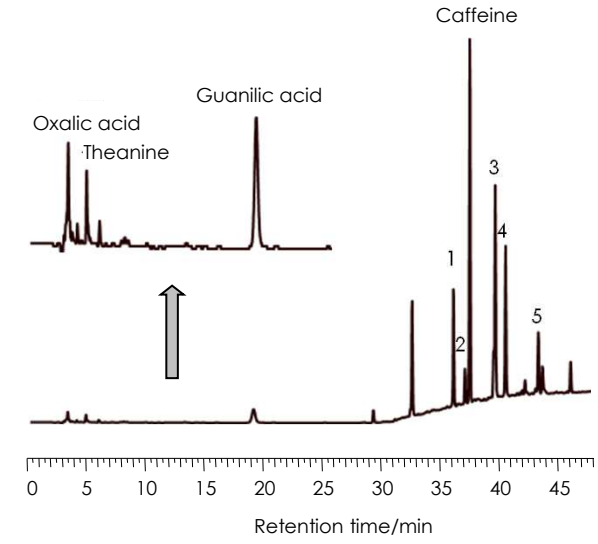
Column: Sunniest RP-AQUA, 5 µm 150 x 4.6 mm
Mobile phase: 40 mM Phosphate buffer pH 6.8
Flow rate: 1.0 mL/min
Temperature: 40 °C
Detection: UV@250 nm
Sample: 1 = Nicotinic acid, 2 = Pyridoxal
3 = Pyridoxine, 4 = Nicotinamide

◆ Separation of organic acids



Column: Sunniest RP-AQUA, 3 µm 150 x 4.6 mm
Mobile phase: 25 mM H_3PO_4 pH 2.5
Flow rate: 1.0 mL/min Temperature: 25 °C
Detection: UV@210 nm
Sample: 1 = Oxalic acid, 2 = Tartaric acid, 3 = Formic acid,
4 = Malic acid, 5 = Lactic acid, 6 = Acetic acid,
7 = Diglycolic acid, 8 = Maleic acid, 9 = Citric acid,
10 = Succinic acid, 11 = Fumaric acid

◆ Separation of Oolong tea

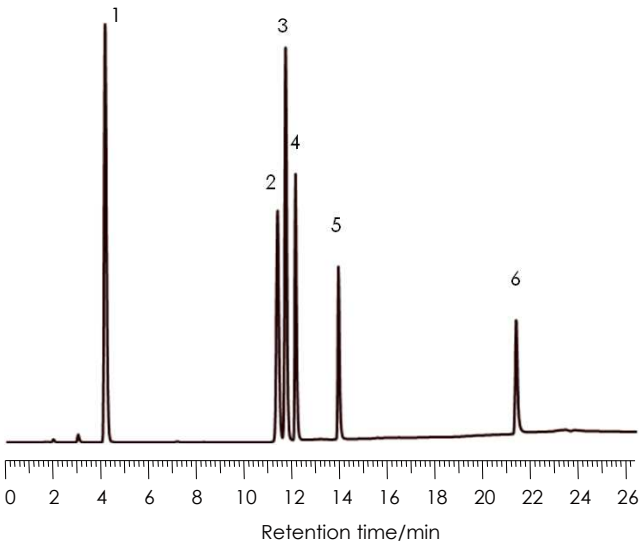


Column: Sunniest RP-AQUA 5 µm, 250 x 4.6 mm
Mobile phase: A) H_2O/H_3PO_4 (99.9:0.1)
B) CH_3CN

Time (min)	0	20	60
%B (%)	0	0	50

Flow rate: 1.0 mL/min
Temperature: 40 °C
Detection: UV@210 nm
Injection volume: 10 µL
Sample: Oolong tea 1 = (-)-Epigallocatechin
2 = (+)-Catechin
3 = (-)-Epigallocatechin gallate
4 = (-)-Epicatechin
5 = (-)-Epicatechin gallate

◆ Separation of water-soluble vitamins using mobile phase for LC/MS

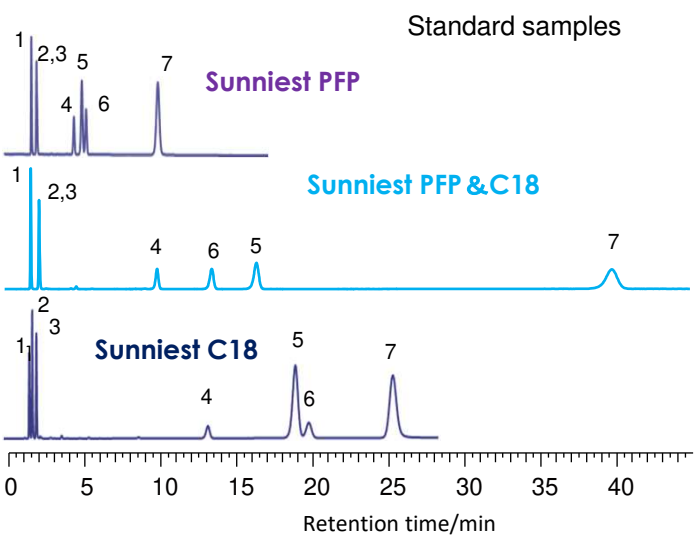


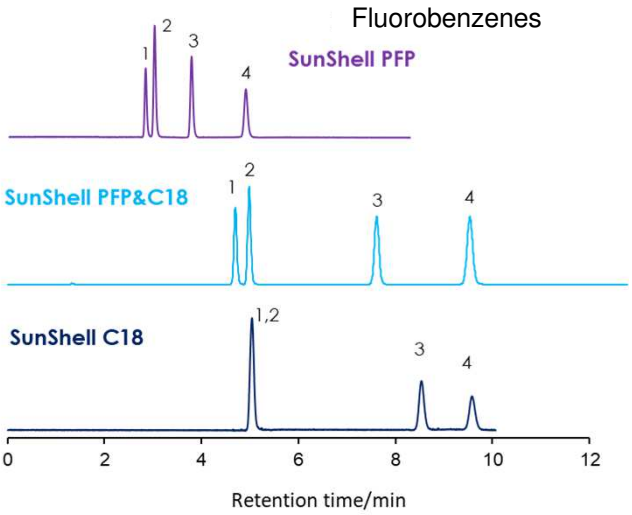
Column: Sunniest RP-AQUA 5 µm, 150 x 4.6 mm
Mobile phase: A) 20mM Ammonium acetate
B) Acetonitrile/ A solution (20:80)

Time (min)	0	5	20	25
%B (%)	0	0	100	100

Flow rate: 1.0 mL/min
Temperature: 40 °C
Detection: UV@250 nm
Sample: 1= Nicotinic acid
2 = Pyridoxine HCl Vitamin B_6
3 = Nicotinamide
4 = Thiamine HCl Vitamin B_1
5 = Folic acid
6 = Riboflavin Vitamin B_2

◆ Comparison of retention time

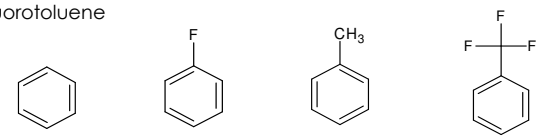




Column dimension: 150 x 4.6 mm
Mobile phase: CH_3OH/H_2O=75/25
Flow rate: 1.0 mL/min
Temperature: 40 °C
Sample: 1 = Uracil, 2 = Caffeine, 3 = Phenol, 4 = Butylbenzene
5 = o-Terphenyl, 6 = Amylbenzene, 7 = Triphenylene

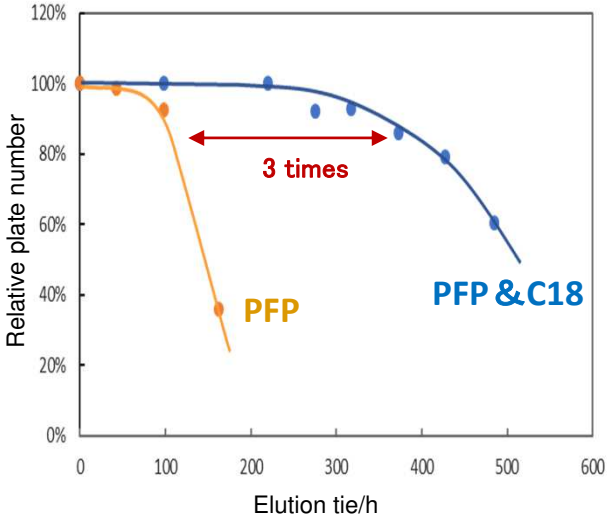
	Hydrogen bond (Caffeine/Phenol)	Hydrophobicity (Amylbenzene/Butylbenzene)	Steric selectivity (Triphenylene/o-Terphenyl)
PFP	1.00	1.29	2.51
PFP&C18	1.00	1.37	2.66
C18	0.43	1.56	1.37

Column: SunShell PFP 2.6 µm, 150 x 4.6 mm
SunShell PFP&C18 2.6 µm, 150 x 4.6 mm
SunShell C18 2.6 µm, 150 x 4.6 mm
Mobile phase: Methanol/water=60/40
Flow rate: 1.0 mL / min
Temperature: 40 °C
Detection: UV@250 nm
Sample:
1 = Benzene, 2 = Fluorobenzene, 3 = Toluene, 4 = α,α,α-Trifluorotoluene



Compared to PFP, PFP&C18 has the same stereoselectivity, but its hydrophobicity is significantly increased and its retention time is longer. As for the separation unique to PFP, such as the separation of fluorobenzenes, PFP&C18 has achieved the same separation.

◆ Evaluation of Stability

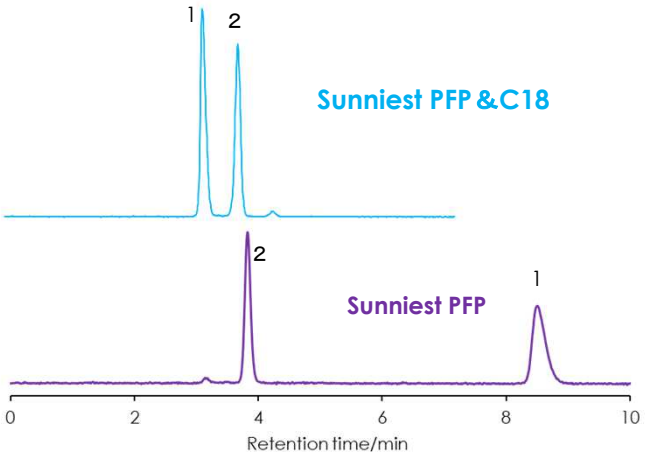


Durable test condition
Column:
Sunniest PFP&C18 5 µm, 150 x 2.0 mm
Sunniest PFP 5 µm, 150 x 2.0 mm
Mobil phase:
CH_3OH/20 mM PB pH 7.0=70/30
Flow rate: 0.2 mL/min
Temperature: 40 °C

Measurement condition
Column:
PFP&C18 5 µm, 150 x 2.0 mm
PFP 5 µm, 150 x 2.0 mm
Mobil phase:
PFP&C18;
Acetonitrile/water=70/30
PFP;
Acetonitrile/water=60/40
Flow rate: 0.2 mL/min
Temperature: 40 °C
Sample: Acenaphthene

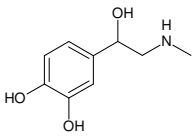
Due to the increased hydrophobicity of the surface, PFP & C18 is about three times more durable than PFP.

◆ Comparison of highly polar compounds



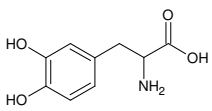
Column: Sunniest PFP&C18, PFP 5 µm, 150 x 4.6 mm
Mobile phase: 12.5 mM Ammonium Formate (pH3)
Flow rate: 1.0 mL/min
Temperature: 25 °C
Detection: UV@260 nm
Sample: 1 = Epinephrine, 2 = Levodopa

1



Epinephrine

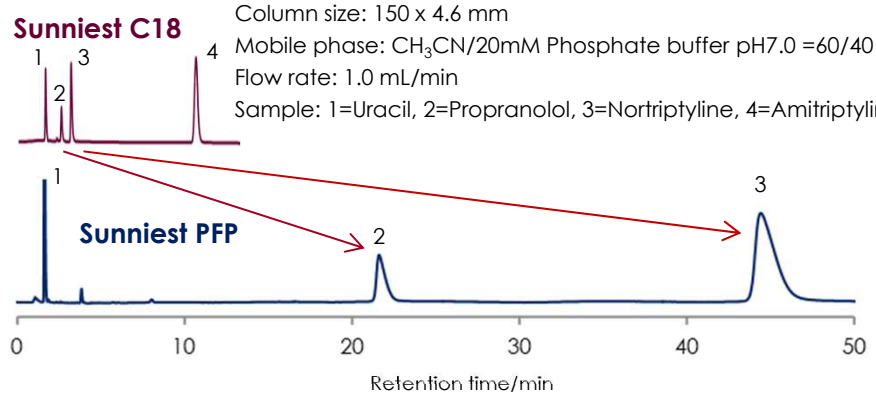
2



Levodopa

Due to the increased hydrophobicity of the surface, PFP & C18 is about three times more durable than conventional PFP. Separation of highly polar compounds such as catecholamines significantly changes the selectivity of PFP and PFP&C18, with PFP tending to retain more.

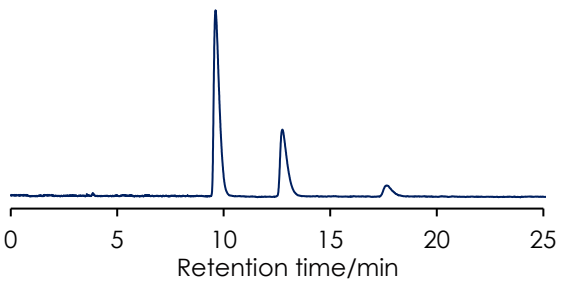
◆ Retention comparison between C18 and PFP



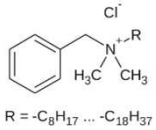
Column size: 150 x 4.6 mm
Mobile phase: CH_3CN/20mM Phosphate buffer pH7.0 =60/40
Flow rate: 1.0 mL/min
Sample: 1=Uracil, 2=Propranolol, 3=Nortriptyline, 4=Amitriptyline

★PFP retains a cation such a nortriptyline much longer than a C18.

◆ Separation of Benzalkonium chloride



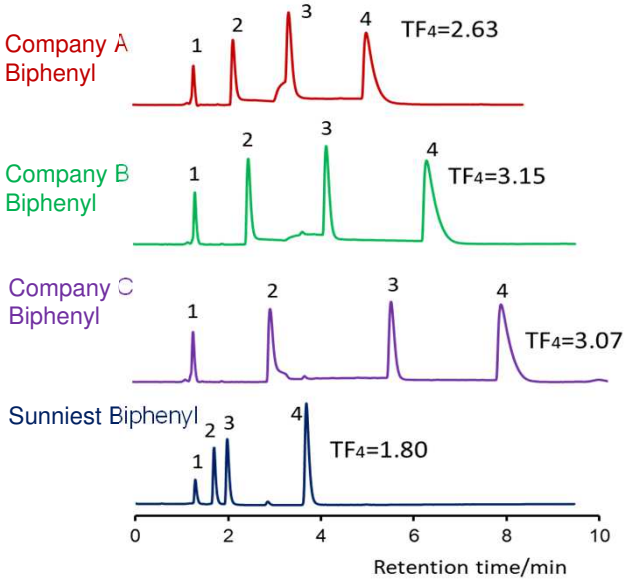
Column: Sunniest Cyano 5 µm, 150 x 4.6 mm
Mobile phase: Methanol/50 m ammonium acetate=70/30
Flow rate: 1.0 mL/min
Temperature: 30 °C
Detection: UV@265 nm
Sample: Benzalkonium chloride



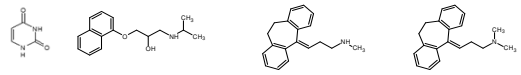
R = -C_8H_{17} ... -$C_{18}H_{37}$

Sunniest Cyano

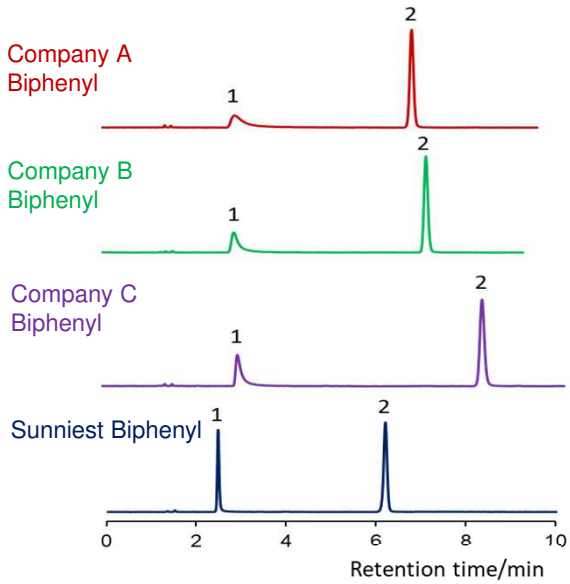
◆ Separation of amitriptyline



Column dimension: 250 x 4.6 mm
Mobile phase: CH_3CN/20 mM Phosphate buffer pH 7.0=60/40
Flow rate: 2.0 mL/min
Temperature: 40 ºC
Detection: UV@250 nm
Sample: 1 = Uracil, 2 = Propranolol, 3 = Nortriptyline, 4 = Amitriptyline



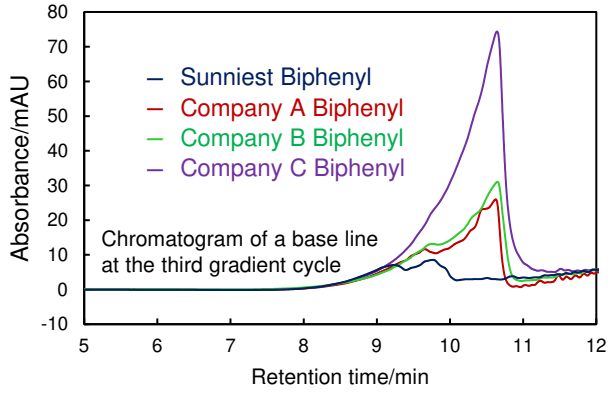
◆ Separation of a chelating compound



Column dimension: 250 x 4.6 mm
Mobile phase: CH_3CN/20mM H_3PO_4=10/90
Flow rate: 2.0 mL/min
Temperature: 40 °C
Detection: UV@250nm
Sample: 1 = 8-Quinolinol (Oxine), 2 = Caffeine

◆ Comparison of stability

Bleed comparison under acidic condition

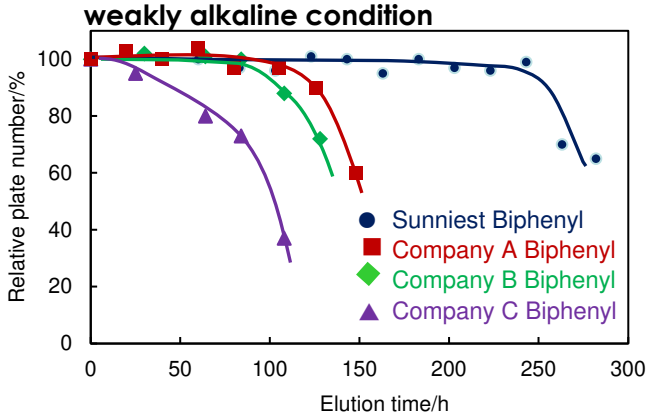


Bleed test condition
Column dimension: 50 x 2.1 mm
Mobile phase: A) 1% H_3PO_4 (pH 1.2)
B) Acetonitrile
Gradient program

Time (min)	0	5	10	17	18	35
%B	10	10	90	90	10	10

Flow rate: 0.3 mL/min
Temperature: 40 ºC
Detection: UV@250 nm

Comparison of plate number under weakly alkaline condition

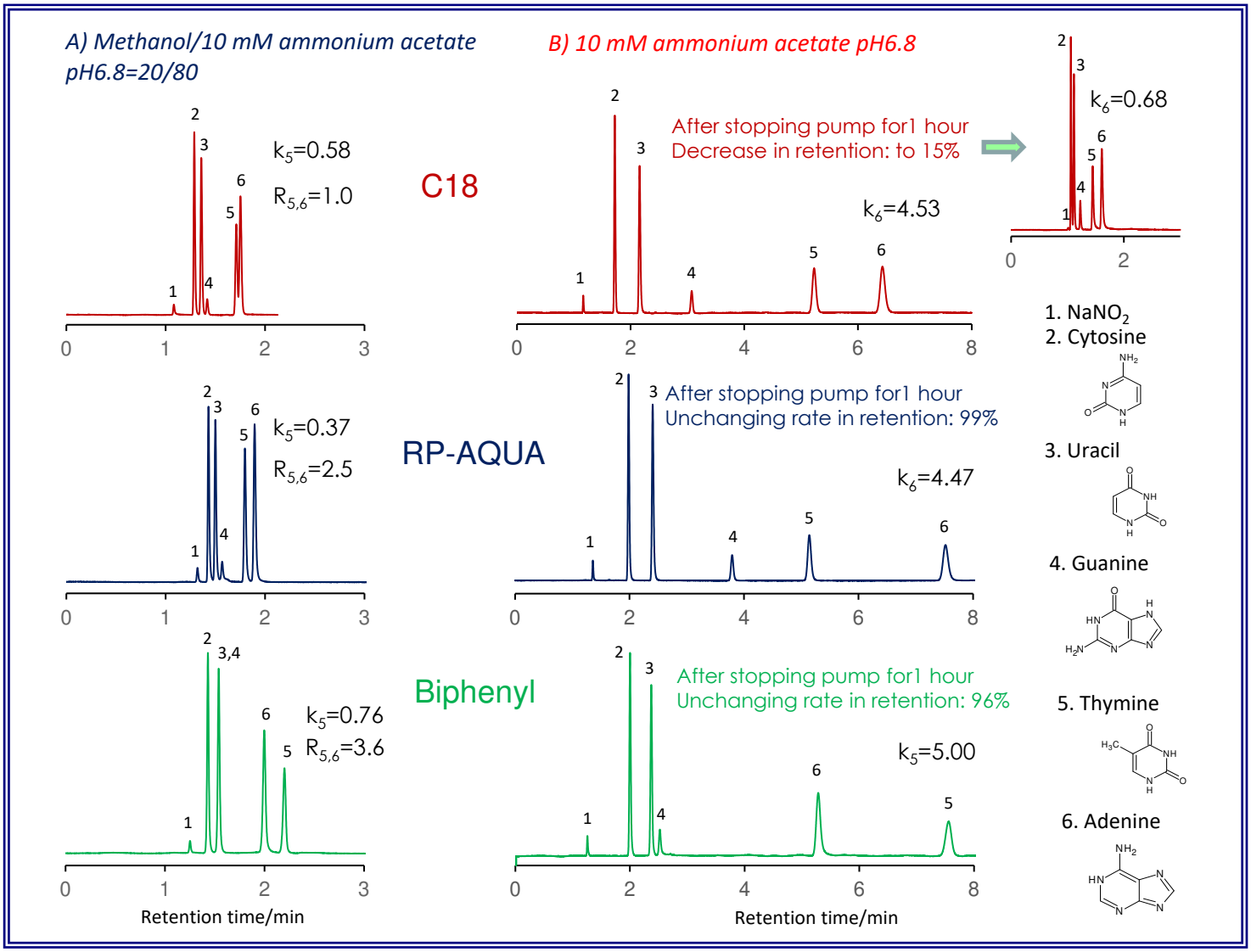


Elution condition of stability test
Column dimension: 50 x 2.1 mm
Mobile phase: 20 mM Sodium phosphate pH 8.0
Flow rate: 0.2 mL/min
Temperature: 40 ºC

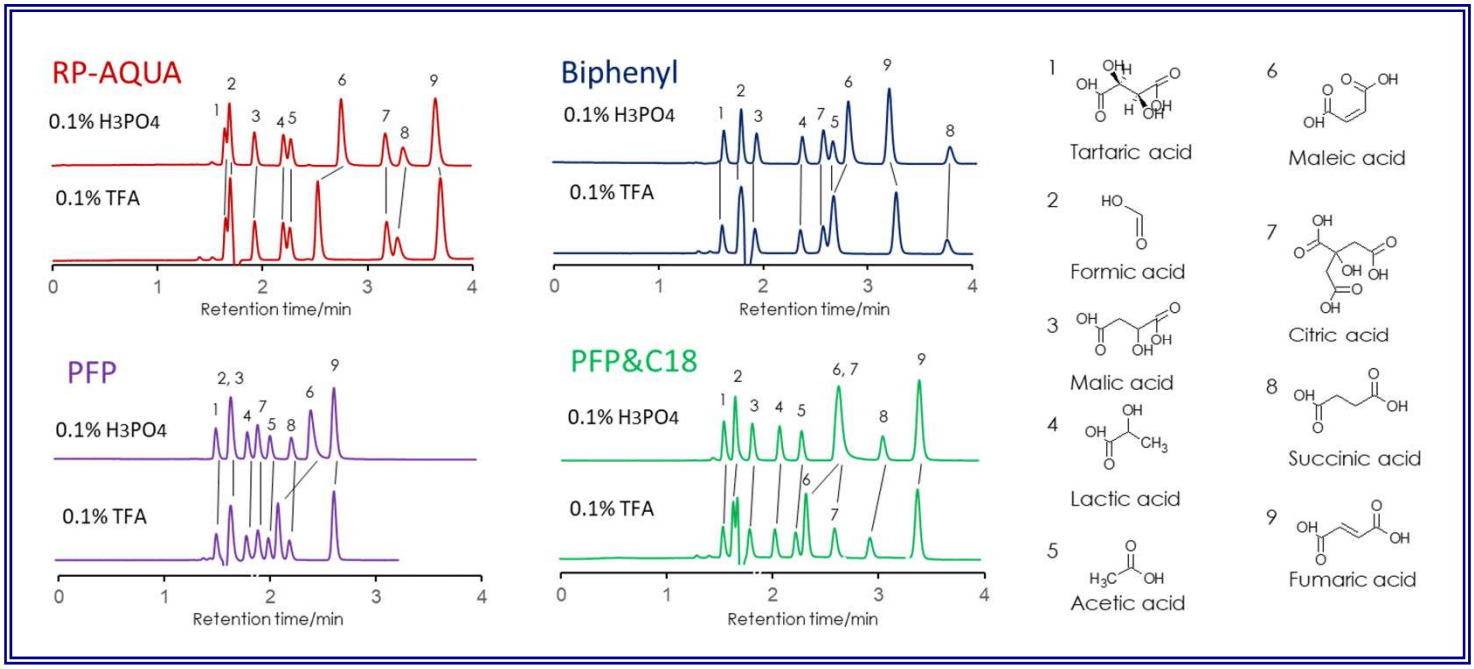
Measurement condition of plate number
Mobile phase: CH_3CN/H_2O=50/50
Flow rate: 0.2 mL/min
Temperature: 40 ºC
Detection: UV@250 nm
Sample: Butylbenzene

Stability under acidic condition compared baseline changes with gradient elution of 1% aqueous phosphate solution and acetonitrile. Biphenyl groups are cut off from the silica surface under acidic condition and elute out of the column as the amount of organic solvent increases. Baseline variability detected cut Biphenyl groups, with Sunniest showing the least desorbed and high acid stability. In addition, under weakly alkaline condition, the silica dissolved and the column-in side was dented, so the theoretical plate number of the columns were compared. Since the Biphenyl column has high reproducibility of retention time even in a 100% aqueous mobile phase (see page 14) and is effective for separating highly polar compounds, stability comparison was performed under the condition of pH 8 that does not contain an organic solvent. Sunniest is more than twice as durable as other companies' columns.

◆ Comparison of stationary phases using nucleic acid bases



◆ Comparison of organic acid

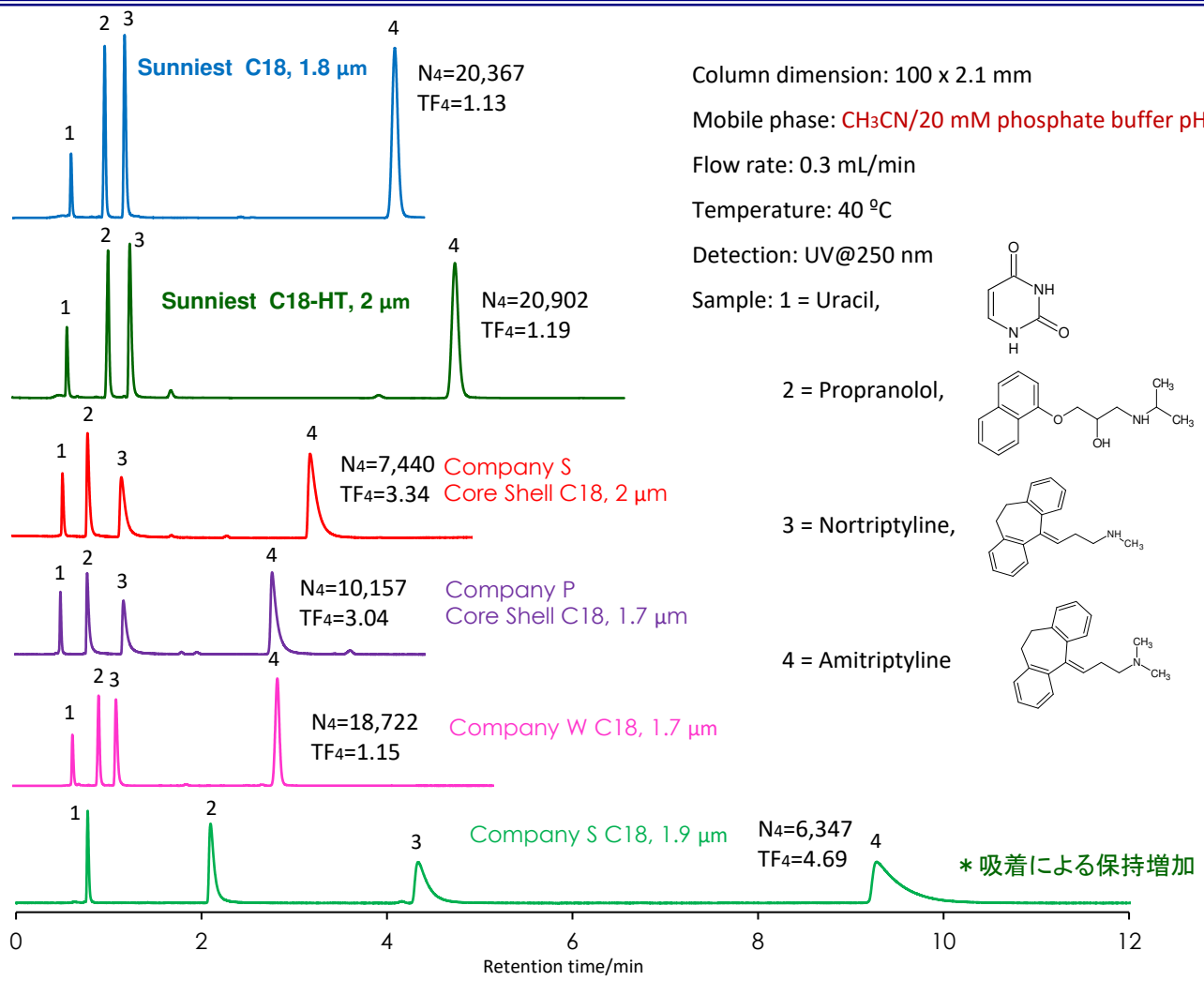


Sunniest C18 1.8 µm, C18-HT 2 µm

Features

✓ The 1.8 µm particles use a silica gel with the same physical characteristics as the 3 µm and 5 µm particles, and there is no difference in separation depending on the particle size.
✓ High-pressure packing achieves 100 MPa of a maximum operating pressure for 1.8 µm particles and 70 MPa of a maximum operating pressure for 2 µm particles.
✓ Low pressure and high theoretical plate by precision classification
✓ The inertness due to the Sunniest end-capping sharpens all peaks and leads usage of a wide pH range (pH 1.5 to 10).
✓ 2 µm Sunniest C18-HT has a 25% lower column pressure than 1.8 µm Sunniest C18.

★Unique surface modification (Comparison of amitriptyline as a basic compound)



Column dimension: 100 x 2.1 mm

Mobile phase: CH_3CN/20 mM phosphate buffer pH 7.0=60/40

Flow rate: 0.3 mL/min

Temperature: 40 °C

Detection: UV@250 nm

Sample: 1 = Uracil,

2 = Propranolol,

3 = Nortriptyline,

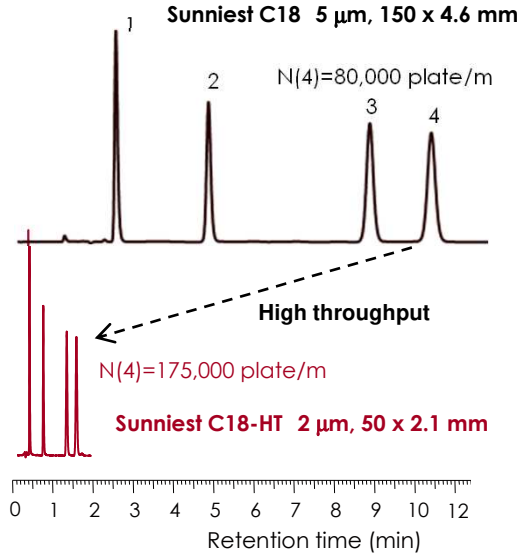
4 = Amitriptyline

Specification of Sunniest C18, 1.8 µm (Sunniest C18 shows the same characteristics for 1.8, 3 and 5 µm.)

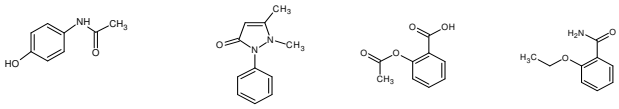
Packings	Particle size (µm)	Pore diameter (nm)	Specific surface area (m^2/g)	Carbon loading (%)	Phase	End-capping	Available pH range	USP category
Sunniest C18	1.8, 3 and 5	12	340	16	C18	High temperature reaction	1.5 - 10	L1
Sunniest C18-HT	2	10	340	16	C18	High temperature reaction	1.5 - 10	L1

＊Maximum operating pressure is 100 MPa for Sunniest C18, 1.8 µm and 70 MPa for Sunniest C18-HT 2 µm.

★ Separation of Analgesics

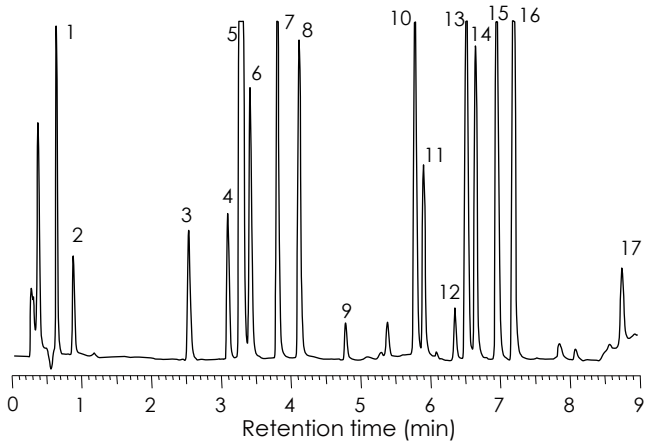


Mobile phase: CH_3CN/0.1% Formic acid = 20/80
Flow rate: 1.0 mL/min for 150 x 4.6 mm
0.6 mL/min for 50 x 2.1 mm
Temperature: 40 °C
Detection: UV@230 nm
Sample:
1=Acetaminophen, 2=Antipyrine, 3=Aspirin, 4=Ethenzamide



2 µm particle allows to reduce retention time because high efficiency is kept under high flow rate conditions. As shown the above chromatograms, analytical time reduced 1/8 without sacrifices of separation by using 2 µm, 50 x 2.1 mm column instead of 5 µm 150 x 4.6 mm column.

★ Separation of Amino Acids derivatized with OPA



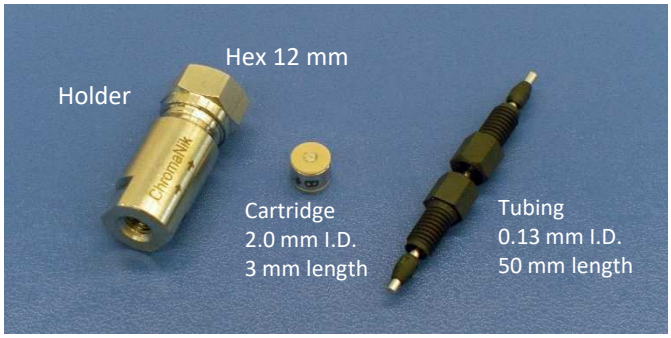
Column: Sunniest C18-HT 2 µm, 100 x 2.1 mm
Mobile phase: A) 10mM Na2PO4 + 10mM Na2B4O7 + 0.5mM NaN3
B) Acetonitrile/Methanol/Water (45/45/10 %V)

Time(min)	0	0.2	7.2	7.8
%B	5	5	50	100

Flow rate: 0.72 mL/min
Temperature: 40 °C
Detection: UV@338 nm
Sample: 1=Aspartic acid, 2=Glutaminc acid, 3=Serine, 4=Histidine, 5=Glycine, 6=Threonine, 7=Arginine, 8=Alanine, 9=Tyrosine, 10=Valine, 11=Methionine, 12=Tryptophan, 13=Pnehylalanine, 14=Isoleucine, 15=Leucine, 16=Lysine, 17=Proline

★ Guard column for Sunniest C18 1.8 µm, C18-HT 2 µm

SunShell guard cartridge column is recommended for Sunniest C18 µm, 2 µm.



- ⋆ The cartridge column is packed with SunShell C18 (RP) and Core shell silica (S) into a cartridge sized 3 x 2 mm i.d.
- ⋆ RP guard cartridge is used for all reversed phases and S guard cartridge for hilic phases.
- ⋆ Low dead volume structure
- ⋆ Upper pressure limit is more than 60 Mpa
- ⋆ Availablr for 2.1 mm i.d. to 4.6 mm i.d. columns

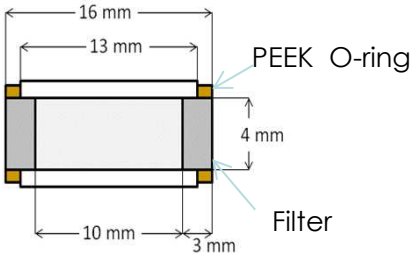
Ordering Information of SunShell Guard Cartridge Column

Description	Part number
SunShell Guard Cartridge RP Starter Kit (holder, cartridge, tubing)	CB32CK
SunShell Guard Cartridge RP for exchange (2 PCS)	CB32CC
SunShell Guard Cartridge S Starter Kit (holder, cartridge, tubing)	CS32CK
SunShell Guard Cartridge S for exchange (2 PCS)	CS32CC
SunShell Guard Cartridge holder	HOL2CC

Guard Cartridge (10 x 4 mm)

Feature

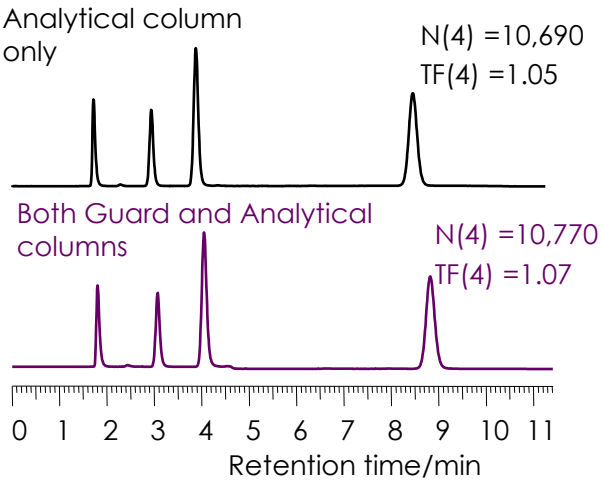
*Simple structure
*Low dead volume
*Available for not only 5 µm column but also 3 µm column



Schematic Diagram of Cartridge 10x4mm

Photo of Cartridge and Holder

Comparison of chromatograms



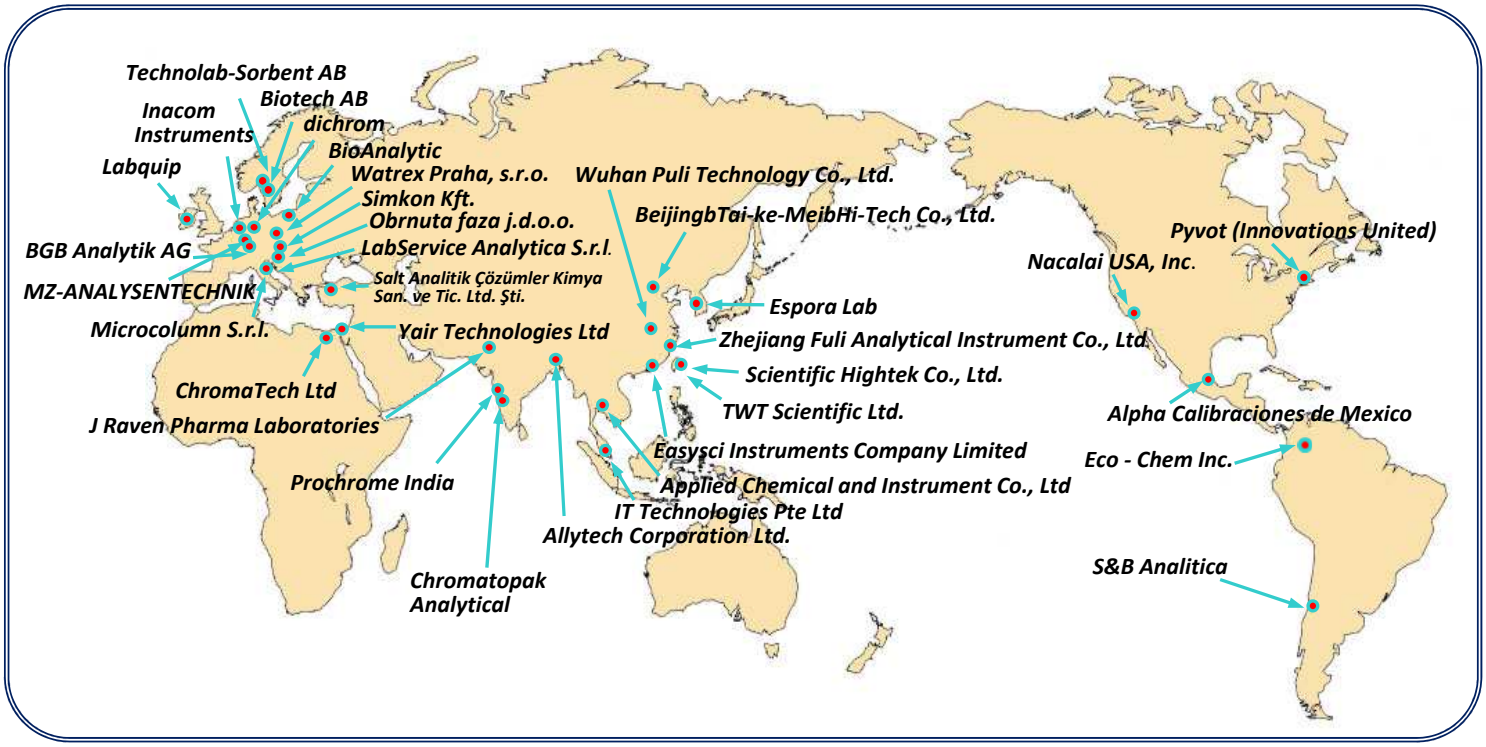
Column: Sunniest C18, 5 µm 150 x 4.6 mm
Guard cartridge 10 x 4 mm
Mobile phase:
CH_3OH/20mM Phosphate buffer pH7.5 = 80/20
Flow rate: 1.0 mL/min
Temperature: 40 °C
Pressure: 4.8 MPa, 5.6 MPa(+guard)
Sample: 1 = Uracil,
2 = Propranolol,
3 = Nortriptyline,
4 = Amitriptyline,
TF: USP tailing factor

	Particle size	Catalog No.
Sunniest C18, 5 µm Guard cartridge column (1-pak + Holder) 4 x 10 mm	5 µm	EB3A1H
Sunniest RP-AQUA, 5 µm Guard cartridge column (1-pak + Holder) 4 x 10 mm	5 µm	ER3A1H
Sunniest C8, 5 µm Guard cartridge column (1-pak + Holder) 4 x 10 mm	5 µm	EC3A1H
Sunniest C18, 5 µm Guard cartridge (4-pak) 4 x 10 mm	5 µm	EB3A1C
Sunniest RP-AQUA, 5 µm Guard cartridge (4-pak) 4 x 10 mm	5 µm	ER3A1C
Sunniest C8, 5 µm Guard cartridge (4-pak) 4 x 10 mm	5 µm	EC3A1C
Sunniest Guard cartridge holder 4 x 10 mm	---	HOLA1C

✻ Sunniest Ordering information

Packings	Inner diameter (mm)	2.1	3.0	4.6	10	20	USP category
	Length (mm)	Catalog number	Catalog number	Catalog number	Catalog number	Catalog number	
NEW Sunniest C18 1.8 µm	30	EBA931	------	------	------	------	L1
	50	EBA941	EBA341	------	------	------	
	75	EBA951	EBA351	------	------	------	
	100	EBA961	EBA361	------	------	------	
	150	EBA971	EBA371	------	------	------	
Sunniest C18-HT 2 µm	30	EB1931	EB1331	------	------	------	
	50	EB1941	EB1341	------	------	------	
	75	EB1951	------	------	------	------	
	100	EB1961	EB1361	------	------	------	
Packings	Inner diameter (mm)	**2.0**	3.0	4.6	**10**	**20**	USP category
	Length (mm)	Catalog number	Catalog number	Catalog number	Catalog number	Catalog number	
Sunniest C18 3 µm	50	EB2241	EB2341	EB2441	------	------	L1
	75	EB2251	------	EB2451	------	------	
	100	EB2261	EB2361	EB2461	------	------	
	150	EB2271	EB2371	EB2471	------	------	
	250	EB2281	EB2381	EB2481	------	------	
Sunniest C18 5 µm	50	EB3241	EB3341	EB3441	------	EB3841	
	100	EB3261	EB3361	EB3461	------	------	
	150	EB3271	EB3371	EB3471	------	EB3871	
	250	EB3281	EB3381	EB3481	EB3781	EB3881	
Sunniest RP-AQUA 3 µm	50	ER2241	ER2341	ER2441	------	------	L62
	75	ER2251	------	ER2451	------	------	
	100	ER2261	ER2361	ER2461	------	------	
	150	ER2271	ER2371	ER2471	------	------	
	250	ER2281	ER2381	ER2481	------	------	
Sunniest RP-AQUA 5 µm	50	ER3241	ER3341	ER3441	------	ER3841	
	100	ER3261	ER3361	ER3461	------	------	
	150	ER3271	ER3371	ER3471	------	ER3871	
	250	ER3281	ER3381	ER3481	ER3781	ER3881	
Sunniest C8 3 µm	50	EC2241	EC2341	EC2441	------	------	L7
	75	EC2251	------	EC2451	------	------	
	100	EC2261	EC2361	EC2461	------	------	
	150	EC2271	EC2371	EC2471	------	------	
	250	EC2281	EC2381	EC2481	------	------	
Sunniest C8 5 µm	50	EC3241	EC3341	EC3441	------	EC3841	
	100	EC3261	EC3361	EC3461	------	------	
	150	EC3271	EC3371	EC3471	------	EC3871	
	250	EC3281	EC3381	EC3481	EC3781	EC3881	
Sunniest PhE 3 µm	50	EP2241	EP2341	EP2441	------	------	L11
	75	EP2251	------	EP2451	------	------	
	100	EP2261	EP2361	EP2461	------	------	
	150	EP2271	EP2371	EP2471	------	------	
	250	EP2281	EP2381	EP2481	------	------	
Sunniest PhE 5 µm	50	EP3241	EP3341	EP3441	------	EP3841	
	100	EP3261	EP3361	EP3461	------	------	
	150	EP3271	EP3371	EP3471	------	EP3871	
	250	EP3281	EP3381	EP3481	EP3781	EP3881	
NEW Sunniest Biphenyl 5 µm	50	E83241	E83341	E83441	------	------	
	100	E83261	E83361	E83461	------	------	
	150	E83271	E83371	E83471	------	------	
	250	E83281	E83381	E83481	E83781	E83881	
Sunniest PFP 5 µm	50	------	------	EF3441	------	------	L43
	100	------	------	EF3461	------	------	
	150	------	------	EF3471	------	------	
	250	------	------	EF3481	------	------	
NEW Sunniest PFP&C18 5 µm	50	EV3241	EV3341	EV3441	------	------	L43
	100	EV3261	EV3361	EV3461	------	------	
	150	EV3271	EV3371	EV3471	------	------	
	250	EV3281	EV3381	EV3481	EV3781	EV3881	
Sunniest Cyano 5 µm	50	EJ3241	EJ3341	EJ3441	------	------	L10
	100	EJ3261	EJ3361	EJ3461	------	------	
	150	EJ3271	EJ3371	EJ3471	------	------	
	250	EJ3281	EJ3381	EJ3481	EJ3781	EJ3881	
Sunniest Silica 3 µm	50	ES2241	ES2341	ES2441	------	------	L3
	75	ES2251	------	ES2451	------	------	
	100	ES2261	ES2361	ES2461	------	------	
	150	ES2271	ES2371	ES2471	------	------	
	250	ES2281	ES2381	ES2481	------	------	
Sunniest Silica 5 µm	50	ES3241	ES3341	ES3441	------	ES3841	
	100	ES3261	ES3361	ES3461	------	------	
	150	ES3271	ES3371	ES3471	------	ES3871	
	250	ES3281	ES3381	ES3481	ES3781	ES3881	

*Our distributors in the world



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