# Analysis of PFAS in Tap Water Using a Pentafluorophenyl Column

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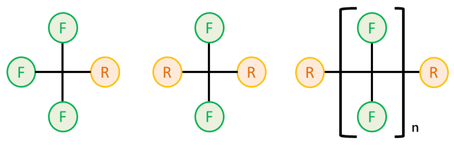
Perfluoroalkyl and polyfluoroalkyl substances (PFAS) are known to pose health risks due to their bioaccumulative nature and environmental persistence. In April 2026, legal restrictions setting a combined limit of 50 ng/L for PFOS and PFOA in tap and mineral water will take effect in Japan. Furthermore, the European Union has already established maximum levels for four PFAS congeners in seafood, and similar regulations are anticipated in the United States.
In this study, we developed a pentafluorophenyl (PFP) column consisting of an ethylene cross-linked hybrid silica gel and a PFP stationary phase. This column is capable of simultaneously analyzing 19 PFAS compounds, ranging from short-chain to long-chain substances. Its applicability to drinking water analysis was evaluated and compared with that of a conventional C18 column. The PFP column exhibited not only greater sensitivity for PFBA but also superior separation of PFHxS isomers compared to the C18 column.

## PFAS

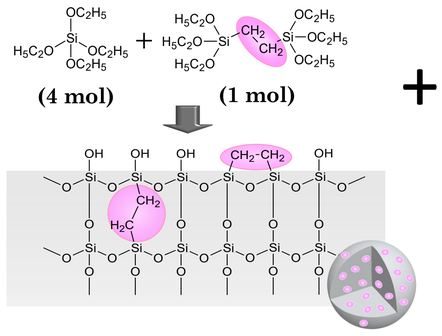
Per- and polyfluoroalkyl substances (PFAS) are defined as "fluorinated substances that contain at least one fully fluorinated methyl or methylene carbon (with no H/Cl/Br/I atoms attached).
As of January 2025, there are 14,735 PFAS with clear chemical structures and 1,915 PFAS with unclear structural information such as polymers and complex mixtures.



PFAS are heat-resistant, water-repellent, and oil-repellent, and are used in many industrial products and daily necessities. On the other hand, they are called "Forever Chemicals" because they are difficult to decompose in the environment and higher bioaccumulative. The main routes of human exposure are oral ingestion of drinking water and food, inhalation of product dust, and skin absorption through contact with products (such as cosmetics).

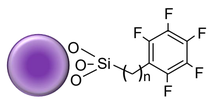
## Hybrid silica PFP and C18

1. **Hybrid silica**
Ethylene cross-linked silica gel

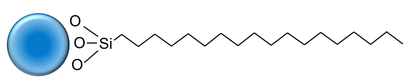



2. **Stationary phase**

PFP (SunBridge PFP-R)



C18 (SunBridge C18)



+ End-capping

## ● Analysis issues

When a conventional C18 column is used,
1) lack sensitivity for short-chain PFAS.
2) insufficient separation of long-chain PFAS isomers.
→ A method that can comprehensively and sensitively analyze a variety of PFASs is needed.

## ● Objectives

Aim to establish a comprehensive and highly sensitive method for analyzing trace PFAS in tap water using PFP columns.

## Measurement conditions

| | |
|---|---|
| HPLC | Ultimate 3000(Thermo Fisher Scientific) |
| Analytical column | SunBridge PFP-R 3 µm, SunBridge C18 3 µm, 100 x 2.1 mm ID |
| Delay column | SunBridge Delay C18 3 µm, 50 x 3.0 mm ID |
| Mobile phase | A) Methanol<br>B) 2 mM Ammonium acetate |
| Gradient | Time (min) %B<br>0.0 30<br>1.0 30<br>21.0 97<br>24.0 97<br>24.1 30<br>28.0 30 |
| Flow rate | 0.3 mL/min |
| Column temperature | 40 °C |
| Injection volume | 4 µL |
| MS | Q Exactive Focus (Thermo Fisher Scientific) |
| Ion mode | ESI (-) |
| Resolution | 70000 (at m/z 200) |

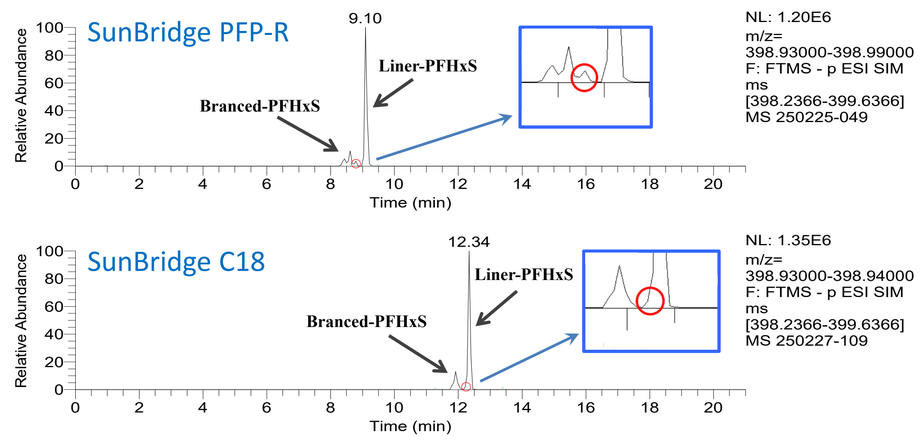
## Sample pretreatment

250 mL sample
+ IS
ISOLUTE 101 (100 mg, Biotage)+ EVOLUTE PFAS (150 mg, Biotage)
+ Load → Discard
+ Water → Discard
+ 0.1% NH3 methanol → Collect
+ Acetic acid
LC/MS measurement

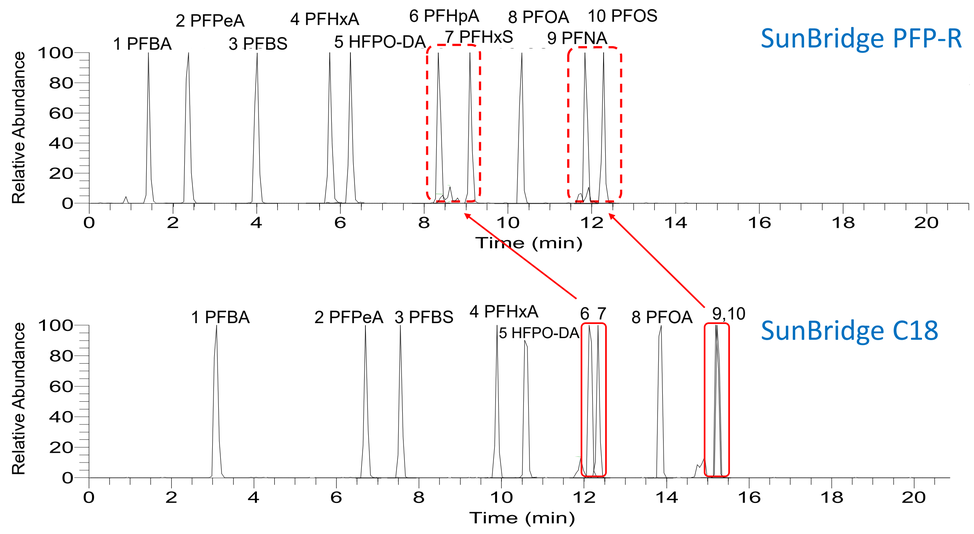
### Analytes

PFOS、PFOA、PFBS、PFHxS、PFBA、PFPeA、PFHxA、PFHpA、PFNA、HFPO-DA

## Comparison of isomer separation




## Comparison of separation of 10 kinds of PFASs

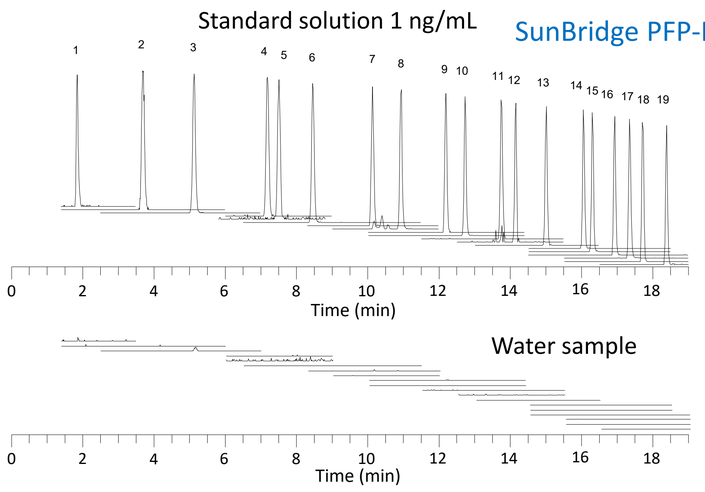



## Comparison of PFBA peak intensity between PFP column and C18 column

| Column | Peak intensity | | |
|---|---|---|---|
| | 100% MeOH | 30% MeOH +70% ammonium formate | 100% MeCN |
| SunBridge PFP-R | 442,000 | 173,000 | 336,000 |
| SunBridge C18 | 277,000 | 110,000 | 218,000 |

Isocratic separation using 100% MeOH, 100% MeCN and 30% MeOH + 70% ammonium formate.
Sample: PFBA (5 ng/mL), injection volume: 4 µL

## Separation of 19 kinds of PFASs in standards and water sample




1 PFBA
2 PFPeA
3 PFBS
4 PFHxA
5 HFPO-DA
6 PFPeS
7 PFHpA
8 PFHxS
9 PFOA
10 PFHpS
11 PFNA
12 PFOS
13 PFDA
14 PFUdA
15 PFDS
16 PFDoA
17 PFTrDA
18 PFTeDA
19 FOSA

**Gradient and Flow rate**

| Time (min) | %B | Flow rate (mL/min) |
|---|---|---|
| 0 | 30 | 0.30 |
| 1.0 | 30 | 0.30 |
| 19.0 | 90 | 0.30 |
| 19.01 | 97 | 0.40 |
| 21.0 | 97 | 0.40 |
| 21.01 | 30 | 0.40 |
| 23.99 | 30 | 0.40 |
| 24.0 | 30 | 0.30 |

Other conditions are same.

## Conclusions

- ✓SunBridge PFP-R exhibited not only greater sensitivity for PFBA but also superior separation of PFHxS isomers compared to SunBridge C18.
- ✓SunBridge PFP-R was able to completely separate 19 kinds of PFASs although the C18 was unable to adequately separate PFNA and PFOS.
- ✓SunBridge PFP-R is made of hybrid silica gel, so it is expected to have a longer column life than conventional PFP columns.