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Application Note
31110

EN 17892-2024

SOLID PHASE EXTRACTION OF 55 PFAS FROM DRINKING WATER USING THE SPE-03 AUTOMATED EXTRACTOR AND AQUARIS™ SPE CARTRIDGES IN ACCORDANCE WITH EN 17892-2024

Authors

Dr. Thomas Gersthagen,
Product Manager
LCTech GmbH

Dr. Suman Kharel
Application Specialist
LCTech GmbH

Raymond Chen
Technical Director
PromoChrom Technologies

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KEY HIGHLIGHTS

- Excellent recovery and low standard deviations of 55 PFAS analytes according to European Norm
- No detectable PFAS background contamination from both systems and cartridges
- Reliable and robust automation with the SPE-03 system
- Fully automated and Parallel processing of 8 samples

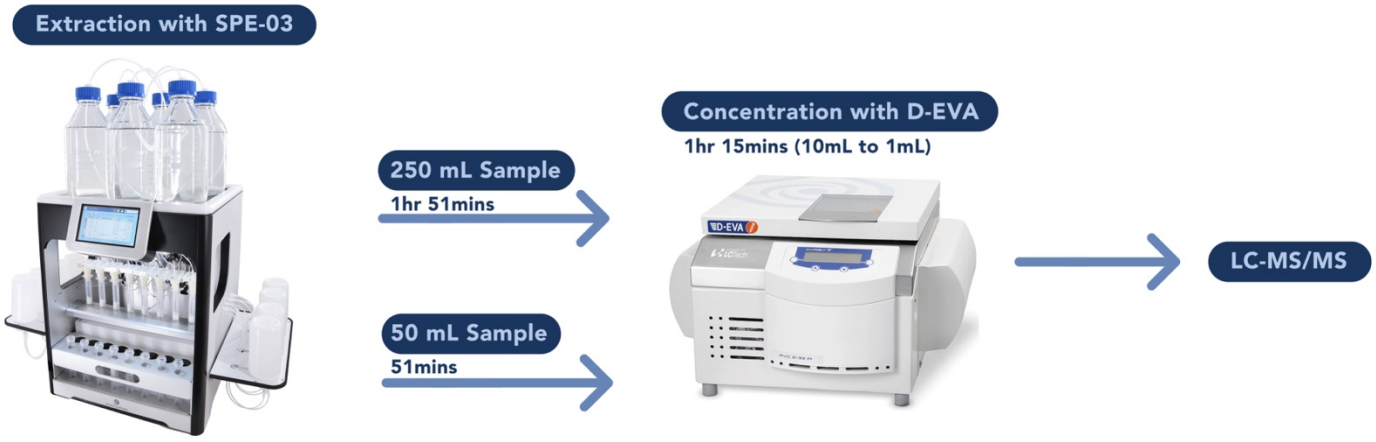
INTRODUCTION

Per- and polyfluoroalkyl substances (PFAS) have been identified as highly toxic, prompting increasingly stringent regulation worldwide. North America was the first to take action by establishing a series of U.S. EPA analytical methods and regulatory frameworks. Europe has since accelerated its efforts, culminating in the release of EN 17892:2024 in January 2026. EN 17892:2024 [1] requires solid phase extraction (SPE) with a weak anion exchanger, mixed-mode polymeric sorbent prior to liquid chromatography-tandem mass spectrometry (LC-MS/MS) analysis.

In this application note, the preparation of drinking water samples was demonstrated using a PromoChrom SPE-03 automated extraction system with Aquaris™ PFAS WAX SPE cartridges, followed by concentration of the final extract using an LCTech D-EVA vacuum concentrator prior to LC-MS/MS analysis. By implementing this workflow, up to eight samples could be processed automatically and efficiently in a single run.

The SPE-03 system is particularly well suited for PFAS applications, as it avoids the use of fluorine-containing plastics such as PTFE. As a result, no measurable PFAS contamination originating from the system was observed.

WORKFLOW OVERVIEW



MATERIALS

- PromoChrom SPE-03 Plus for PFAS analysis with upside-down sample loading
- Aquaris™ PFAS WAX cartridge:
    - C-WAX-3mL-60mg: 60 mg WAX sorbent in 3 mL cartridge ideal for small sample size.
    - C-WAX-6mL-200mg: 200 mg WAX sorbent in 6 mL cartridge
- Reagents and standards following EN 17892-2024
- D-EVA Vacuum Concentrator
- LC-MS/MS

METHOD SUMMARY

Sample Preparation:

For experiment 1, 50 mL of drinking water was poured into 250 mL bottle in replicate of 4. Formic acid was added to adjust the pH to range of 4 to 7. 55 Native PFAS and 24 isotope dilution standards were spiked as mentioned in table below. 50 mL samples were extracted with C-WAX-3mL-60mg cartridge.

For experiment 2, 250 mL of drinking water was poured into 250 mL bottle in replicate of 4. Formic acid is added to adjust the pH to range of 4 to 7. 55 Native PFAS and 24 isotope dilution standards were spiked as mentioned in table below. The 250 mL samples were extracted with C-WAX-6mL-200mg cartridge.

Table 1 – 55 Native PFAS and 24 isotope dilution standards

Compounds	ng
Labelled compounds	1.64– 33.3
11Cl-PF3OUdS, 9Cl-PF3ONS, ADONA, HFPO-DA, NFDHA, PFEESA, PFMBA, PFMPA, PFPeA	8
PFBA, 4:2FTS, 6:2FTS, 8:2FTS	16
N-MeFOSE, N-EtFOSE	40
5:3 FTCA, 7:3 FTCA	80
FBSA-I, PFECHS, FHXSA-I, P37DMOA, FOUEA, 6:2 diPAP, 8:2 diPAP	6.67
PFHxDA, PFODA	3.33
L-PFUdS, L-PFTrDS	2
6:2 PAP, 8:2 PAP, PFDPA	13.33
All other PFAS*	4

*All PFAS are visible in Figures below

SPE Extraction:

Solvent 1 = Methanol, **Solvent 2** = H_2O, **Solvent 5** = 0.1% NH4OH MeOH
W1 = Aqueous waste, **W2** = Organic waste

Table 2 – EN 17982-2024 extraction steps programmed on the SPE-03.

Action	Inlet 1	Flow	Volume	*Description*
Elute W2	Solvent 5	5 mL/min	10 mL	*Condition cartridges with 10 mL 0.1% NH4OH MeOH*
Elute W2	Solvent 1	5 mL/min	10 mL	*Condition cartridges with 10 mL Methanol*
Elute W1	Solvent 2	5 mL/min	10 mL	*Condition cartridges with 10 mL Water*
Add Sample W1	Sample	5 mL/min	65 / 285 mL	*Load samples at 5mL/min. Using an excess amount to ensure all sample liquid in the bottles are loaded*
Shake	Time based		20 sec	*Vibrate the bottle to remove water droplet from bottle wall.*
Add Sample W1	Sample	5 mL/min	5 mL	*Drain any residue liquid*
Rinse	Solvent 2 (Air 20%)	70 mL/min	5 mL	*Rinse bottles with 4 mL H_2O+1 mL of air. The air helps with dispensing the liquid for better rinsing.*
Add Samp W1	Sample	5 mL/min	10 mL	*Deliver all rinsate through cartridges to waste*

Shake	Time based		15 sec	*Vibrate the bottle to remove water droplet from bottle wall.*
Air-Purge W1	Air	5 mL/min	5 mL	*Purge large water droplets out of cartridges*
Add Samp W1	Sample	5 mL/min	5 mL	*Deliver residue rinsate through cartridges*
Blow N2	Time based		5 mins	*Dry cartridges with nitrogen for 5 mins at 2.5 L/min*
Rinse	Solvent 5 (Air 20%)	70 mL/min	6 mL	*Rinse bottles with 4.8 mL 0.1% NH4OH MeOH+1.2 mL air*
Collect 1	Sample	5 mL/min	5 mL	*Collect rinsate through the cartridges into fraction 1*
Rinse	Solvent 5	70mL/min	5 mL	*Rinse bottles with an additional 5mL 0.1% NH4OH MeOH*
Collect 1	Sample	5 mL/min	5 mL	*Collect rinsate through the cartridges into fraction 1*
Shake	Time based		10 sec	*Vibrate the bottle to remove solvent droplet from bottle wall.*
Collect 1	Sample	5mL/min	10mL	*Collect rinsate through the cartridges into fraction 1*

The extraction took just 51 minutes and 1 hour 51 minutes to complete for 8 x 50 mL and 8 x 250 mL samples, respectively. The extract was collected for post-processing and concentration.

Post Extraction and Concentration:

5 µL of concentrated acetic acid and 10 µL NIS (MPFAC-HIF-IS) solution were added to each sample eluate and vortexed. Depending on the sensitivity of the instrument, samples could be directly measured by LC-MS/MS or evaporated to 1 mL using a D-EVA Rotational Vacuum Concentrator (temperature: 45 °C, vacuum: 20 mbar) and transferred into a 1.5 mL polypropylene vial for LC-MS/MS analysis (kept at 0–4 °C if storage was required). In this application note, the extract was concentrated to 1 mL.

RESULTS

A cartridge blanking test was performed by eluting the cartridge with 10 mL of 0.1% NH_4OH in MeOH, then concentrating the basic MeOH to 100–200 µL and measuring it by LC-MS/MS. Aquaris™ PFAS WAX

cartridges (both C-WAX-3 mL-60 mg and C-WAX-6 mL-200 mg) were free of blank values, as shown in Figure 1 (both cartridges were tested, but only the C-WAX-6 mL-200 mg data are shown).

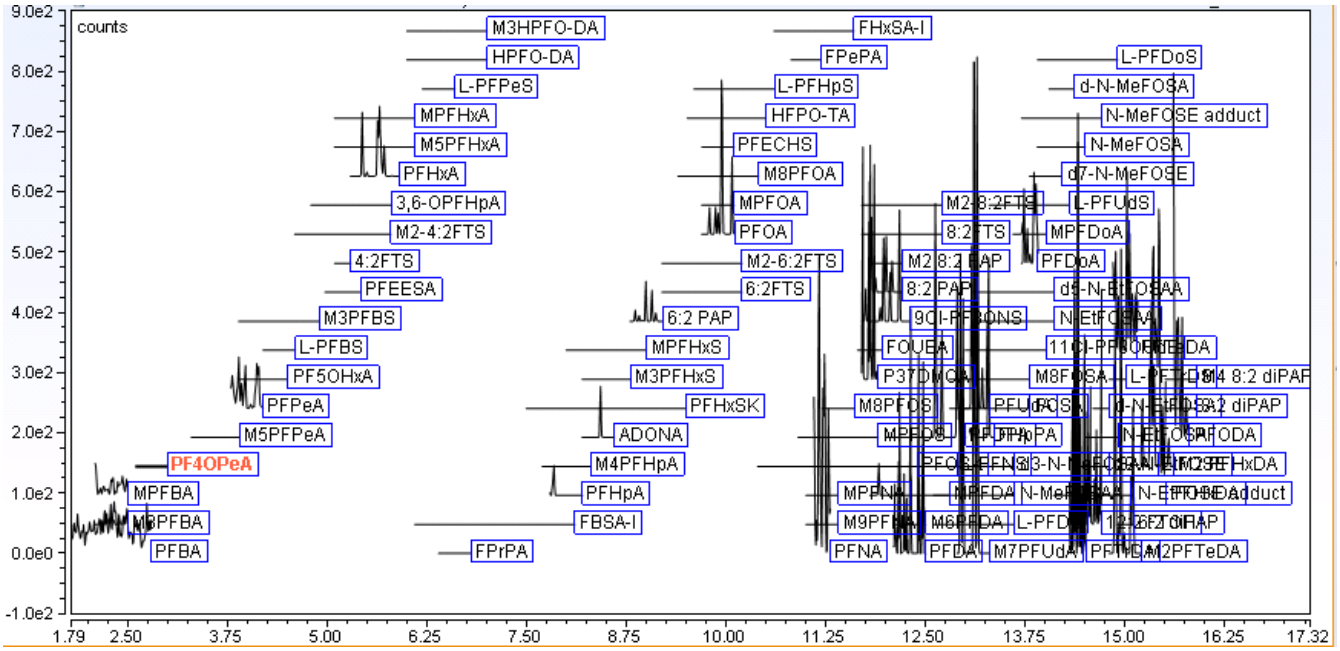


Figure 1 – Chromatogram demonstrating that Aquaris™ PFAS WAX cartridges were free of blank values when screened for 55 PFAS analytes.

Recoveries of 55 native PFAS using different Aquaris™ PFAS WAX cartridges at varying sample volumes were shown in Figures 2 and 3. Native recoveries represented absolute recoveries without surrogate correction. Most analytes met or exceeded EN 17892 performance data (red dots), except FOSA at 250 mL (but still recovered at 85%). Overall, mean recoveries and %RSDs for all analytes remained within the interim acceptance criteria (±30% mean recovery, <30% RSD).

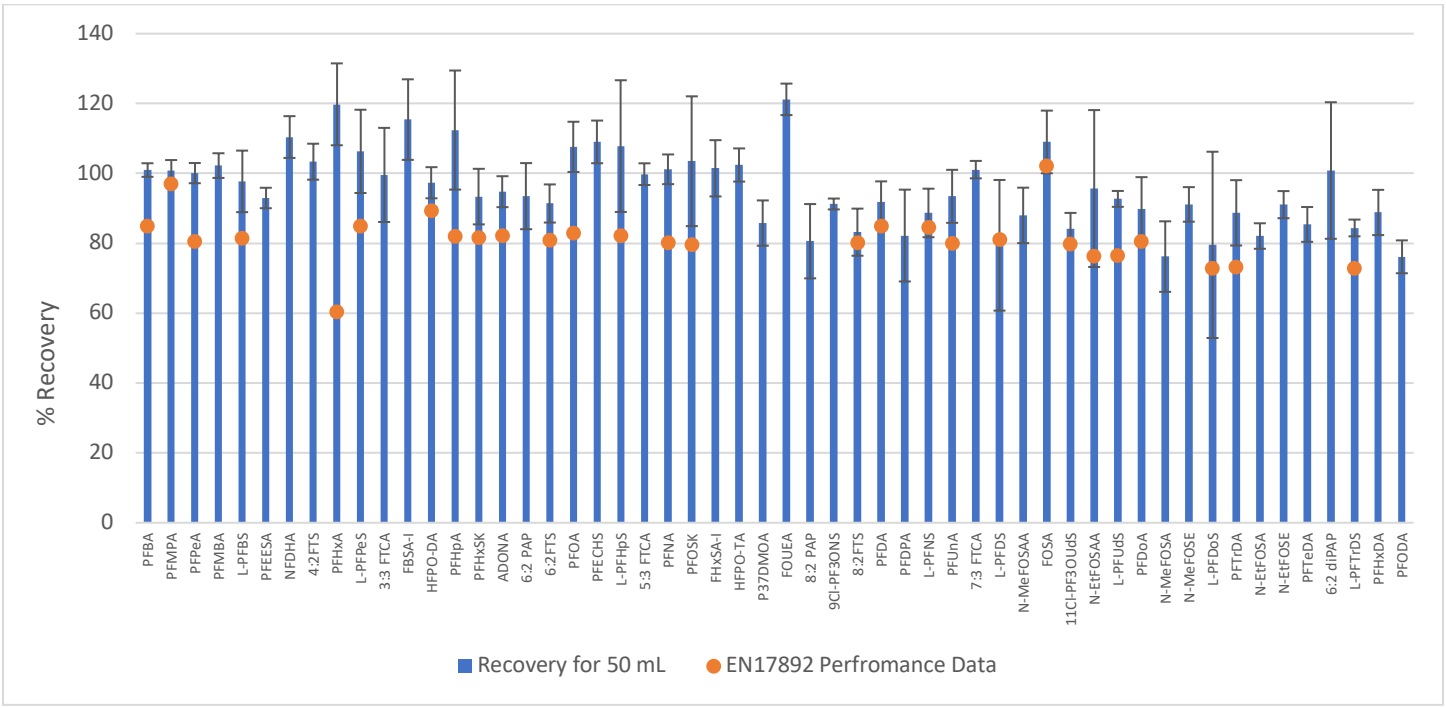


Figure 1 – Extraction of 55 native PFAS with Aquaris™, PFAS WAX, 60 mg, 3 mL, sample volume = 50 mL drinking water (n= 4)

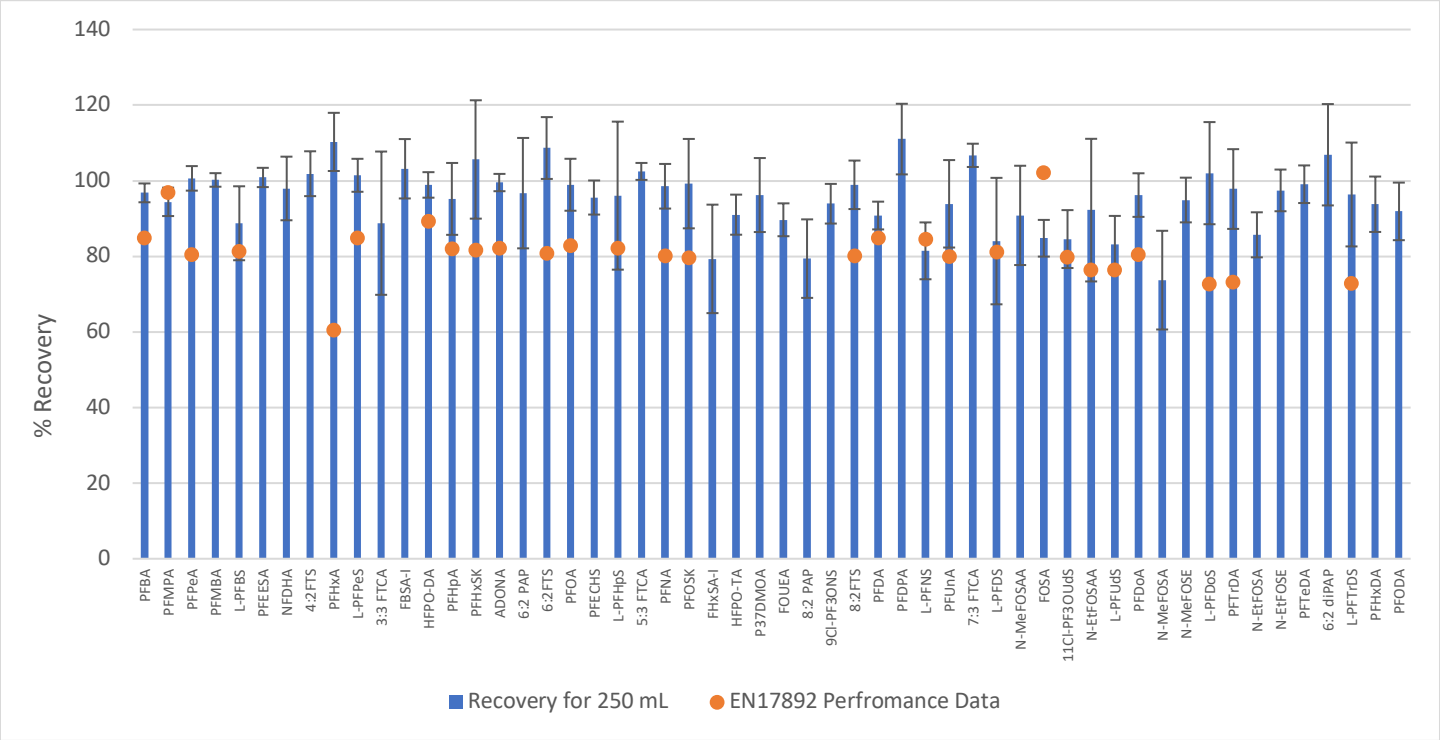


Figure 2 – Extraction of 55 native PFAS with Aquaris™, PFAS WAX, 200 mg, 6 mL, sample volume = 250 mL drinking water (n= 4)

The recoveries of 24 surrogate PFAS in different Aquaris™ PFAS WAX cartridges in relation to different sample volumes were shown in Figure 4. For all surrogates, the average recoveries and %RSDs were well within the interim acceptance criteria of ±30% from the true value for mean recovery and <30% for RSD.

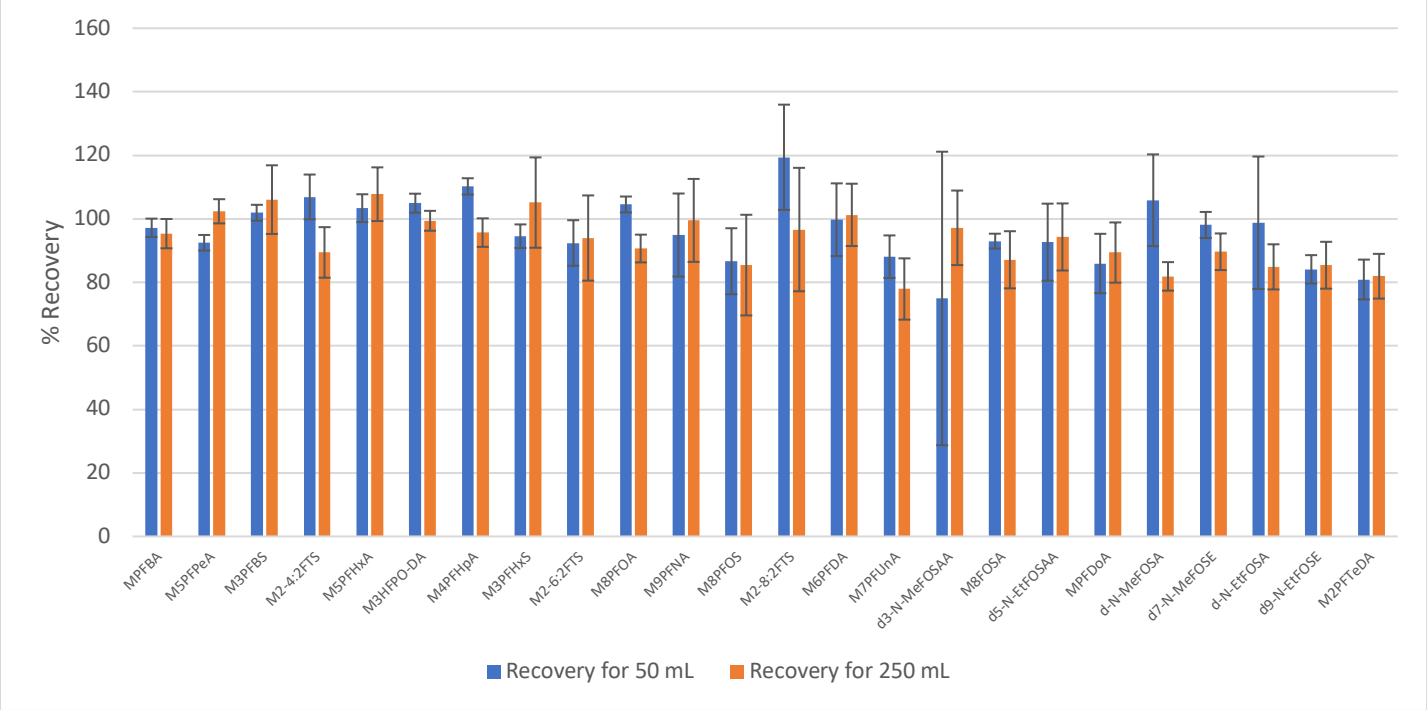


Figure 3 – Extraction of 24 surrogate PFAS with Aquaris™, PFAS WAX, 60 mg, 3 mL, sample volume = 50 mL drinking water (n= 4) ***blue bar*** *and Aquaris™ , PFAS WAX, 200 mg, 6 mL, sample volume = 250 mL drinking water (n= 4)* ***red bar***

Overall, the SPE-03 system with PromoChrom's Aquaris™ PFAS WAX cartridges demonstrated excellent recoveries and consistency.

Effect of Elution Volume on Long Chain (C9-C18) PFAS

Many PFAS eluted readily with low elution volumes; however, long-chain PFAS bound more strongly to the cartridges. When recoveries of long-chain PFAS were reduced, increasing the elution volume improved analyte release. Figure 5 compared 5 mL and 10 mL elution volumes for C9 and higher PFAS.

The additional 5 mL elution was particularly beneficial for 9Cl-PF3ONS, PFDPA, L-PFDS, 11Cl-PF3OUdS, L-PFUdS, L-PFDoS, and L-PFTrDS, increasing recoveries to nearly 100%. Nevertheless, even with only 5 mL elution, recoveries of all long-chain analytes remained within the interim acceptance criteria (±30%) and also met the EN 17892 performance data for those compounds.

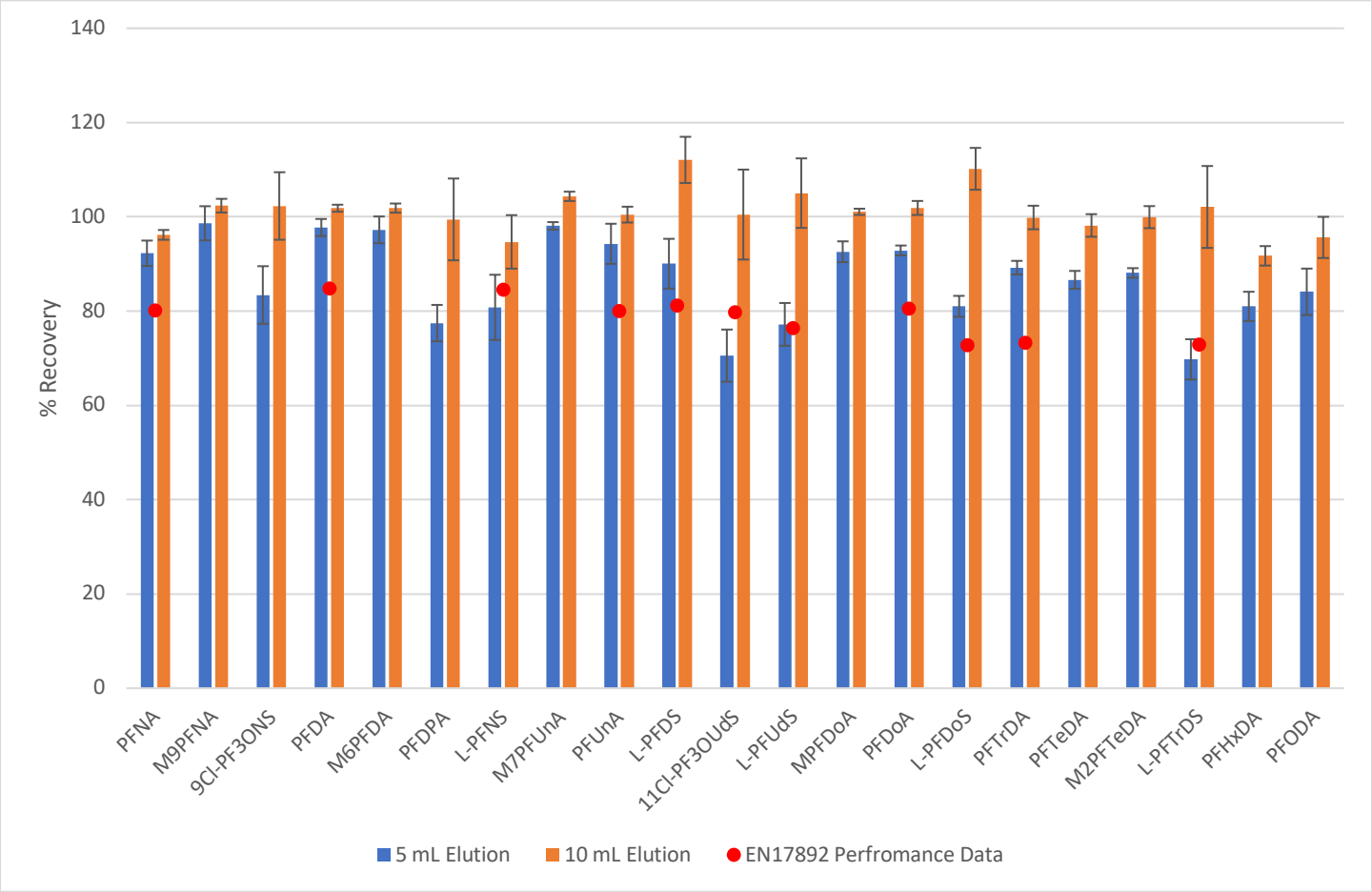


Figure 4 – Extraction of long chain PFAS in Aquaris™, PFAS WAX, 60 mg, 3 mL, sample volume = 50 mL drinking water (n= 4)

CONCLUSIONS

PromoChrom's SPE-03 system, coupled with Aquaris™ PFAS WAX cartridges, offered a quick and effective solution for the extraction of PFAS from drinking water following the EU method. Aside from achieving excellent recoveries, it provided high efficiency by fully automating the extraction process for 8 samples in parallel. It delivered reliable and robust results. Automating SPE is a time- and cost-saving alternative for every laboratory.

ORDERING INFORMATION

Part No.	Description	Notes
SPE-03-P-PE with -ADD-002 -S03-ADD002-SA-L-D-PE -S03-P-SA-C-CM	PromoChrom SPE-03 Plus for PFAS analysis with upside-down sample loading (≤250mL)	Automated SPE System https://www.promochrom.com/spe-03
C-WAX-3mL-60mg	60 mg WAX sorbent in 3 mL cartridge	To extract PFAS from small sample size aqueous samples https://www.promochrom.com/spe-cartridges
C-WAX-6mL-200mg	200 mg WAX sorbent in 6 mL cartridge	To extract PFAS from aqueous samples https://www.promochrom.com/spe-cartridges
F-HC-30	High-Capacity Inline Filter	To enable the extraction of samples with particulates https://www.promochrom.com/inline-filters
D-EVA	Automated evaporation device	For automated evaporation https://www.lctech.de/de/produkte/pcdd-f-pcb-und-weitere-pops/evaporation-d-eva

References

[1] ISO/CEN. (2024). EN 17892:2024 – Water quality – Determination of selected per and polyfluoroalkyl substances in drinking water – Method using LC MS/MS. European Standard

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