

Demonstration of Low PFAS Background Associated with the TurboVap® LV Automated Solvent Evaporation System

Environmental laboratories require a system which is clean, reliable, and affordable to evaporate the extracts resulting from the preparation of samples for PFAS testing. This document will outline a protocol that was developed for the TurboVap® LV system to evaporate extracts in methanol to dryness consistent with typical environmental PFAS procedures. It will also show data resulting from this protocol which demonstrates the cleanliness of the system for PFAS compounds using a sample analogue.



Experimental Design

To simulate a standard PFAS extract which would result from either an automated or a manual solid-phase extraction (SPE) procedure, 15 mL of methanol was added directly to polypropylene centrifuge tubes (VWR p/n 21008-670). The centrifuge tubes were loaded onto the 48-position Multi Rack within a TurboVap® LV and the protocol provided in Table 2 was used to concentrate the samples to dryness. The dry extracts were reconstituted in 1-mL storage vials using 990 µL of 96% methanol/4% water and 10 µL of an internal standard mixture was added. The resulting extracts were analyzed on an LC-MS/MS for the target compounds given in Table 1.

Note: For more in-depth information on the preparation procedure or the materials and equipment used, please refer to

application note AN958 entitled “Manual Extraction of PFAS in Drinking Water in Compliance with EPA Method 537.1.”

Table 2. TurboVap® LV Concentration Protocol.

| | |
|-------------------------|------------------------|
| Bath Temp | 60 °C |
| Evaporation Mode | Method (Ramp Gradient) |
| Manifold Setup | 48 positions |
| Rack Row Height | 120 mm* |
| Step 1 | 2.5 L/min for 15 min. |
| Step 2 | 3.0 L/min for 15 min. |
| Step 3 | 3.5 L/min for 45 min. |

*The nozzle position was adjusted such that it was as far to the right as possible to give the user a clear view of the vortex within the tube.

Table 1. PFAS analytes examined as possible contaminants within the evaporation and analysis steps of a standard extraction procedure.

| Target Analyte | Acronym | CASRN |
|---|--------------|--------------|
| Perfluorobutanesulfonic acid | PFBS | 375-73-5 |
| Perfluorohexanoic acid | PFHxA | 307-24-4 |
| Hexafluoropropylene oxide dimer acid | HFPO-DA | 13252-13-6b |
| Perfluorohexanesulfonic acid | PFHxS | 355-46-4 |
| 4,8-dioxa-3H-perfluorononanoic acid | ADONA | 919005-14-4e |
| Perfluoroheptanoic acid | PFHpA | 375-85-9 |
| Perfluorooctanoic acid | PFOA | 335-67-1 |
| Perfluorooctanesulfonic acid | PFOS | 1763-23-1 |
| Perfluorononanoic acid | PFNA | 375-95-1 |
| 9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid | 9Cl-PF3ONS | 756426-58-1d |
| Perfluorodecanoic acid | PFDA | 335-76-2 |
| Perfluoroundecanoic acid | PFUnA | 2058-94-8 |
| N-ethyl perfluorooctanesulfonamidoacetic acid | NETFOSAA | 2991-50-6 |
| 11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid | 11Cl-PF3OUdS | 763051-92-9c |
| N-methyl perfluorooctanesulfonamidoacetic acid | NMeFOSAA | 2355-31-9 |
| Perfluorododecanoic acid | PFDoA | 307-55-1 |
| Perfluorotridecanoic acid | PFTrDA | 72629-94-8 |
| Perfluorotetradecanoic acid | PFTA | 376-06-7 |

Results

The data shown in Table 3 was generated using a protocol with a Minimum Reporting Level (MRL) of 2 ng/L for all compounds. In the cases where certain compounds were available only in their salt form, the masses of the compounds were adjusted accordingly to correct for the salt content (Table 3). As typical of many environmental methods, for a system to be deemed

“clean,” it must demonstrate that any background present is less than one-third of the MRL ($1/3$ MRL). An examination of the background data collected shows that the highest observed concentrations detected for all analytes are approximately 3.5x lower than the $1/3$ MRL limit given by typical environmental methods.

Table 3. Results of PFAS Evaporation Background Study (recoveries in ng/L).

| Replicate | MRL Conc. | TurboVap® LV | | | | | |
|---------------|-----------|--------------|-------|-------|-------|-------|-------|
| | | 1 | 2 | 3 | 4 | 5 | 6 |
| PFBS* | 1.77 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. |
| PFHxA | 2.0 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. |
| HFPO-DA | 2.0 | N.D. | N.D. | N.D. | 0.002 | 0.006 | N.D. |
| PFHxS* | 1.89 | N.D. | N.D. | N.D. | N.D. | 0.061 | N.D. |
| ADONA* | 1.89 | N.D. | N.D. | N.D. | N.D. | N.D. | 0.004 |
| PFHpA | 2.0 | N.D. | 0.030 | 0.012 | 0.031 | 0.024 | 0.012 |
| PFOA | 2.0 | 0.073 | 0.069 | 0.050 | 0.071 | 0.071 | 0.063 |
| PFOS* | 1.91 | 0.143 | 0.143 | 0.115 | 0.145 | 0.130 | 0.137 |
| PFNA | 2.0 | N.D. | 0.015 | 0.013 | 0.005 | 0.014 | N.D. |
| 9CI-PF3ONS* | 1.86 | N.D. | 0.004 | N.D. | 0.005 | 0.002 | 0.003 |
| PFDA | 2.0 | N.D. | N.D. | N.D. | 0.005 | 0.013 | N.D. |
| PFUnA | 2.0 | N.D. | N.D. | N.D. | 0.026 | N.D. | 0.012 |
| NEtFOSAA | 2.0 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. |
| 11CI-PF3OUdS* | 1.88 | N.D. | 0.006 | N.D. | N.D. | 0.003 | N.D. |
| NMeFOSAA | 2.0 | N.D. | N.D. | N.D. | N.D. | N.D. | 0.013 |
| PFDoA | 2.0 | N.D. | 0.004 | N.D. | 0.007 | 0.008 | 0.007 |
| PFTTrDA | 2.0 | N.D. | 0.003 | N.D. | 0.013 | 0.014 | N.D. |
| PFTA | 2.0 | N.D. | N.D. | N.D. | N.D. | 0.004 | N.D. |

*Analytes were used in their salt form and calculated concentrations were corrected to compensate where needed.

Note: Where “N.D.” is indicative of the inability of the target peak to be separated from the system background.

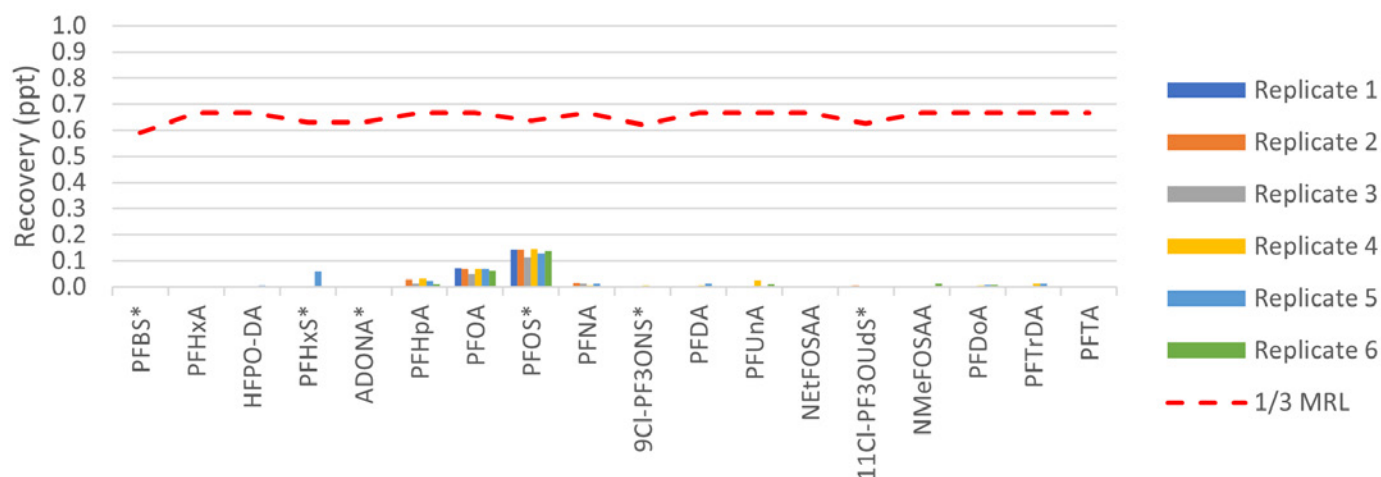


Figure 1. PFAS Background of the TurboVap® LV.

*Analytes were used in salt form and their calculated concentrations were corrected to compensate.

Discussion

Separating the sample preparation process into its major components and examining them independently allows for the systematic elimination of factors contributing to the background of the overall process. In this document, the extraction process for a typical PFAS environmental sample was eliminated, and the evaporation and analytical processes were examined using a sample analogue. The experiment demonstrates that the TurboVap® LV, along with the other supplies and equipment used, fulfill the requirements for PFAS background levels and are thus acceptable to use in the general production of PFAS data for environmental compliance work.

Ordering Information:

| Part Number | Description |
|---------------|--|
| 415000 | TurboVap® LV Automated Solvent Evaporation System |
| 414964 | TurboVap® LV Multi Rack (48 Positions, 10-20 mm Tubes) |

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