PFAS Sentinel Passive Samplers

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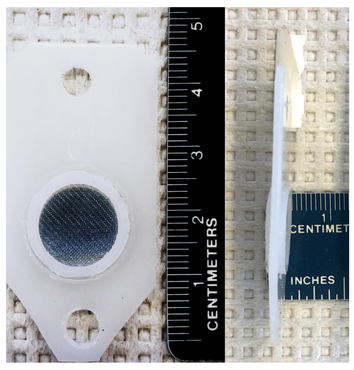
Sentinel™ passive sampler description

- Designed for rapid uptake using an Osorb®-based adsorbent modified for optimal PFAS adsorption
- Small (2.5 cm x 4.5 cm x 2 mm) and durable (HDPE or stainless steel) sampler body
- Measures a wide range of PFAS analytes and yield representable results
- Provides time-weighted average concentrations in surface water, groundwater, sediment porewater and industrial discharges.

Passive sampler design

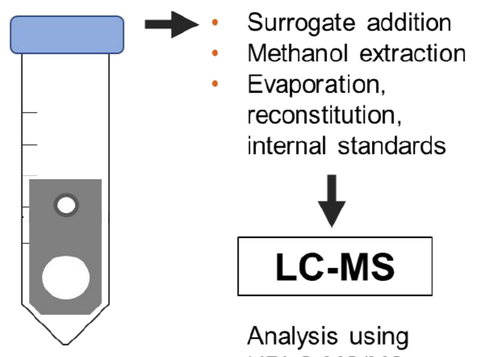
- Prototype designed in SERDP project ER20-1127
- Commercial manufacture by Aquanex Technologies, LLC*
  - Sentinel™ PFAS passive samplers for water and sediment pore-water are commercially available
  - Multiple deployments in North America and Europe



Polyethylene construction with 80-mesh granular Cu(II)-polyethyleneimine-Osorb® adsorbent

Stainless steel for sediment pore-water

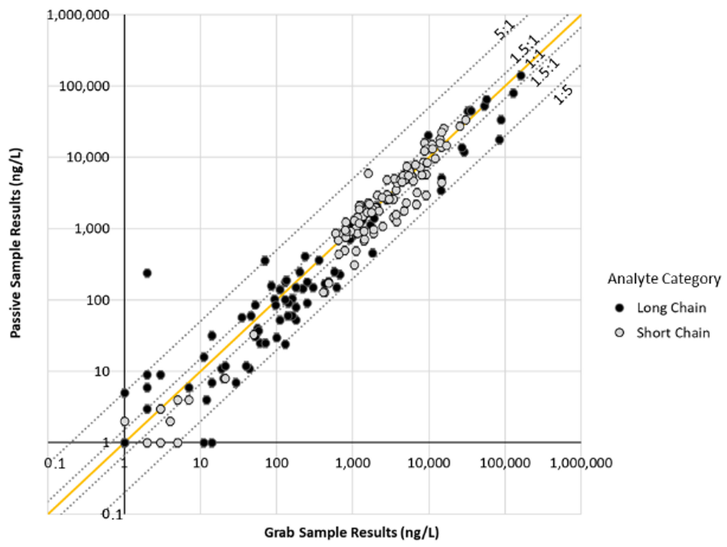
- Swellable hydrophobic particles
- Weak anion-exchange groups
- Cu(II) for high affinity binding of short chain PFAS



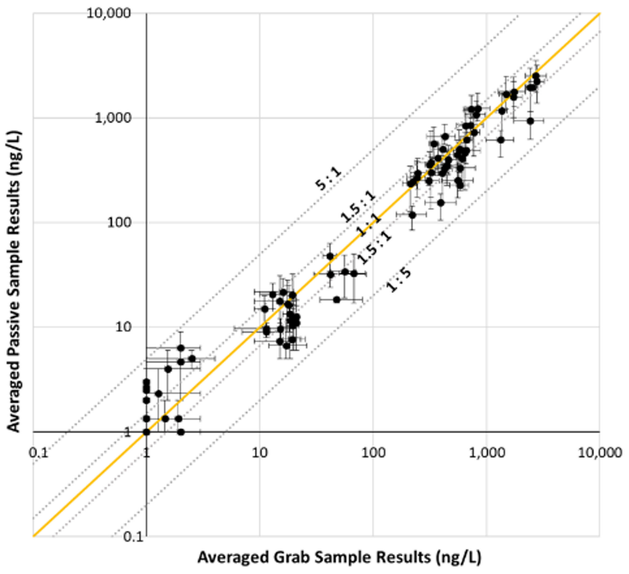
Sampler recovered and shipped in standard centrifuge tube.

Analysis using HPLC-MS/MS or total organofluorine methods.

Field results



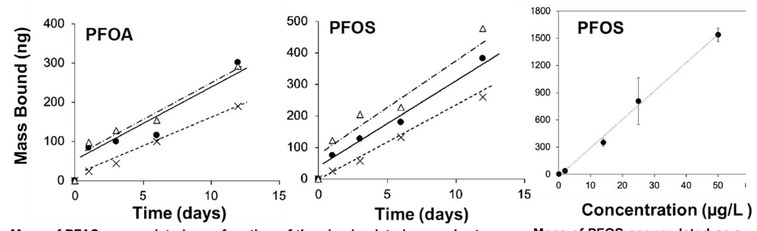
- 14-day deployment at 7 well locations, 2 sample events
- 56% of 163 paired passive and grab sample detections matched <1.5X
- 71% matched <2X of each other, 97% <5X of each other
- No distinction between long- and short-chains
- Measurement precision within symbol size



- 3 passive samplers deployed at each of 5 locations
- Multiple paired grab samples collected over 4-day passive sampler deployment period (n=2 to 8)
- 58% of avg passive sampler results and 47% of individual passive sampler results matched <1.5X of avg grab results
- 77% of avg passive sampler results and 70% of individual passive sampler results match <2X of avg grab results
- Surface water grab samples represent snapshots in time. Passive samplers represent time-weighted average.

- Overall 1:1 Correspondence with grab samples over five orders of magnitude concentrations.
- Good performance for both short- and long-chained PFAS.
- Provides time-weighted average concentrations – key for understanding discharges and mass flux.
- Applications in surface water, groundwater, sediment porewater and industrial discharges.

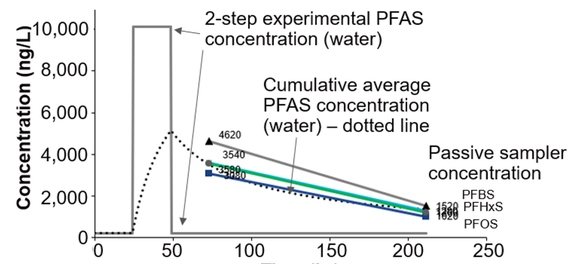
Laboratory results



Mass of PFAS accumulated as a function of time in simulated groundwater, 1 µg/L PFAS, T=25°C. Flow rates varied: 0.038 cm/min (cross), 0.38 cm/min (circle), 1.9 cm/min (triangles). Uptake is linear.

Mass of PFOS accumulated as a function of concentration. Uptake is linear.

- Consistent and fast uptake rates show applicability to a wide range of environmental water types (typically 2-3 weeks deployment time);
- Limited sensitivity to water ionic strength, pH and TOC;
- Integrative sampling provides concentration values that are time-averaged.



PFAS concentration profile during variable-concentration experiments demonstrates integrative (time-weighted) behavior

Field deployments of Sentinel™ Samplers