Time Integrative In Situ Field Extraction Techniques and Advantages

AQUALYTICAL

C-I-Agent® STORM-WATER SOLUTIONS

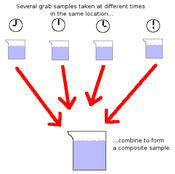
The Problem With Samplers

Standard grab sampling

only provides a few second snap shot in time of a changing dynamic system, and a liter sample to take to the laboratory for extraction and analysis.

Automatic and Composite Sampling

Equipment is bulky, heavy, and expensive. Hydrophobic contaminates will adhere to the receiving container walls and tubing, **biasing the results low**. Provides a liter aliquot, an intermitter sample, and standard reporting limits.



Passive samplers

provides a time integrative partitioning event, and ultra low detection. The results are dependent upon; temperature, flow, bio-fouling, compound specific reference coefficients, and complicated mathematical modeling for any approximate values.

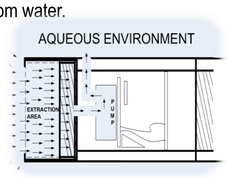
"The ideal sampler should be small, stealth, and able to continuously field sample for extended periods of time in a quantitative manner. It should also be immune to the effects of temperature, flow and bio-fouling, and provide ultra-low quantitative detection capabilities if necessary."

Extracting A Solution

A Submersible SPE Extractive Sampler was Designed to Address the Problem

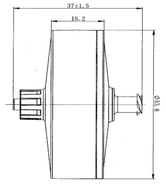
The **C.L.A.M. (Continuous Low -Level Aquatic Monitoring**) was developed to produce this unique extract. The **C.L.A.M.** is a small submersible extraction sampler, using EPA approved methodology **3535**, utilizing **SPE** (Solid Phase Extraction) media disks to sequester Pesticides, Herbicides, PAH's, TPH, and other trace organics from water.

The **C.L.A.M. Actively** extracts the water submerged, by vacuum drawing water through a SPE disk. It provides a pre-extracted **quantitative** sampling event, with a **known water volume** of up to 100 liters, lowering the laboratory detection limits a hundred fold.



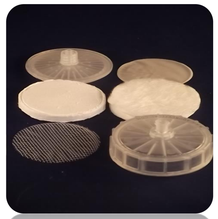
C.L.A.M.s weigh just over one pound, including the 4 AA batteries, and many can be easily taken to remote areas and left unattended to sample continuously for up to 36 hours at submerged depths up to 50 feet in marine or fresh waters.

C.L.A.M. Disk Design and Capabilities



The **C.L.A.M.** uses field hardened encasements to actively draw a known volume of water through the SPE media during the extraction event. All the SPE media types are supported in custom housings which incorporate inlet flow dispersion, triple lofted glass pre-filters, supporting filters, and inert screens to field harden and reduce clogging.

•Disk encasements are manufactured using high density polypropylene (HDPP)
•The disposable SPE extraction cartridges, disks and syringes used in the laboratory for over 15 years are made of the same HDPP
•The disks interior design uses HDPP media supporting screens, dispersion baffles, and glass pre-filtration filters to ensure an inert environment.



The Solid phase media disks contain the standard media types: **HLB** for polar and non-polar compounds and CEC's. **C-18** for most non-polar groups such as PCB's, pesticides, PBDE's Dioxins, Furans and TPH. **Glass Depth filtrations disks** with 1.5 micron rating are also available.

The disks can be Luer-Locked together to provide a multi-stage system for total and dissolved studies, varied media stages or breakthrough studies. The disks are also supplied with Luer plugs which can seal the disks after conditioning or deployment for secure transportation.

SPE Disk Conditioning and Elution

- **C.L.A.M.** Disks need to be solvent cleaned and conditioned prior to field deployment.
- Spiking surrogates / analytes can be added before or after deployment prior to elution by spiking directly into the inlet disk media..
- The disk encasement acts as both a shipping container and disk elution support holder.

- Disks are solvent eluted with a syringe or vacuum eluted like current SPE cartridge or disks in the laboratory are today..
- Laboratory acceptance criteria can be performed for each method, just as with standard SPE disks or cartridges.
- MDL and IDC's can be performed prior to field deployment.

Shipping and Extraction Costs

- The disk encasement is supplied with Luer Lok plugs which seal the disk after conditioning or deployment, providing a secure container for shipment and storage.
- Field extraction leaves the water behind saving on shipping costs. A disk after extracting 100 liters weighs just **0 .05 pounds,** whearas100 liters of water could weigh over **300 pounds** including bottles, ice and shipping coolers.

- A fully deployed disk represents a time integrative extraction event of up to 36 hours, and a field extracted volume of up to 100 liters.
- The a small dry disk to solvent elute and analyze, providing **Ultra low** detection levels with out the effort of extracting huge volumes of bottled water.

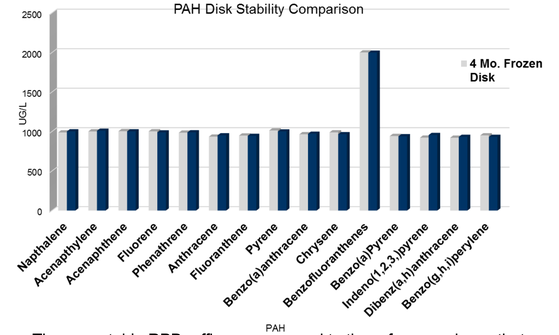
Holding Time Study and Storage Advantages

Water samples submitted to environmental laboratories for trace organic analysis have a 7 day holding time period to extract the sample, or face non-conformance issues. The C.L.A.M. SPE disks are considered a solid, and avoid these issues. The disks can be frozen unlike bottled water samples , and stored for months without losing analyte integrity.

- A four month holding time efficacy study was conducted on disks conditioned with oleophilic bacteria enriched water, spiked with a 100ul PAH solution mix of 100 mg/l, and stored frozen at -20 C.
- After four months, the disk was thawed and solvent eluted, the extract was dried and adjusted to a final concentration of 10 ml's.
- A new disk was conditioned, spiked and eluted along with the four month frozen stored disk as a reference disk. Recovery data from the frozen disk was compared to this disk for RPD comparison.
- The resulting extracts were analyzed using GC/MS per method 8270 the resulting data and graph is shown below.

Analyte	4 mo. Frozen Disk Solution Conc. ug/l	Reference Disk Solution Conc.ug/l	Relative Percent Difference
Naphthalene	989	1002	1.41
Acenapthylene	1002	1010	0.99
Acenaphthene	1005	1002	0.29
Fluorene	1003	989	1.41
Phenathrene	986	990	0.41
Anthracene	936	952	1.69
Fluoranthene	950	945	0.53
Pyrene	1014	1001	1.23
Benzo(a)anthracene	926	972	4.85
Chrysene	990	966	2.45
Benzofluoranthenes	2022	1908	5.31
Benzo(a)Pyrene	944	990	5.18
Indeno(1,2,3,)pyrene	923	956	3.51
Dibenz(a,h)anthrace	922	993	7.42

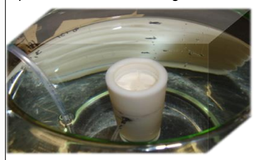
Graph of Efficacy of 4 Month Frozen VS. Reference



The acceptable RPD efficacy compared to the reference shows that the deployed disk can be stored in a frozen state for months without analyte degradation. Stopping the holding time clock for this method of sampling provides laboratories sample scheduling flexibility in peak times saving time and materials .

Composite Sampling Analyte Loss

In the real world, the aquatic environment is not contained in bottles, to sample it accurately the water must not contact any vessel, tubing or pump which isn't **solvent** rinsed and combined with the **sample extract**. Composite sampling where aliquots of samples are taken from a larger container to provide method samples does not provide solvent rinsing of the initial container walls.



A study of surface adhesion of non polar compounds with high Kow values were lost on the surface walls, tubing and pump. The study showed losses of up to 75% of the carcinogenic PAH's such as BAP , and other non-polar compounds.

Sub-set sampling as done today, is providing samples to the environmental laboratory that are **biased low** for most all non-polar target analytes, simply because the holding container can't be solvent rinsed into the sub-set bottles.

The **C.L.A.M.** solves this problem by drawing the sample into the disk first before contact with any tubing or pump, providing a continuous time integrated sample that is orders of magnitude lower in detection. The solvent elution extract volume of the disk can then be divided into equal subsets, each representing many liters for analysis of multiple methods..

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