Traditional environmental monitoring relies on water or soil samples being taken at various time increments and sent to offsite laboratories for analysis. Presence on grab samples generally captures limited "snapshots" of environmental contaminant concentrations, is time intensive, costly, and generates residual waste from excess sample and/or reagents used in the analysis procedures. As an alternative, we are evaluating swellable organosilica sorbents to create passive sampling systems for monitoring applications. Previous work has focused on absorption and detection of fuels, chlorinated solvents, endocrine disruptors, explosives, pesticides, fluorinated chemicals, and metals including Ba, Sn, Hg, Pb, Fe, Cu, and Zn. The advantages of swellable organosilicates are that the material can capture target compounds for an extended periods of time, does not absorb natural organic matter, and resists biofilm formation since the sorbent possesses an annulated surface morphology.

**Project Goals:**

1. Measure capture affinity for a wide range of chemical species related to oil and gas E&P operations.
2. Develop effective calibration methods for quantification.

Swellable organosilicas are capable of absorbing liquid and gaseous compounds.

**Commercially available as Osorb®:**

**Absorbs organic solvents out of water:**

- Swellable organosilicas capture target compounds for extended periods of time, do not absorb natural organic matter, and resists biofilm formation, since the sorbent possesses an annulated surface morphology.

**Surface Area and Pore Volume**

- **Type**
  - Type A: 1000 m²/g
  - Type B: 500 m²/g
  - Type C: 100 m²/g

**Tests & Distributions (%):**

- Knudsen diffusion: 40%
- Diffusion: 30%
- Micropores: 30%

**Complex Emulsions**

- **Metal and Emerging Contaminants**
  - Sampling and Recovery of Pharmaceutical Compounds from Natural Waters

**Chemical Composition**

- **Hydrocarbons**
  - Saturated hydrocarbons
  - Aromatic hydrocarbons
  - Polycyclic aromatic hydrocarbons

**Vapors**

- **Water**
  - Water vapor sampling

**Solvents and Hydrocarbons**

- **Hydrocarbons**
  - Saturated hydrocarbons
  - Unsaturated hydrocarbons
  - Aromatic hydrocarbons
  - Polycyclic aromatic hydrocarbons

**Chromatogram run monitoring for TNT detection in passive water sampler (50°C).**

**Application:**

- Oceanic sensor for spill detection.
- Water quality.
- Reel-to-Reel sampling.

**Surface Pore Distribution (%)**

- **Type A**
  - Total surface area = 1000 m²/g
  - Pore volume = 1000 m³/kg

**Initial work studying the use of swellable organosilicas for passive sampling applications has shown that the materials have the ability to absorb a wide number of chemical species.**

**Extraction of organic compounds is most pronounced due to the hydrophobic expandable matrix.**

**Silica matrix can be functionalized with ligands that bind metals or to tailor to bind fluorinated compounds.**

**Preliminary field testing shows sampling can be done for at least 16 days with minimal biofilm formation.**

**Disso Dissolved hydrocarbons**

- **TNT**
  - Concentration = 10 ppb
  - Time = 2 days
  - Concentration = 100 ppb
  - Time = 16 days

**Metal and emerging contaminants**

- **Sampling and Recovery of Pharmaceutical Compounds from Natural Waters**

**Form Factors**

- **Treatment of Ag Water and Flow Back Water**
  - Initial work on sewage and flow back water.
  - Treatment of flow back water with 0.4% swellable organosilica.

**Kinetically driven processes:**

- 60% ± 10% faster

**Power free:**

- Some temporal data may be achieved by depth of penetration into Osorb.

**Uses Osorb’s ability to swell to actuate an alarm:**

- Application: Oceanic sensor for spill detection.

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