

Polycyclic Aromatic Hydrocarbons in Drinking Water by Solid Phase Extraction (SPE)



Introduction

PAHs are hazardous compounds found in petroleum and emissions from fossil fuel consumption. Physically, PAHs are neutral, nonpolar organic molecules that comprise two or more benzene rings arranged in various configurations. Members of this class of compounds exhibit toxic and hazardous properties, and for this reason the U.S. Environmental Protection Agency has included 16 PAHs on its list of priority pollutants to monitor in water and waste.

Analytically, PAHs present challenges for testing labs. Their volatile nature can make them problematic to extract without loss using manual methods. This is especially true for the evaporation/concentration of sample extracts.

The following procedure utilizes the FMS PowerPrep™ SPE extraction system in combination with the SuperVap™ concentrator (Figure 1) to extract PAHs from drinking water.

Instrumentation

- FMS, Inc. PowerPrep SPE (Solid Phase Extraction) System
- FMS, Inc. SuperVap Concentrator
- FMS, direct-to-vial concentrator tubes
- Thermo Trace Ultra GC with DSQ MS

Consumables

- Waters Oasis® HLB (1 gram)
- Fisher Pesticide Grade Methanol
- Fisher Pesticide Grade Methylene Chloride
- Fisher HPLC Grade Water
- Fisher Anhydrous Sodium Sulfate

Procedure

PowerPrep SPE

1. Cartridges conditioned with 10 mL MeOH
2. Cartridges conditioned with 15 mL H₂O
3. Samples loaded across cartridges at ~75 mL/min
4. Sample bottles rinsed with H₂O; Rinse loaded across cartridges.
5. Cartridges dried with N₂ for 1 minute each.
6. Cartridges eluted with 10 mL Methylene Chloride.
7. Cartridges eluted with 5 mL Methylene Chloride.
8. Elution nitrogen purged directly into FMS SuperVap for concentration.

Total Time ~55 minutes

SuperVap Concentrator

1. Preheat temp: 20 minutes at 40 °C
2. Sensor mode / temp: 40 °C
3. Nitrogen Pressure: 10 PSI



Figure 1: PowerPrep SPE and SuperVap Concentrator systems.



Results

Table 1: Results for five, 1 liter replicates spiked at 50 ppb.

| Compound | Mean Rec. | STD DEV |
|-------------------------|-----------|---------|
| Naphthalene | 86.6% | 4.6% |
| 2-Methylnaphthalene | 88.2% | 3.3% |
| 1-Methylnaphthalene | 83.4% | 4.3% |
| Acenaphthylene | 81.7% | 4.8% |
| Acenaphthene | 92.3% | 6.8% |
| Fluorene | 79.4% | 5.1% |
| Phenanthrene | 87.0% | 3.0% |
| Anthracene | 81.4% | 2.8% |
| Fluoranthene | 93.5% | 2.4% |
| Pyrene | 100.8% | 3.2% |
| Benzo[a]anthracene | 88.3% | 5.1% |
| Chrysene | 93.6% | 6.6% |
| Benzo[b]fluoranthene | 85.5% | 7.0% |
| Benzo[k]fluoranthene | 91.8% | 3.9% |
| Benzo[a]pyrene | 90.5% | 5.1% |
| Indeno[1,2,3-cd]pyrene | 88.9% | 4.0% |
| Dibenzo[a,h]anthracene | 92.3% | 5.2% |
| Benzo[g,h,i]perylene | 88.1% | 3.7% |
| Nitrobenzene-D5 (Surr) | 93.6% | 6.1% |
| 2-Fluorobiphenyl (Surr) | 96.4% | 4.9% |
| p-Terphenyl-d14 (surr) | 81.7% | 5.2% |

Conclusions

Results reported from the PowerPrep™ SPE and SuperVap™ Direct-to-Vial Concentration system (Table 1) show high levels of precision and accuracy for the parallel extraction and concentration of PAHs using the FMS integrated Sample-to-Vial systems. With expanded modules, the PowerPrep SPE system enables the lab to simultaneously extract full batches of sample (up to 30) hands free. Compared to manual extraction processes, this automated technique frees up chemists to focus on increasing sample throughput. The addition of direct to GC vial concentration tubes eliminates the need to manually transfer extract from the concentration tubes to the vials and reduces operator error.

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