Use of a Commercially Available Polyethylene Bag as an Absorptive Medium for Semi-volatile PAH Analyses

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Background

- Solidification/Stabilization [S/S] technology
- Established treatment for MGP sites
- Blend treatment reagents into contaminated material
  - Produce chemical/physical changes
  - Reduce environmental impact to GW/SW
- Technology is applicable
  - Inorganics - Metals
  - Organics - Pest/Herb/PAHs/PCBs/VOCs
Background

- Leachability is a primary S/S performance parameter
- Does the stabilized material retain the contaminants?
- To assess performance:
  - Recognized methods – TCLP
    - Single batch extraction procedures
  - New U.S. EPA LEAF methods
    - Batch
    - Column
    - Flux based leaching
EPA Method 1311 – TCLP
Toxicity Characteristic Leaching Procedure

- TCLP is a batch leaching test
- Single point leachate test
- Particle Size reduction to 9.5mm
- Volatile Extraction fluid- pH 4.93
- Semivolatile/Metals Extraction fluid- acetic acid / sodium hydroxide
- 20:1 liquid/solid ratio
- Leachate generation is 18 hrs
- Designed to simulate leaching a waste will undergo if co-disposed with municipal solid waste
- Used for hazardous waste determination
Science Advisory Board  
Recommendations from 1999  

- TCLP is applied to broadly  
- Leach tests can be improved by accounting for additional parameters  
- Agency’s reliance on a single management scenario has caused difficulties.
EPA Method 1315

- Mass transfer rates of constituents in monolith or compacted granular material using a semi-dynamic tank leaching procedure
- Provides mass transfer rate of COPC as a function of time.

<table>
<thead>
<tr>
<th>Interval Label</th>
<th>Interval Duration (hours)</th>
<th>Interval Duration (days)</th>
<th>Cumulative Leaching Time (d)</th>
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<tbody>
<tr>
<td>T01</td>
<td>2.0 ± 0.25</td>
<td>-</td>
<td>0.08</td>
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<tr>
<td>T02</td>
<td>23.0 ± 0.5</td>
<td>-</td>
<td>1.0</td>
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<tr>
<td>T03</td>
<td>23.0 ± 0.5</td>
<td>-</td>
<td>2.0</td>
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<tr>
<td>T04</td>
<td>-</td>
<td>5.0 ± 0.1</td>
<td>7.0</td>
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<tr>
<td>T05</td>
<td>-</td>
<td>7.0 ± 0.11</td>
<td>14.0</td>
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<tr>
<td>T06</td>
<td>-</td>
<td>14.0 ± 0.1</td>
<td>28.0</td>
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<tr>
<td>T07</td>
<td>-</td>
<td>14.0 ± 0.1</td>
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<tr>
<td>T08</td>
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<td>7.0 ± 0.1</td>
<td>49.0</td>
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<tr>
<td>T09</td>
<td>-</td>
<td>14.0 ± 0.1</td>
<td>63.0</td>
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</table>
U.S. EPA LEAF 1315

• S/S technology creates a monolith
  • Flux based leaching
  • Time - dependent release
• Method is specific for inorganics

1.4 This method is not applicable to characterize the release of organic analytes with the exception of general dissolved organic carbon.

• Challenge: how to use 1315 to evaluate organics [PAHs] associated with MGP sites
Leaching Assessment Methods for the Evaluation of the Effectiveness of In-Situ Stabilization of Soil Material at Manufactured Gas Plant Sites

- Report to evaluate the effectiveness of S/S at MGP sites with an alternative leaching assessment methodology for estimating PAHs from S/S treated soils

- Concerns regarding the low aqueous solubility & potential vaporization of PAHs → Leachate collection modification

  ~ Adsorptive phase polydimethylsiloxane [PDMS] for PAHs from soil/sediment cores
EPRI’s test evaluated 6 primary PAHs
- Included naphthalene and benzo(a)pyrene

Method modification for organics
- Used PDMS as the solid phase absorbent to isolate the free PAHs
- PDMS was extracted with acetonitrile and analyzed by HPLC

Note:
- Extraction efficiency was 50%, therefore the data for the first extract is doubled [2x]
- IDEAL – Integrated Devices for Environmental Assessment and Leaching*

*U.S. patent
Passive Sampler

• TestAmerica considered other passive sampler options
  • Avoid bias correction due to low recoveries [2x factor]
  • Compatible sample prep to facilitate GC/MS analysis
• TestAmerica has experience with passive samplers & PDMS
  • U.S. EPA Method 8272 - Parent and Alkylated PAHs in Sediment Pore Water using Solid Phase Microextraction [SPME] and GC/MS
  • Evaluated material
    ~ PDMS
    ~ Polyethylene [PE]
    ~ POM
PE Approach
PE Approach
PE Approach
PE Approach

- Water extracted via SW846 Method 3520A
- PE Bag extracted via SW846 Method 3580
- Extracts combined and analyzed via SW846 Method 8270D
6 Laboratory Control samples were created.

Average recovery of 17 PAH compounds was 78%.

Average %RSD: 4.80%

Benzo(a)Pryene: Average recovery 72%, 71% recovered from PE Bag. %RSD 4.5%

Naphthalene: Average recovery 84.2%, 57% recovered from PE Bag, 27% recovered from water. %RSD 3.5%
## LCS Data

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<th>LCS1</th>
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<th>LCS3</th>
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<td>Polyethylene Bag</td>
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<tr>
<td>Water Recovery</td>
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<tr>
<td>Combined Recovery</td>
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<td>72.89</td>
<td>73.55</td>
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</table>
Monolith Sample Data

**Graph**

- **Y-axis:** Duplicate Sample Leach (ug/L)
- **X-axis:** Original Sample Leach (ug/L)
- **Legend:**
  - S1T1
  - S2T1
  - S3T2
  - S4T2
- **1:1 line**

**Note:**
- The graph illustrates the leach data comparison between duplicate and original samples.
- Data points for each sample type are plotted across the graph.

**Source:** TestAmerica
Monolith Matrix Spike Data

Matrix Spike Duplicate Leach (μg/L)

Matrix Spike Leach (μg/L)

1:1 line

S1T1

S2T1
Conclusion

• Availability of Polyethylene sampling media vs. patented IDEAL system.
• Availability of GC/MS vs. HPLC
• Selectivity and specificity of GC/MS vs. HPLC