Getting the Lead out (and other Trace Metals)  
Solving Mine Water Problems with Peat-based Sorption Media

The Shameless Promotion Continues

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American Peat Technology
Overview

- Peat based sorption media
- The Site
- Feasibility testing
- Pilot testing
  - Design
  - Results
- Full scale treatment
  - Conceptual design
  - Costs
- Summary
- Next Steps
What is Peat based sorption media?

- APTsorb™
  - Patented peat based sorption media
  - Hardened granule
Why should I care?

- APTsorb™
  - Large surface area
  - High hydraulic conductivity (~1 cm/sec)
  - High metal affinity (1-15% max dry wgt)

APTsorb™ Granule 1500x
The Site

- Base metal mine

Water from several locations

- pH ~ 8
- Elevated Pb, Zn, Cd
Feasibility Testing

- Preliminary laboratory test
  - Can your water be treated with APTsorb?
  - Known operating range
    - pH 4-8
  - Recent data at pH up to 9.5
  - Low pH tests starting
Feasibility Testing

Upflow; velocity of 0.4 m/hr;
Column contains 72 g APTsorb
EBCT = 7.5 min
<table>
<thead>
<tr>
<th>Site</th>
<th>1</th>
<th>2</th>
<th>3</th>
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<tr>
<td>Bed Volumes</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>0 (Initial)</td>
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<td>80</td>
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<td></td>
<td>17</td>
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<td>17.8</td>
<td>3.4</td>
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<td>3.1</td>
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<td>8.7</td>
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<td>8.1</td>
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<td>11.5</td>
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<td>11.0</td>
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**Feasibility Test Effluent Results, Pb, ug/l**

Green < permit limit
## Feasibility Testing, Effluents Unfiltered Zinc ug/l

<table>
<thead>
<tr>
<th>Bed Volumes</th>
<th>Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 (Initial)</td>
<td>730</td>
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<tr>
<td>8</td>
<td>40</td>
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<td>35</td>
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<td>145</td>
<td>80</td>
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<tr>
<td>177</td>
<td>90</td>
</tr>
<tr>
<td>205</td>
<td></td>
</tr>
<tr>
<td>209</td>
<td>90</td>
</tr>
<tr>
<td>236</td>
<td>100</td>
</tr>
<tr>
<td>Permit limit</td>
<td>216.5</td>
</tr>
</tbody>
</table>

**Green < Permit Limit**
Plan

- Specific site selected
- Developed scope of work
- Install pilot October 2013
The best laid schemes of mice and men Often go awry.

Robert Burns
The Challenge

- Treat direct mine discharge
- High and variable TSS
- Low limits
  - Pb  11 ug/l
  - Zn  137 ug/l
  - Cd  0.5 ug/l
- Treatment cost not to exceed $0.001/gallon ($1/1000 gallons)
Additional Testing

- On site columns
- Sand
- + 30 APTsorb
- - 30 APTsorb
“Semi”- Active
Approach

- Sand filter to remove suspended solids
- APTsorb Treatment tank
  - 1000 gallon
  - 500 gallons media
  - Design for periodic backwash
  - System remotely monitored
Details

-30 mesh material
  - Small column tests

Better filtering capacity
Hydraulic conductivity ~ 0.1 cm/sec
First pilot with this size

Operating conditions
  - Mine pressure ~ 50 psi
  - Flow 30 – 100 gpm
  - Typical flow ~ 50 gpm
  - EBCT 10 minutes
Biocells

- Input water filtered through sand filter
- +30 mesh media
- Three loading rates
  - 1 gpm/ft²
  - 0.5 gpm/ft²
  - 0.25 gpm/ft²
- Residence time 15 – 60 minutes
Long term column

- Water filtered
  - Sand filter
  - Household filters
    - Graded (20 - 1 micron)
    - 0.35 micron nominal

- Media capacity
RESULTS
Mine water
Sand filter
APTsorb tank

Pb ug/l

Solids, Pressurized tank
Solids, gravity flow
Solids, gravity flow
Passive - Biocells
The graph shows the concentration of Pb (µg/l) over weeks for three different treatment processes: Mine water, Sand filter, and Biocell. The y-axis represents the concentration of Pb, ranging from 0.1 to 10,000 µg/l, while the x-axis represents the weeks, ranging from 0.3 to 24.3 weeks.

- **Mine water**: The concentration fluctuates significantly, especially during the early weeks, and stabilizes after 15,000 bed volumes.
- **Sand filter**: The concentration is relatively stable, with minor fluctuations, and remains below 100 µg/l throughout the weeks.
- **Biocell**: The concentration increases gradually, reaching a peak near 15,000 bed volumes, and continues to rise thereafter.

The graph highlights the effectiveness of different treatments in reducing Pb levels, with the Biocell showing the most significant improvement in Pb concentration.
APTsorb, Cost per gallon treated

Cost per gallon treated $/gal vs Bed Volumes

- Target cost
- Biocell treatment, lead tank
Results to date

- Guaranteed treatment cost < $0.0005
  - Employ 2\textsuperscript{nd} tank to reduce costs
  - Standard lead/lag design
- Passed all treatment requirements
  - Pb, Cd and Zn substantially below permit limit
  - No toxicity

Long Live the Cerriodaphnia!
Three Tank Module
- Horizontal Design
  - 10 feet diameter
  - 30 feet long

Lead/Lag Approach
- Standard treatment
- ~1200 gpm per module
- 7 modules
# Full Scale Treatment - 8000 gpm

<table>
<thead>
<tr>
<th>Costs</th>
<th>Chemical Precipitation</th>
<th>APTSorb</th>
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<tbody>
<tr>
<td>Capital Cost</td>
<td>10-15</td>
<td>5</td>
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<td>$ million</td>
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<tr>
<td>Treatment cost</td>
<td>1</td>
<td>0.5</td>
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<tr>
<td>($/1000 gallons)</td>
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<tr>
<td>Annual cost</td>
<td>2.6</td>
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<tr>
<td>$ million</td>
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**Potential Metal Recovery**
Peat based sorption media is a cost effective approach for mine drainage treatment
- Cost<$0.0005/gallon (50 cents/1000 gallons)

Can be used in either active or passive systems

Low maintenance

May provide opportunities for metal recovery
Next Steps

- Second pilot started in April
  - Pressurized tank
- Proposal for third pilot submitted last week
  - Passive; Biocell
- More shameless promotion ASMR 2015
There are no rules here. We’re trying to accomplish something.

Thomas Edison
Proof of Concept Testing

APTsorb Performance
Small volume column testing

Pb (µg/L)

Initial, 99
Initial, 102
Initial, total, 94

Effluent, Site 1, 13
Effluent, Site 2, 18
Effluent, Site 3 total, 17

Effluent, Site 3 dissolved, 62

Effluent, Site 4, 4
Effluent, Site 5, 3

A CHANGE OF DIRECTION...
Wet Test

The Cerriodaphnia live!
Mine water
Sand filter
APTsorb tank
Biocell
Column
column dissolved

Pb ug/l

11500
6400
Results to date

- Guaranteed treatment cost < $0.0005
  - Employ 2\textsuperscript{nd} tank to reduce costs
  - Standard lead/lag design
- Passed all treatment requirements
  - Pb, Cd and Zn substantially below permit limit
  - No toxicity
Peat based sorption media is a cost effective approach for mine drainage treatment
- Cost<\$0.0005/gallon (50 cents/1000 gallons)
- Can be used in either active or passive systems
- Low maintenance
- May provide opportunities for metal recovery
Questions?
Looking for Answers?

Ask a question!

“There are no rules here. We’re trying to accomplish something.”

Thomas Edison
Mine water
Sand filter
Biocell

Pb ug/l

10/31/13 11/05/13 11/10/13 11/15/13 11/20/13 11/25/13 11/30/13 12/05/13 12/10/13 12/15/13 12/20/13 12/25/13 12/30/13 01/04/14 01/09/14 01/14/14 01/19/14 01/24/14 01/29/14 02/03/14 02/08/14 02/13/14 02/18/14 02/23/14
Pb ug/l


Mine water
Sand filter
APTsorb tank

6400
Bed Volume = Volume of reactive media in treatment tank or system (gallons)  
500 gallons

Empty bed contact time (min) = \( \frac{\text{Volume of reactive media(gallons)}}{\text{Flow rate (gallons/min)}} \)

5- 20 minutes