PEAT SORPTION MEDIA
PASSIVE TREATMENT OF TRACE METALS WITHOUT A STINK

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Passive treatment of trace metals
Peat sorption media
Site
Pilot testing
  - Design
  - Results
Summary
Biochemical Reactors (BCR)

Constructed Treatment Wetlands
- Organic substrate
  - Generally mixture
  - Hay, wood chips, limestone, manure
- Vertical flow
- Anaerobic processes
- Microbial driven
  - Sulfate reducing bacteria
**Constructed Treatment Wetlands**

- Horizontal flow across surface
- Water depths generally 6-12”
- Aerobic Processes
- Primary removal - interaction with substrate
Limitations

- BCRs
  - Non uniform media
    - Preferential flow paths
  - Start up
    - 1-2 weeks incubation
  - Initial release of organic rich water
    - BOD
    - Nutrients
  - Color lasts ~ 3-6 months
  - Odors
    - Hydrogen sulfide

Residence time ~ 1-2 days
Limitations

- **Wetlands**
  - Large footprint
  - Start up
    - 2 weeks for plant transplants to set roots
    - 1-3 years for vegetation to fully establish
  - Flow Distribution
    - Potential for channelization
  - Winter performance

Residence time ~ minimum 1-2 days
What is Peat sorption media?

- APTsorb™
  - Patented peat based sorption media
  - Hardened granule
Properties

- Size -10, +30 mesh (0.6 to 2 mm)
- Large surface area
- High hydraulic conductivity (~0.5 cm/sec)
- High metal affinity (1-15% max dry wt.)
Mechanisms

- Dissolved Metal Removal
  - Ion exchange
  - Adsorption
  - Chemisorption
  - Complexation
  - Adsorption-complexation

- Particulate Metal Removal
  - Filtration
  - Interaction with surface
  - Successful removal of 3 - 5 micron particles
The Site

- Base metal mine
Direct discharge from active underground mine

Water quality
- Elevated and variable suspended solids
- pH ~ 8
- Pb controlling metal

<table>
<thead>
<tr>
<th>Metal</th>
<th>Total</th>
<th>Dissolved</th>
<th>Permit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pb</td>
<td>2100</td>
<td>150</td>
<td>11.5</td>
</tr>
<tr>
<td>Zn</td>
<td>115</td>
<td>70</td>
<td>137.3</td>
</tr>
<tr>
<td>Cd</td>
<td>0.8</td>
<td>0.2</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Flow up to 8,000 gallons/min
**ACTIVE MINE DISCHARGE**

- **Sand filter**
- **Media tank**
- **Biocell**
- **Biocell**
- **Biocell**

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**Pilot Design**
Passive - Biocells

- Water (1.5"
- Peat Sorption Media (24"
- Gravel (6"

Diagram showing the layers and dimensions of the biocell system.
## Biocells

- Input water filtered through sand filter
- Media, -10, +30 mesh
- Design

<table>
<thead>
<tr>
<th>Biocell</th>
<th>Flow rate (gpm)</th>
<th>Hydraulic loading (gpm/ft²)</th>
<th>Residence time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.6</td>
<td>0.25</td>
<td>60</td>
</tr>
<tr>
<td>2</td>
<td>2.4</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>1.2</td>
<td>0.5</td>
<td>30</td>
</tr>
</tbody>
</table>

10 month pilot test
Temperature -10 to 100
RESULTS
Biocells Solids Removal

- Sand filter did not remove all suspended solids
- Solids confined to top inches
Cd removal, Biocell 2, Cd vs Bed Volume

- **input**
- **after sand filter**
- **after APTsorb**

**Graph Values:**
- Y-axis: Cd, ug/l
- X-axis: Bed Volumes
- Data points for each category are plotted against bed volumes.
Cost per gallon treated

~30 cents per 1000 gallons

target cost

Biocell 2
Pb removal biocell 2

- Blue line: Input
- Red line: After sand filter
- Green line: After APTsorb

~85% removal
ACTIVE MINE DISCHARGE

Sand filter

Biocell

Biocell

Zinc vs Bed Volume

Bed Volumes

Zn (ug/l)
<table>
<thead>
<tr>
<th>BV</th>
<th>Min</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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<tbody>
<tr>
<td>0.2</td>
<td>2</td>
<td>1.9</td>
<td>3.6</td>
<td>5.2</td>
<td>7.5</td>
<td>9.7</td>
</tr>
<tr>
<td>1.9</td>
<td>15</td>
<td>30</td>
<td>45</td>
<td>65</td>
<td>85</td>
<td>115</td>
</tr>
<tr>
<td>3.6</td>
<td>30</td>
<td>45</td>
<td>65</td>
<td>85</td>
<td>115</td>
<td>160</td>
</tr>
<tr>
<td>5.2</td>
<td>45</td>
<td>65</td>
<td>85</td>
<td>115</td>
<td>160</td>
<td>18.3</td>
</tr>
</tbody>
</table>
Good News: water meets discharge limits, but.....

What do we do with the exchange media?
Removing Media

- Light weight
- Easily moved by pumping or suction
Disposal Options

- Potential metal recovery
  - Pb ~1%
  - Ore 3%
- Disposal in tailings basin
  - Potential amendment to improve vegetation
- Off site disposal
  - TCLP
  - Metals strongly bound to media
### TCLP - Stormwater

**Metal Plating Facility; 3 years**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Influent ug/L</th>
<th>Solid (mg/kg)</th>
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</thead>
<tbody>
<tr>
<td>Chromium</td>
<td>526</td>
<td>1346</td>
</tr>
<tr>
<td>Cadmium</td>
<td>219</td>
<td>566</td>
</tr>
<tr>
<td>Zinc</td>
<td>565</td>
<td>1338</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>Regulated Level (mg/L)</th>
<th>TCLP results (mg/L)</th>
<th>% metal released</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cadmium</td>
<td>1</td>
<td>0.1</td>
<td>0.4</td>
</tr>
<tr>
<td>Chromium</td>
<td>5</td>
<td>ND</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Zinc</td>
<td>NR</td>
<td>2.8</td>
<td>4.6</td>
</tr>
</tbody>
</table>
The Big Question?

How long will the media last?
<table>
<thead>
<tr>
<th>Application</th>
<th>Duration</th>
<th>Metals of concern</th>
<th>Time between media change</th>
<th>Bed volumes treated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mine water</td>
<td>1 year</td>
<td>Cu</td>
<td>&gt; 1 year</td>
<td>32,000</td>
</tr>
<tr>
<td>Mine water</td>
<td>9 months</td>
<td>Pb,</td>
<td>&gt; 9 months</td>
<td>28,000</td>
</tr>
<tr>
<td>Mine water</td>
<td>5 months</td>
<td>Zn, Pb, Cd</td>
<td>4 months</td>
<td>12,500</td>
</tr>
<tr>
<td>Stormwater</td>
<td>9 years</td>
<td>Cr, Cd, Zn</td>
<td>1.5 to 3 years</td>
<td>500-1000</td>
</tr>
<tr>
<td>Roof runoff</td>
<td>3 years</td>
<td>Zn</td>
<td>&gt;3 years?</td>
<td>Unknown</td>
</tr>
<tr>
<td>Stormwater</td>
<td>7 years</td>
<td>Cu</td>
<td>&gt; 3 months</td>
<td>Unknown</td>
</tr>
<tr>
<td>Treatment</td>
<td>pH</td>
<td>Residence time</td>
<td>Nuisance parameters</td>
<td>Winter Operation</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-----</td>
<td>----------------</td>
<td>---------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>Wetland</td>
<td>6-8</td>
<td>1-2 days</td>
<td>Initial Fe, color</td>
<td>Problematic</td>
</tr>
<tr>
<td>BCR</td>
<td>3-8</td>
<td>1-2 days</td>
<td>Color, BOD, nutrients, odor</td>
<td>Needs Insulation Rates slow</td>
</tr>
<tr>
<td>Peat Sorption Media</td>
<td>6-8</td>
<td>15 min</td>
<td>Minimal color</td>
<td>Needs insulation</td>
</tr>
</tbody>
</table>
Summary

- Met permit limits
- Cost 70% below target
- Uniform media with high permeability
- 15 minute contact time
- No nuisance parameters
- Easy to replace
- Potential metal recovery
Got Questions?

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