Utilization of Barrier and Treatment Designs to Address Irregular Shoreline Surfaces and Control of Contaminant Migration

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Contaminated Site Assessment, Remediation, and Redevelopment

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www.aquablokinfo.com
AquaBlok Particle

dense core (e.g. aggregate)

clay (sealant) layer

hydration

time

minerals, treatment agents, organics, seeds, etc.

not to scale
AquaBlok Before Hydration

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AquaBlok After Hydration and Expansion

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not to scale
Self-Compacting Low Permeability Cap

1. Chemical Sequestration

2. Insulation of Benthic Community

3. Reduce Physical Mobility of Contaminated Sediments
Demonstrating Compliance in a Dynamic Environment

*Split-core from Section A (2.5 yrs after placement)*

- New sediment Deposits
- AquaBlok Clean Cap Layer
- Discrete boundary
- Contaminated Sediment
Higher Permeability Application

1. Uniform application of high-value, low quantity materials – match bed advective flows

2. Higher concentration of treatment materials in a PRB or Gate configuration
# Delivery of In-Situ Sediment Treatment

## Technologies for Reactive Gate Materials

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>Treatment Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAHs and BTEX</td>
<td>PAC, EHC-O*, Oxygen Delivery, Rubber, ORGANOCLAYs**</td>
</tr>
<tr>
<td>Gasoline</td>
<td>EHC-O*, Oxygen Delivery, Nutrients, ORGANOCLAYs**</td>
</tr>
<tr>
<td>VOCs</td>
<td>Fe⁰*, EHC*, Bimetallic, PAC</td>
</tr>
<tr>
<td>Metals, Ammonia</td>
<td>Fe⁰*, EHC-M*, Organic Carbon, Zeolites, Ferric Sulfides</td>
</tr>
<tr>
<td>Acid Mine Drainage</td>
<td>EHC-M*, Organic Carbon</td>
</tr>
<tr>
<td>Nitrate</td>
<td>EHC*, Organic Carbon</td>
</tr>
</tbody>
</table>

* Adventus Group Products
** Various Manufacturers
AquaBlok+PACTM

Activated Carbon is a recognized material for absorption of a wide range of contaminants – The AquaBlok manufacturing approach can expand layer thickness with less material usage

<table>
<thead>
<tr>
<th>Material</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate</td>
<td>Nominal AASHTO #8 (1/4-3/8&quot;), or custom-sized to meet project-specific need</td>
</tr>
<tr>
<td></td>
<td>* Limestone or non-calcareous substitute, as deemed project-appropriate</td>
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<tr>
<td>Clay</td>
<td>Bentonite (or montmorillonite derivative)</td>
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<tr>
<td></td>
<td>* Typically 5 – 10% by weight</td>
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<tr>
<td>Activated Carbon</td>
<td>Powdered – Iodine Number 800 mg/g (minimum)</td>
</tr>
<tr>
<td></td>
<td>⊗ 99% (minimum) through 100 mesh sieve</td>
</tr>
<tr>
<td></td>
<td>⊗ 95% (minimum) through 200 mesh sieve</td>
</tr>
<tr>
<td></td>
<td>⊗ 90% (minimum) through 325 mesh sieve</td>
</tr>
<tr>
<td></td>
<td>* Typically 2 – 5% by weight</td>
</tr>
<tr>
<td>Binder</td>
<td>Cellulosic polymer</td>
</tr>
<tr>
<td>Permeability</td>
<td>1 x 10^-1 to 1 x 10^-2 cm/sec</td>
</tr>
<tr>
<td>Dry Bulk Density</td>
<td>85 – 90 lbs/ft³</td>
</tr>
<tr>
<td>Moisture</td>
<td>10 – 12% (maximum)</td>
</tr>
</tbody>
</table>

Above: Intact AB+PAC 5% after perm test

Above: Flex-wall permeameter – Flow 14,774 cm/day or greater used in three runs - *Significantly in excess of the conservative 10 cm/day estimate for high advective flow conditions*
Ability to Add Treatment Material for Treatment of Flux from Contaminated Sediment

Test Column

Column Packed with AB+Gate (2.5%EHC-M*, 8%AB Clay)

* Adventus Group Product

Initial Results (Arsenic and Chromium)

AB+EHC-M Gate Material
3 months of flow

Concentration (μg/L)

Residence Time (hrs)
MGP Site – Combining Treatment and Sequestration

- **Setting/Purpose:** Canal/River (freshwater). MGP Site – Treatment barrier and low permeability barrier/cap over contaminated sediments. Site area was approximately 4,000 square feet.

- **Contaminant(s) of Concern:** Coal Tar associated with historic MGP site, including PAH (polynuclear aromatic hydrocarbons) and DNAPL (Dense Non-Aqueous Phase Liquids).

**Project Status:**
Completed February 2008

Placement of stone armor over AquaBlok low permeability capping material
AquaBlok Cap Design/Site Area: Multi-layer design comprised of a one inch basal layer AquaBlok+ORGANOCLAY covered with a hydrated layer (~6 inches in target thickness) of AquaBlok 3070FW. The cap was then armored with a two inch layer of AASHTO #2 stone.

Method of AquaBlok Placement: Shore-based excavator
MGP Site – Combining Treatment and Sequestration

Project Status: Completed February 2008

PROPOSED SECTION A–A

SCALE 1/4"=1'-0"
Combination Stream Bank Stabilization and Landfill Cap

- **Setting/Purpose:** Freshwater Creek – Control of Cap/Bank Erosion on Closed Landfill.

- **Contaminant(s) of Concern:** Creek bed erosion penetrated historic landfill cap and was causing a release of leachate from landfill into creek. AquaBlok, a bentonite coated aggregate sealant, was selected to provide the low permeability (in the range of 10-9 cm/sec) interface with the existing landfill cap.

![Overview of Completed Slope Repair/Stabilization with AquaBlok Landfill Cap Seal/Repair](image-url)
Combination Stream Bank Stabilization and Landfill Cap

- **AquaBlok Cap Design/Site Area:** Ohio EPA approved design that incorporated AquaBlok as primary low permeability seal for re-establishment of the certified landfill cap.

A multi-layer design was used to first re-establish the landfill cap, then to provide bank/slope protection to high flow conditions in the creek bed. The first layer utilized a 6” thick Geocell to maintain the AquaBlok capping/sealant material on the slope of the creek. This was then covered in a geofabric and a layer of stone. An articulated concrete mat was placed over the entire area to provide the final level of protection from long-term erosion to the bank. Site area was comprised of 3,000 square feet of embankment area.

- **Method of AquaBlok Placement:** Land-based excavator.

**Project Status:** Completed January 2008
Combination Stream Bank Stabilization and Landfill Cap

Project Status:
Completed January 2008
Trench Pipe Cap/Salt Water

- **Setting/Purpose:** Shoreline/Saltwater Pipeline cap and trench dams. Objective was to cut off site contaminant pathways during excavation and installation of combined sewer overflow pipeline.

- **Contaminant(s) of Concern:** No contaminant characterization or analysis was performed since objective was to simply isolate the pipeline trench and attempt to provide a neutral zone between the pipe and the surrounding hydrogeologic conditions.

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Placement of low permeability pipe capping material
Trench Pipe Cap/Salt Water

- **AquaBlok Cap Design/Site Area:** The project engineering design called for a permeability within a range of 10-6 and 10-7 in order to best match site hydrogeologic conditions. Material blends were provided in advance and independent lab tests confirmed the saltwater blend achieved the target permeability.

- **Installation Notes:**
  - Coffer Dam approach used to isolate pipe trench from surrounding soil
  - Continuous measurement of AquaBlok performed to insure design thickness of cap
  - Water in trench is full strength sea water
  - Additional trench dams to be placed at intervals along pipeline

- **Method of AquaBlok Placement:** Shore-based Stone Slinger.

**Project Status:**
Completed November 2008

![Loading AquaBlok from site delivered bulk bags into aggregate truck with stone slinger](image)
Demonstration of the AquaBlok Sediment Capping Technology
National Risk Management Research Laboratory (NRML)
Office of Research + Development
U.S. EPA – Cincinnati, Ohio

Excepts from the Innovative Technology Evaluation Report:

1. STABILITY – Will it stay in place?
   “…Overall results of the AquaBlok® SITE demonstration indicate that the AquaBlok® material is highly stable, and likely more stable than traditional sand capping material even under very high bottom shear stresses.”

2. CONTAMINANT ISOLATION – Will it seal off COCs?
   “The AquaBlok® material also characteristically more impermeable, and the weight of evidence gathered suggests it is potentially more effective at controlling contaminant flux, than traditional sand capping material.”

3. RESTORATION – Will the habitat recover?
   “AquaBlok® also appears to be characterized by impacts to benthos and benthic habitat generally similar to traditional sand capping material.”
Anti-Seep Collar and Trench Dam

Cutting Off Preferential Pathways from Pipe Penetrations

Common Problem:  Water seepage along pipe due to poor surrounding soils

Before:  Flow of Water following piping pathway

Solution:  Excavate and apply AquaBlok around pipe structures

Trench Dam application can reduce potential for piping to act as a preferential pathway
Cut-Off Wall & Seep Protection

AquaBlok anti-seep or cut-off wall

Rip-rap or articulated concrete blocks

AquaBlok anti-seep liner

Typical Problem: Water Entering or Flowing in Section of Trench

Section of Completed Cut-off Wall
Handling/Installation Factors

Handling/Installation Advantages:

• Place directly through water column

• Self-compacts on bottom – hydration fills voids to create stable erosion resistant cap layer

• Conventional construction equipment used for placement

• Easy to confirm uniformity of installation (core samples)

• Handles like sand or gravel (rugged) during installation

• Can be manufactured on-site for significant cost savings
Summary – Q&A

**AquaBlok as a Thin Capping Barrier/Remediation Technology**

- All Natural Clay Material Provides Low Hydraulic Conductivity for Effective Contaminant Physical and Chemical Isolation (Addresses Immediate Food Chain Issues)
- Serves as a Delivery System for a Wide Range of Treatment Materials
- Easy to Handle and Install – Provides Mechanism for Post Cap Monitoring
- Implementable in Connection with Either MNA or Dredge/Cap Strategy
- Highly Cost Effective Alternative and Less Invasive than Dredging

**AquaBlok as a Geotechnical Material for Water Control and Other Applications**

- Innovative Construction Material for Dam or Pond Repair and Design Applications
- Ability to Line Process Ponds without Taking Out of Service
- Simple to Handle and Use Alternative for Landfill Penetrations, Caps, and Liners
- New and Unique Well Sealant Material with Performance Superior to Coated Pellets
- Improved Performance of Conventional Flood Containment and Spill Prevention (Sand Bags)

For project specific inquiries, please submit a *Site Evaluation Form* from the AquaBlok website: [www.aquablokinfo.com](http://www.aquablokinfo.com) or call 800-688-2649