

IN SITU AMENDMENTS

at Contaminated Sediment Superfund Sites

A Primer on an Innovative Technology for Cost-Effective Sediment Remediation.

WHAT ARE IN SITU AMENDMENTS?

Specialized materials used to reduce risk through in situ sequestering or destruction of contaminants in sediment.

- Activated carbon
- Organoclay
- Phosphate additives

WHY USE AMENDMENTS?

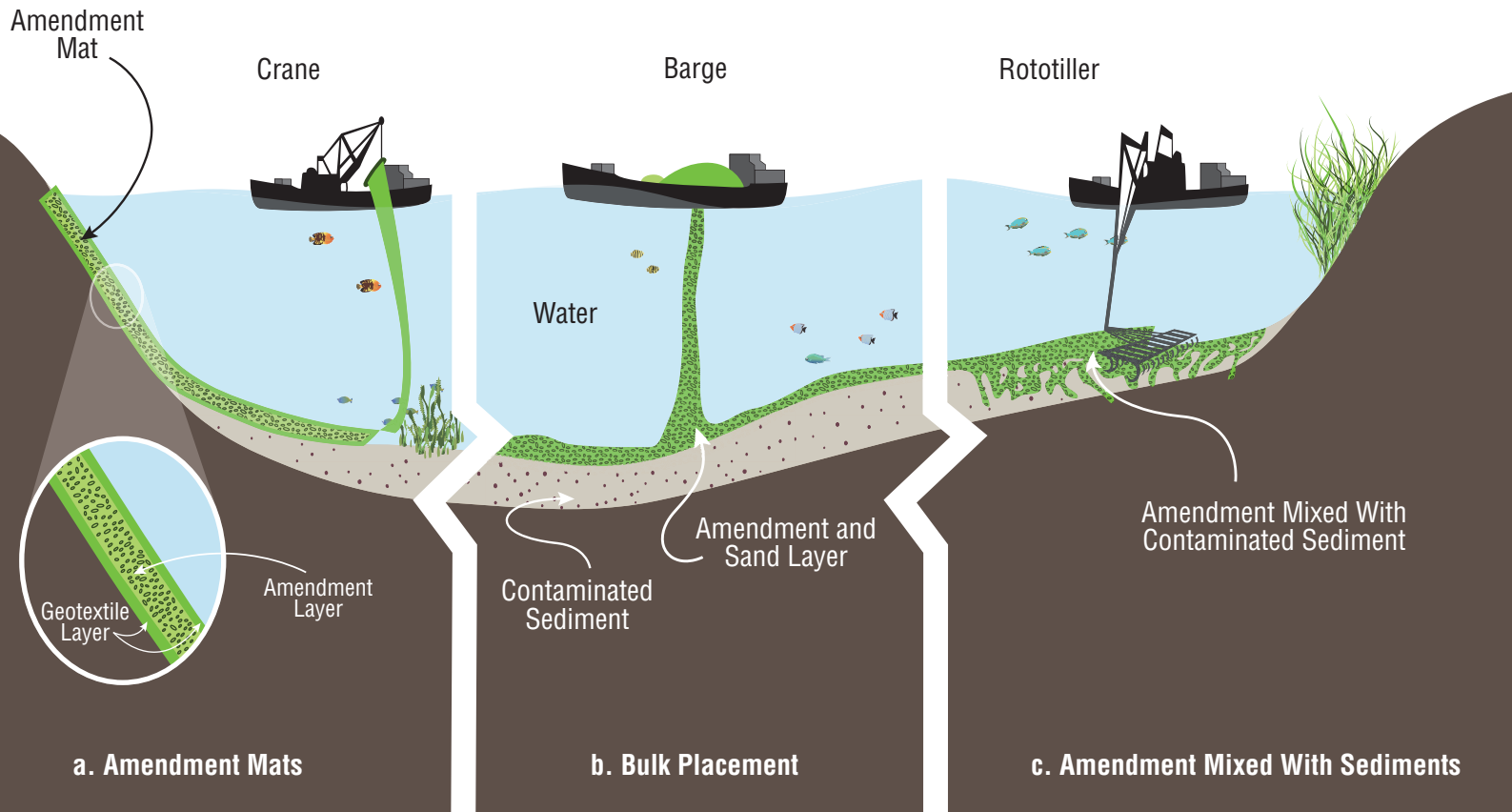
- Decrease contaminant bioavailability by sorption
- Reduce thickness of traditional sand caps
- Reduce advective transport of contamination by ebullition, non-aqueous phase liquid (NAPL) or groundwater flow
- Enhance resistance to erosion events
- Promote degradation of contaminants

HOW ARE AMENDMENTS APPLIED?

Used alone or in conjunction with other sediment remedies.

- Contained within a geotextile mat (amendment mat)
- Placed into or onto sediment surface, alone or temporarily adhered to a higher density conglomerate (bulk placement)
- Mixed into sediment
- Combined with other capping materials

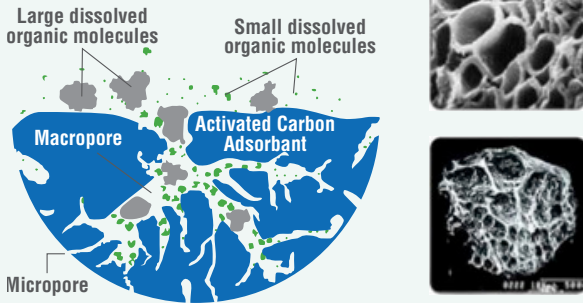
Placement Methods for Sediment Amendments



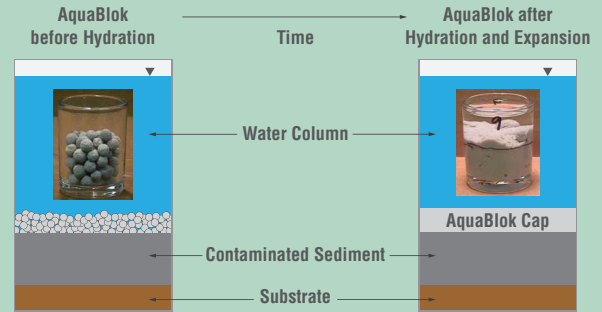
TYPES OF AMENDMENTS

1 ACTIVATED CARBON (and other carbon sources) -- treats PAHs, PCBs, dioxins

How Activated Carbon Works



2 ORGANOCLAY™ -- treats NAPL, PAHs, PCBs, metals



Integrated Conceptual and Actual View of AquaBlok® Capping Material
(EPA Tech Trends, February 2000)

3 PHOSPHATE ADDITIVES (such as apatite) -- treats metals



EPA does not endorse any products or services that may appear on this document.

4 ADDITIONAL AMENDMENTS currently being researched at the bench-scale stage: bauxite, biopolymers, zeolite, nanoscale ZVI and palladium

5 MICROBIOLOGICAL TECHNOLOGIES (bioaugmentation) are currently being developed to degrade PCBs in sediment

DESIGN CONSIDERATIONS FOR SELECTION OF AMENDMENTS

- **CONTAMINANT PROPERTIES** – hydrophobic/hydrophilic, concentration, level of reduction required
- **AMENDMENT PROPERTIES** – sorption capacity, buoyancy, grain size, porosity/permeability
- **SEDIMENT PROPERTIES** – organic content, hydraulic conductivity
- **SITE CONDITIONS** – current, energy and depth of waterway; potential for bioturbation and erosion; presence of NAPL
- **FATE AND TRANSPORT MECHANISMS** – advection, upwelling, gas ebullition, tidal fluctuation

APPLICATIONS

OF AMENDMENTS FOR SEDIMENTS AT SUPERFUND SITES



More information: http://www.thegrassriver.com/activated_carbon_details.html

Grasse River Superfund Site, New York

- Bulk granular activated carbon for PCBs
- Pilot scale installed Fall 2006
- Applied directly to sediments:
 - (1) Rototiller with rotors,
 - (2) Tine sled, and
 - (3) Rototiller without rotors
- Compared to pre-amendment conditions in 2006, concentrations of total freely dissolved PCB concentrations at the sediment-water interface were reduced by 96%, 92%, and 82% in 2007, 2008, and 2009, respectively



More information: http://www.dec.ny.gov/docs/regions_pdf/capdemo.pdf

Onondaga Lake Superfund Site, New York

- Bulk granular activated carbon (placed with sand in 9-inch thick layer) for sequestration of organic contaminants
- Field demonstration (1 acre) implemented in November 2011
- Full scale placement began in 2012
- Carbon/sand slurry placed using barge-mounted spreader
- Water depths ranged from 5 to 30 feet
- Monitoring data not yet available

APPLICATIONS

OF AMENDMENTS FOR SEDIMENTS AT SUPERFUND SITES, CONTINUED



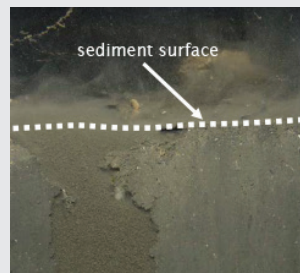
More information:

<http://www.aquablok.com/clientuploads/library/Bremerton%20Results%20Presentation.pdf>

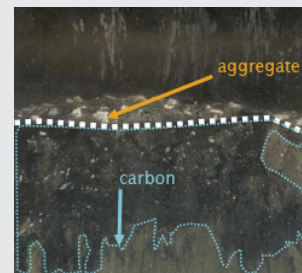
EPA does not endorse any products or services that may appear on this document.

Puget Sound Naval Shipyard Complex Superfund Site, Washington

- Powdered activated carbon amendment for PCBs
- Bulk placement in 2012 at 0.5-acre site
- AquaGate + PAC™ Amendment (Aquablok)
- 75%, 86%, and 81% reductions in total PCB sediment porewater concentrations observed at 10-, 21-, and 33-month monitoring events, respectively



Before



After



St. Louis River, Interlake, Duluth Tar Site, Minnesota

- Absorptive core mat with activated carbon and sand
- Contaminant of concern – PAHs (naphthalene)
- Full-scale (11 acre) cap placed in Stryker Bay in 2006
- Most recent long-term monitoring data (2015) showed that 9 of 10 pore water samples had no exceedances of final chronic values for naphthalene

More information: http://www.cetco.com/DesktopModules/Bring2mind/DMX/Download.aspx?Command=Core_Download&PortalId=0&EntryId=497

EPA does not endorse any products or services that may appear on this document.

LEARN MORE

EPA OSRTI white paper *Use of Amendments for In Situ Remediation at Superfund Sites*

https://clu-in.org/download/techdrct/In_situ_AmendmentReportandAppendix_FinalApril2013.pdf