Treatment Technologies for Mining-Influenced Water

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www.cluin.org/mining
Overview

- Technology Assessment Branch
- Mining Website
  - www.cluin.org/mining
- Mining Webinar Series
- MIW Treatment Technologies
Technology Assessment Branch

- Demonstrates and promotes the use of new and innovative treatment technologies for more cost effective cleanups
- Assesses and communicates to site managers state-of-the-art remedy technology information
- Provides site-specific support through five Technical Support Centers and staff consultation
Mining Website: CLU-IN
Mining Sites Focus Area

www.cluin.org/mining
CLU-IN Mining Sites Focus Area

- Launched in 2012 (www.cluin.org/mining)
- Maintained on CLU-IN: Contaminated Site Cleanup Information (www.cluin.org)
- Goal: develop a source of information on site assessment, characterization, cleanup, and revitalization technologies & training opportunities
- Initial focus: abandoned mine lands
- Today: current and former (i.e., active, closed and abandoned) sites
CLU-IN Mining Sites Focus Area

- Target audience: site managers, regulatory agencies, consultants, general public
- Spotlight, overview, and RSS feed
- Case studies
- Characterization
- Revitalization and reuse
- Resources and links
- Conference proceedings and presentations
- Training and events
CLU-IN Mining Sites Focus Area

- Spotlight and overview
- RSS feed
CLU-IN Mining Sites Focus Area

- Case studies
  - Successful remediation and revitalization efforts
  - Grouped by mining site type
    - Hardrock
    - Coal
    - Uranium
Characterization

Cleanup technologies (adapted from ITRC)
- Mining solid waste
- Mining-influenced water
- Both media

Revitalization and reuse
CLU-IN Mining Sites Focus Area

- Resources & links
- Conference proceedings and presentations
- Training & events

www.cluin.org/mining/events
CLU-IN Mining Webinar Series

www.cluin.org/mining
CLU-IN Mining Webinar Series

- Launched in June 2012
- Complements CLU-IN Mining Sites Focus Area
- Held quarterly
- Goal: technology transfer resource and additional information source on innovative technologies and approaches for mine waste and MIW treatment
CLU-IN Mining Webinar Series

- Six webinars held since the launch
- Example topics:
  - EPA resources and training opportunities
  - Overview of the Global Acid Rock Drainage (GARD) Guide
  - Impact of soil restoration at mine sites on ecosystem function and services
  - Using biosolids and coal combustion products for soil remediation at mining sites
CLU-IN Mining Webinar Series

- Case studies and field applications at different types of mining sites and mine waste/MIW
- 1050 attendees total (average 175 per webinar)
  - Environmental, engineering, and mining professionals – government, consulting firms, academia, natural resource exploration industries
CLU-IN Mining Webinar Series

- Next webinar: Fall 2014
- Updates and archived mining webinars: www.cluin.org/mining/events

Contact: mahoney.michele@epa.gov to sign up for mailing list
EcoTools Tools for Ecological Land Reuse

Ecological reuse returns polluted or otherwise disturbed lands to a functioning and sustainable use by increasing or improving habitat for plants and animals. "Ecological land reuse" is a broad term that encompasses a number of interrelated activities including the reconstruction of antecedent physical conditions, chemical adjustment of the soil and water, and biological manipulation which includes the reintroduction of native flora and fauna.

ECOTOOLS SPOTLIGHT

- **Land Application of Municipal Biosolids**
  In June 2014, the U.S. Geological Survey created a webpage focused on the land application of municipal biosolids. The application of municipal biosolids on land may be a widespread source of emerging contaminants to surface and ground water. The USGS scientists and their collaborators are conducting projects including the development of analytical methods for characterizing the potential emerging contaminants in biosolids-derived composts and other products, sampling biosolids to characterize the occurrence of emerging contaminants; an investigation to assess the ability of a range of wastewater treatment technologies to remove selected pharmaceuticals and other emerging contaminants from municipal sewage; and an investigation to determine the persistence and vertical transport in the soil zone of emerging contaminants derived from biosolids applied to the land surface.

- **ASA, CSSA, & SSSA International Annual Meeting: November 2-5, 2014 in Long Beach, CA**
  The American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America will host more than 4,000 scientists, professionals, educators, and students at the 2014 International Annual Meeting, "Grand Challenges—Great Solutions:"

- **Contaminant Uptake in Food Crops grown on Brownfield Sites: September 26,**
2014 EPA Reference Guide

- Compilation of MIW treatment technologies
- For regulators, site owners and operators, and other stakeholders
Document Development

- EPA National Mining Team
- External Stakeholders
Document Objectives

- Identify and describe MIW treatment technologies
- Support selection of appropriate and cost-effective treatment technologies
- Inform decision makers on up to date and available treatment technologies
Long-term Goal

- Support development of technologies
  - Low energy needs
  - Low costs
  - Low maintenance
MIW

- MIW: water whose composition has been affected by mining or mineral processing
- Includes acid rock drainage, neutral and alkaline waters, mineral processing waters and residual waters
- Affects over 10,000 miles of receiving waters in the United States
Treatment Considerations

- Available land surface and its topography
- System longevity
- Maintenance needs
- Flow rate and strength
- Site accessibility and remoteness

- Availability of power sources
- Performance criteria
- Design, capital and operation costs
- Maintenance costs
- Local climate impacts on system effectiveness
Reference Guide Content

- 16 Technology Narratives
  - 7 passive
  - 9 active

- 31 Technology Summaries
### Summary Table Snapshot

<table>
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<th>Technology</th>
<th>Technology Description</th>
<th>Treated Constituents</th>
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<th>Operations</th>
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<td>Anoxic Limestone Drains (ALD)</td>
<td>A limestone drain is a simple treatment method which involves the burial of limestone in air-tight trenches that intercept acidic discharge water. Keeping carbon dioxide within the drainage pipes can enhance limestone dissolution and alkalinity production. Furthermore, keeping oxygen out of contact with the discharge water minimizes the potential for oxidation of dissolved iron and the consequent precipitation of solid iron hydroxide (Fe(OH)₃), which could clog the limestone and clog the drains.</td>
<td>Al, Fe, acidity</td>
<td>Full-scale</td>
<td>Fabius Coal Preparation Plant, AL</td>
<td>The construction of an ALD consists of a trench containing limestone (typically 90% calcium carbonate equivalent minimum) encapsulated in a plastic liner and covered with clay or compacted soil to maintain anoxic conditions, as well as to prevent water infiltration and to keep CO₂ from escaping. The width and length of the trench are based on the levels of dissolved metals present in the mines drainage, the retention time needed to raise the pH, as well as the amount of area that is available for construction. The ALD may be capped with topsoil and vegetation to control erosion.</td>
<td>Routine maintenance is typically limited to inspection of the surface for evidence of leakage in the anoxic cover material, and periodic cleaning of the discharge point to remove accumulated iron oxides. The systems are generally designed for limestone replacement every 15–23 years, depending on the characteristics of the drainage flow.</td>
<td>ALDs are suitable to treat MiW that has low concentrations of ferric iron, dissolved oxygen, and aluminum. When any of these three parameters are elevated, amending of limestone can occur and slow the dissolution rate of limestone. When the dissolution rate slows, there is a higher build-up of ferric iron and aluminum on the limestone, which, eventually, clogs the open pore spaces, resulting in abnormally high flow rates that can reduce both the retention time of MiW within the ALD and the reactive surface area of the limestone.</td>
<td>With only a few exceptions, passive systems cannot handle Acidity Loads in excess of 100–150 kg of CaCO₃ per day. Metal removal must occur elsewhere to prevent clogging of the bed and system failure. ALD's must be kept anoxic to prevent the oxidation of soluble ferrous iron to the insoluble ferric species. Field tests show that relatively high rates of limestone dissolution occur within the initial 15 hours of contact with mine water. After that period, the rate of dissolution is much slower. For this reason, ALD's are sized to have a 15-hour retention time at the end of its design life (25–30 years). Although ALDs are documented to have success in raising pH, the differing chemical characteristics of the influent mine water can cause variations in alkalinity generation and retention of metals. Most ALD systems exhibit reduced effectiveness over time and eventually require maintenance or replacement. To meet effluent compliance limits, (Tennessee Valley Authority) TVA advocates the use of ALD's only as a staged portion of aerobic acid drainage wetlands systems, and does not recommend their use as stand-alone systems, or as a stage of an anaerobic wetlands system.</td>
<td>Passive treatment systems can provide low cost solutions unless they are used for inappropriate applications, which have resulted in many being far more costly (per ton of acid neutralized) than conventional active treatment plants. The cost of installing ALDs can vary from site to site, depending largely on location and chemical makeup of the MiW. Operation of the Tennessee Valley Authority abandoned mine site in Alabama reported that their capital cost was approximately $0.25/1000 gal of water and their operation and maintenance costs were approximately $10/1000 gal of treated water. Passive treatment systems provide low cost solutions with low to medium capital costs ($25,000–200,000) and generally very low operating costs (&lt;$1,000/year). A 'typical' ALD constructed at most locations in Canada is expected to cost in the range of $4,000 to $21,000 depending on chosen dimensions and design flows. This estimation would not apply to remote sites, or sites where establishment of an ALD would require extensive excavation or blasting.</td>
</tr>
</tbody>
</table>

**Notes:**
- ALD: Anoxic Limestone Drain
- MiW: Mine Water
- TVA: Tennessee Valley Authority
Reference Guide Content

- Treatment technologies
- Contaminants treated
- Pre-treatment requirements
- Costs
- Long-term maintenance needs
- System performance
Reference Guide Content

- System costs
- Example sites
- Data gaps and research needs
- Resources for more information on each technology
Technologies

- Anoxic limestone drains
- Successive alkalinity producing systems
- Aluminator
- Constructed wetlands
- Biochemical reactors
Technologies

- Phytotechnologies (http://cluin.org/products/phyto/)
- Permeable reactive barriers
- Fluidized bed reactors
- Reverse osmosis
- Zero valent iron
Technologies

- Rotating cylinder treatment systems
- Ferrihydrite adsorption
- Electrocoagulation
- Ion exchange
- Biological reduction
- Ceramic microfiltration
Anticipated Outcomes

- Supplement and complement existing reference materials
- Identify promising technologies and best practices
- Determine data needs
- Develop pilot projects
- Present information publically
For More Information


- Characterization, Cleanup and Revitalization of Mining Sites: [http://www.cluin.org/mining](http://www.cluin.org/mining)
Contact

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