



Mining Remediation Technology Developments and Information Resources

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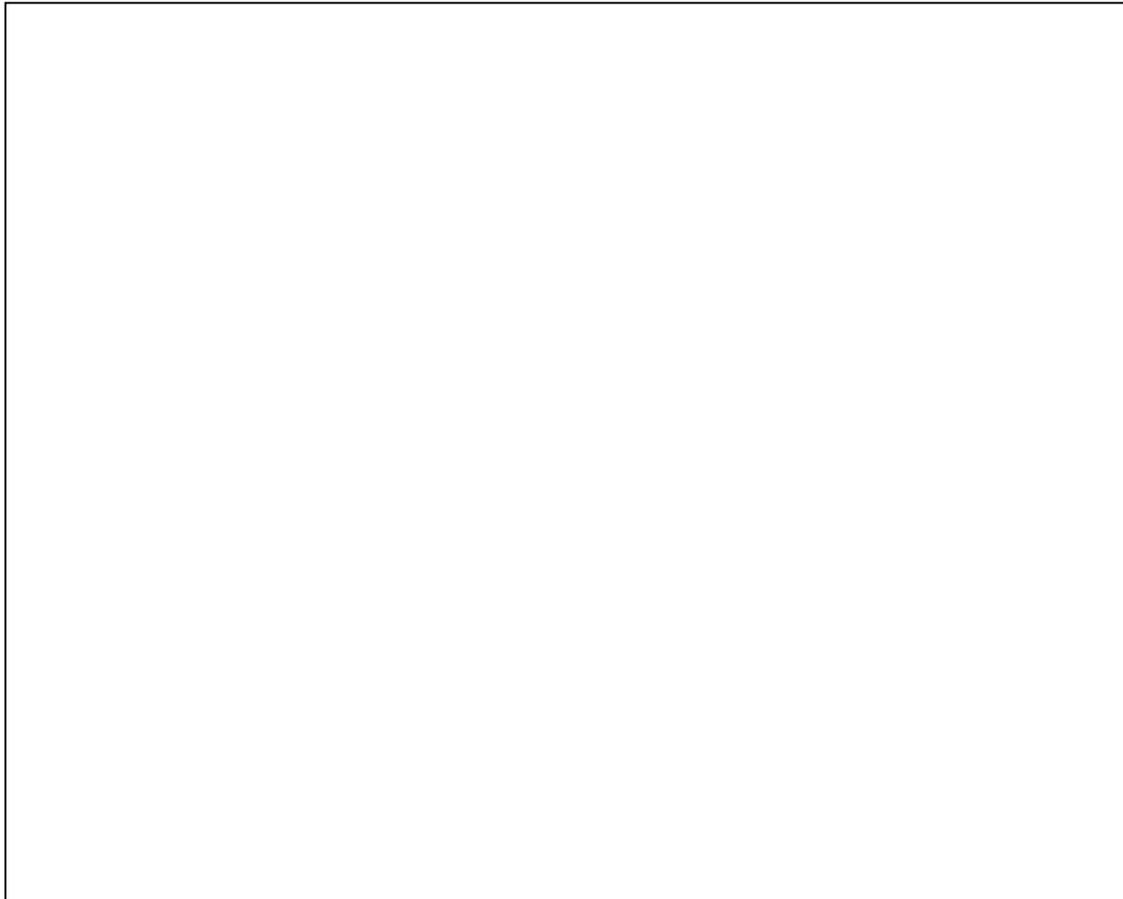
Outline

- Background
- Environmental issues in mining
- Currently applied remedies
- Ongoing R&D at EPA/DOE Mine Waste Technology Program
- Case studies
- Other mining remediation information resources
- Conclusions



Number of Mining Sites in the US

| Federal Agencies | Estimated Number of Sites | Explanations / Comments |
|---|---|--|
| Bureau of Land Management (Dol) 1996, 2003 | 100,000 – 500,000 | BLM Lands based on targeted surveys & the Abandoned Mine Land Inventory (draft) |
| Forest Service (Department of Agriculture) 1996, 1999 | 25,000-34,500 | On lands within FS boundaries; based on aerial photos, fieldwork, and Dept. of Agriculture data. |
| National Park Service (Department of Interior) 1996 | 2,500 | Actual count in some states, not including Alaska and part of California |
| Fish and Wildlife (Department of Interior) 1996 | 240 | Based on department files and field office confirmation |
| Bureau of Mines (defunct agency) 1996 | 15,300 on Dept. of Interior lands; 12,500 on Dept. of Agriculture lands | Based on databases of past mineral deposits activities |
| Total | 163,509 to 565,000 | |





Environmental Issues in Mining

Waste Streams Generated

- Mine Water
- Waste rock
- Overburden
- Tailings



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Environmental Issues in Mining

- Landscape alteration
- Ecological disturbance
- Change in groundwater regime
- Sedimentation of mountain streams
- Dust, including contaminated particles
- Surface and groundwater contamination



Environmental Issues in Mining

Surface and groundwater contamination

- Acid mine drainage (AMD): Hydrogen ion releases in newly exposed sulfide minerals overwhelm water buffering capacity and result in acidification.
- Heavy metals: The exposure of metal bearing rocks to oxygen and water also results in the release of heavy metals into solution in water



Treatment of Contaminated Waste

Traditional approaches:

Solids: Generally intended to adjust pH, alter redox conditions, or stabilize waste, but do not reduce the toxicity of the waste:

- Relocation of waste causing contamination– Ex: containment in lined pits
- Covering waste piles – Ex: Landscape adjustment

Water: Treatment facilities & diversion tactics – Ex: Diverting surface runoff away from waste piles



Treatment of Contaminated Water

Goals

- Neutralization of acidity
- Removal of heavy metals

Traditional approaches (Often water treatment plants)

- Required continuous O&M and staffing
- Produces a waste material

Innovative approaches

- Low level or no use of chemicals
- Less equipment required
- Passive treatment action



EPA/DOE Mine Waste Technology Program

- Implemented through the Montana State University System
- Financed at levels of \$2.5 - \$7.5 per year since 1991
- Focus is on the development and demonstration of innovative technologies at the bench and pilot scale in three priority areas
 1. Source controls, including in-situ
 2. Treatment technologies “end of pipe”
 3. Resource recovery



New Developments: EPA/DOE Mine Waste Technology Program

Projects completed to date:

- 20 Research projects
- 31 Demonstration projects for source control and AMD treatment, including;
 - 10 bioreactor related technologies
 - 9 Stabilization projects
 - 3 Physical/chemical separation or precipitation
 - 2 Containment demonstrations
 - 2 Permeable reactive barriers
 - 2 Phytoremediation projects



Acid Mine Drainage

- Limestone Drains
 - Trend is now toward anoxic, low O_2 conditions because they do not form precipitates that coat the rock
- Sulfate Reduction
 - Bacteria reduces metals to metal sulfides
 - Consume H^+ and pH increases
- Microbial Reactors
 - Bacteria Target Specific Metals
 - Not effective for drainage that includes numerous metals



Case Study: Bioreactor Treatment of Acid Mine Drainage

- Field tested at Golden Sunlight Mine near Whitehall Montana in the fall of 2001
- Focus:
 - Develop a sulfate-reducing bacteria system (SRB) that will not be inhibited by the acidity and high metal concentration in the AMD
- Solution:
 - 2 stage process separating the abiotic and biotic reactions occurring during AMD treatment
- High levels of acidity and metal are toxic to SRB. The design prevents contact between SRB and the acidic metal-laden AMD and prevents clogging of the bioreactor with metal precipitates



Case Study: Permeable Reactive Barrier for of Arsenic (Passive Arsenic Removal)

Focus

- Develop a system capable of removing arsenic from AMD in remote mine locations
- Innovative (Passive Treatment)
 - Manganese-dioxide-coated sand
 - Granular ferric hydroxide in gravity-fed reactors
 - Limestone
 - Sulfide
 - Activated Carbon
- Functional in remote mine locations
- Results through 500 pour volumes all test media removed over 99% of the arsenic



Mine Waste Technology Program

- Mine Waste Technology Annual Reports
- Project list, Contact, and Publications Information
- Panorama & Video Files
- List of Proposals for 2002/2003
- Links to Call for Proposal Descriptions
- See: <http://www.epa.gov/ORD/NRMRL/std/mtb/mwtphome.html>



Acid Mine Drainage Research Project

- Christine Costello (NNEMS Intern)
- 10 week project focusing on “Acid Mine Drainage: Innovative Treatment Technologies”
- Examination of 10 methods of treatment:
 - Constructed Wetlands
 - Anoxic Limestone Drain
 - Bioreactors
 - Alkalinity Production Systems
 - Permeable Reactive Barriers
 - Biosolids
 - Phytoremediation
- Report to be mounted at www.cluin.org/ by November 2003

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Hazardous Substance Research Center (HSRC)

- Rocky Mountain Regional HSRC officially serves EPA's region 8
- Consortium of participants from several academic and non-academic organizations from regions within the United States and Canada
- The center's focus
 - improving on existing methods
 - developing new Mine Waste technologies that are cost effective and lead to clean ups that are protective of human health and environment
- RMRHSRC Annual Report, 2002
- See: www.engr.colostate.edu/hsrc



Summary

- Future Issues concerning mine waste remediation
 - Developing treatment methods that will provide higher levels of purification of contaminants
 - Creating more cost effective methods of treating contaminated sites
 - Developing passive technologies that are durable and require little maintenance



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Highlights

- Broadcasts periodic e-mail messages to the list of 16,500 subscribers in 60 countries
- Highlights events of interest to site remediation and site assessment professionals.
- Describes new products and provides instructions on how to obtain them.

