Floating SRB Bioreactor

LAURENTIAN VISION PARTNERSHIP
OCTOBER 6, 2014

CLEARWATER LAYLINE LLC
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Why is this important?

1. Mining in Minnesota?
2. Environmental impact?
3. Sulfate?
4. Wild Rice?
5. AMD?
6. Mercury?
7. Dissolved metals?
8. Economics?
9. IR City water?
Conceptual model of sulfate-mediated chemical changes in sediment. This is not a complete representation of all the factors controlling how sulfate might affect wild rice habitat. For instance, water movement might carry organic matter away, altering bacterial activity. The nitrogen cycle is much more complicated than represented. Numbered notes in the diagram are...
SRB Sulfate Reduction

$$2 \text{CH}_2\text{O} + \text{SO}_4^{2-} \rightarrow 2 \text{HCO}_3^- + \text{H}_2\text{S}$$

Metal Sulfide Precipitation

$$\text{H}_2\text{S} + \text{M}^{2+} \rightarrow \text{MS}\downarrow + 2\text{H}^+$$
Spring Mine Creek @ 600 GPM
Would require about 2,280 lbs of dissolved iron / day
Collaborative Initiative

Laurentian Vision Partnership – IRRRB
East Range Joint Powers Board – ERJPB
Natural Resource Research Institute – NRRI/CMRL
Dr. Mark Reinsel – Apex Engineering
PolyMet Mining
Barr Engineering, NTS & Pace Labs
Cliffs Natural Resource
Premier Plastics
Silicon Energy
2 Stage Floating Sulfate Reducing Bioreactor Concept

Mine Pit Lake Environment:
High Sulfate
Low Oxygen
No Mercury
Below freeze zone
Pit Lake on May 4, 2013 – Ice out on May 10
March 5th
SiE Solar Panels, nutrient feed & iron dosing
Sulfate Reduction – Summer 2013 on 4 Bioreactors
Total Accumulated Flow = 2,577,563 gal
As of 10/3/14
Raft A Bioreactor Effluent

- Sulfate (mg/l)
- Sulfide (mg/l)
- ORP

Start  6/5/14  7/17/14  8/20/14  9/12/14
Modular and Scalable System

**Current System:** 14 bioreactors covering 900 ft² with total flow of +/- 10 gpm.

**SD033 Full Flow System:** Discharge of SD033 into Spring Mine Creek is +/- 600 gpm with about 3,200 ppm of sulfate. Needs an estimated 900 units covering 1 acre to reduce sulfate levels to <200 ppm.

**Pit 1 Full Flow System:** Mesabi Nugget was discharging +/- 4,000 gpm from Pit 1 last winter. An estimated 5,800 units covering 6.5 acres we expect could reduce sulfate levels to <200 ppm.
MnDrive Grant

Implementation of Smart Bioremediation Technology to Reduce Sulfate Concentrations in NE Minnesota Watersheds

PROJECT LEADER
DAVID HENDRICKSON – UMD NRRI

MICHAEL SADOWSKY – UM BIOTECH INST.

FFREY HANSON – CLEARWATER LAYLINE

GRANT AWARD - $500,000 OVER 2 YEARS
MnDrive Grant Objectives

- Optimize bacterial activity to most efficiently reduce sulfate concentrations to help meet regulatory limits for existing and new mining operations, municipal wastewater treatment plants and various industrial businesses in NE Minnesota.
- Demonstrate that sulfate reduction bioremediation can be operated and controlled in remote locations.
- Demonstrate that smart technology modular platforms can be effectively monitored and controlled by in-situ communication transmitters and controls powered by solar power.
### Collaborative Minnesota Water Technology

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<thead>
<tr>
<th>Institutional Collaborators</th>
<th>Private Collaborators</th>
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</thead>
<tbody>
<tr>
<td>UMD – NRRI</td>
<td>• Clearwater Layline</td>
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<tr>
<td>RRRB - Laurentian</td>
<td>• PolyMet Mining</td>
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<td>ERJPB</td>
<td>• Cliffs Natural Resource</td>
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<tr>
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<td>• Barr Engineering (PM)</td>
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<tr>
<td>MPCA</td>
<td>• NTS &amp; Pace Labs (PM)</td>
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<td>MTO</td>
<td>• Silicon Energy</td>
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<td>• ERP and IEC</td>
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Laurentian Vision Partnership – Thank You for Your Support

The Laurentian Vision Partnership has been working with mining, government, business and community interests to demonstrate how mining process can create land forms to accommodate the residents, the environment, and economy of this region's promising future. Read more.