The Feasibility of Utilizing Vetiver (Chrysopogon Zizaniodes) as Silt Barriers for Sediment Control of Run Off from Open Pit Mines

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Photo from: Mines and Geosciences Bureau, Philippines
Baay. Tan., Philippines. 2015
Carrascal Nickel Corporation
Carrascal, Surigao Del Sur

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• Nickel Lateritic soils have very fine sediments (63 microns)
• Siltation in the run-off water is mitigated by employing siltation ponds and silt traps.
Carrascal Nickel Corporation
Carrascal, Surigao Del Sur
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Rio Tuba Nickel Mining Corporation
Bataraza, Palawan
Baay, Tan., Philippines. 2015
Why Vetiver?

The dense root system of the Vetiver grass has been used for soil erosion control, agriculture, and for waste and sewage treatment with significantly increasing research on its capability to absorb heavy metals and toxic wastes.
Current Applications of Vetiver

Slope Stability

Vetiver used for slope stability along the embankment of LosBaños, Laguna in 2013.

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Kalibo- Caticlan erosion control and revegetation on cut slope

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Vetivers placed in pontoons used for minimizing algal bloom to regulate oxygen for fish and other aquatic life in a pond at Balog Creek, in Itogon, Benguet in 2013.
Current Applications of Vetiver

Pythoremediation

Vetivers placed in pontoons used for cleaning the Pasig River and Ad campaign for Hana Shampoo by Vetiver Farms Philippines

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Objectives of the Study

- To utilize Vetiver as silt barriers
- To demonstrate the ability of vetiver to trap silt
- To determine relationship of vetiver density and efficiency in trapping silt
Scope and Limitation

• The study intends to show only the capacity of the Vetiver Root System to trap and accumulate silt in recirculated water and quantify its effectivity.

• Results and conclusions are only applicable for heavily silted water.

• Silt of Nickel Lateritic origin with size less than 63 microns.
Methodology: Plant Propagation

Figure 1. Propagation of Vetiver Grass.

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Methodology: Plant Propagation

Figure 2. Washing of Vetiver Root Bundles.

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Methodology: Plant Propagation

Figure 3. Propagated Vetiver Root Bundles

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Methodology: Particle Size Reduction

Figure 4. Particle size reduction by Ball Milling, and RoTap and sieving.

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Methodology: Set-up Design

Figure 5. Experimental Set-up without Vetiver System, without silt.

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Methodology: Experiment

<table>
<thead>
<tr>
<th>Vetiver Density</th>
<th>Amount of silt (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>50</td>
</tr>
<tr>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>0</td>
<td>150</td>
</tr>
</tbody>
</table>

Table 1. System 1: No Vetiver System, Varying Silt Concentration

<table>
<thead>
<tr>
<th>Vetiver Density</th>
<th>Amount of silt (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 row</td>
<td>100</td>
</tr>
<tr>
<td>2 rows</td>
<td>100</td>
</tr>
<tr>
<td>3 rows</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 2. System 2: Varying Vetiver Density, Constant Silt Concentration

<table>
<thead>
<tr>
<th>Vetiver Density</th>
<th>Amount of Silt (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 rows</td>
<td>50</td>
</tr>
<tr>
<td>4 rows</td>
<td>100</td>
</tr>
<tr>
<td>4 rows</td>
<td>150</td>
</tr>
</tbody>
</table>

Table 3. System 3: Varying Silt Concentration

Constant Vetiver Density

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Methodology: Experiment

Baay. Tan., Philippines. 2015
Methodology Experiment

SYSTEM 1 No Vetiver, Varying Silt Concentration
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Methodology Experiment

SYSTEM 2: Constant Silt Concentration, Varying Number of Vetiver Rows
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Methodology Experiment

SYSTEM 3: Constant Number of Vetiver rows, Varying Silt Concentration
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Methodology: Sampling and monitoring

Figure 6. Samples collected from system 3
Methodology

Filtering and Drying

Figure 7. Silt collected from the system is decanted and filtered

Figure 8. Silt filtered from the system.

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Methodology

Root System

Figure 9. Vetiver Root System without silted water

Figure 10. Vetiver Root System with silted water

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Data and Interpretation

SYSTEM 1: NO VETIVER WITH VARYING SILT

Suspended Solids (g/L)

Time (hr)

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SYSTEM 3: 4 ROWS OF VETIVER WITH VARYING SILT

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Relationship of Accumulated Silt and Number of Vetivers

\[ y = 9.967x + 42.618 \]

\[ R^2 = 0.9721 \]
<table>
<thead>
<tr>
<th>Silt (g)</th>
<th>No. of Rows</th>
<th>Mass (g)$_0$</th>
<th>Mass (g)$_4$</th>
<th>Percent Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>0-4</td>
<td>16.78</td>
<td>25.86</td>
<td>54.11</td>
</tr>
<tr>
<td>100</td>
<td>0-4</td>
<td>40.56</td>
<td>80.32</td>
<td>98.03</td>
</tr>
<tr>
<td>150</td>
<td>0-4</td>
<td>59.06</td>
<td>104.28</td>
<td>76.57</td>
</tr>
</tbody>
</table>

*Table 5: Percent Change from zero to four rows of Vetivers*
System 1 and 3 - The amount of total silt accumulated in the main reservoir relatively increased as compared to no Vetivers at all.

System 2 – The amount of Vetiver rows introduced into the system is proportional to the amount of accumulated silt.
Statistically significant differences were observed between the no vetiver system and the vetiver-present system.
Recommendation

The researchers recommend that a further and more comprehensive study be conducted involving:

• More species of plants
• Industrial silt barriers such as Geotextiles
• Optimum time to allow saturation of silt barrier
• Perform the experiment in the actual mine set-up


Baay. Tan., Philippines. 2015
References

Sponsors

MINERCON International Inc.
Mining, Minerals, Metals Energy and Environment

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Special Thanks

VETIVER FARMS PHILIPPINES

DEPARTMENT OF MINING METALLURGICAL AND MATERIALS ENGINEERING • 1936 •

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