Tailings as a Growth Medium: Eliminating Topsoil Dependency

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Introduction

Upwards of 320 new tailings storage facilities (TSFs) were constructed between 2010 and 2020, more than any previous decade*

TSFs are often barren or sparsely vegetated

Resulting in erosion which may lead to environmental contamination

Rehabilitation is crucial for this increasing environmental hazard

Mining companies are under growing pressure to showcase their current efforts to reduce environmental impact

Introduction

The most used technologies involve constructing an inert or biological cap over mine tailings, such as topsoil, rock, or gravel.*

Expensive and environmentally detrimental

The goal is to foster germination and the establishment of a vegetative cap, leading to plant succession and the eventual formation of a stable vegetative community on the site.

Consequently, using the tailings itself as a growth medium would:

Reduce costs
Reduce environmental damage at topsoil host sites

*Gil-Loaiza et al., 2016
Organic Amendment

First plant growth is poor, and the plants are not strong.

The growth medium undergoes changes in structure and biochemistry.

The plant growth improves as the growth medium becomes more like soil and needs less intervention.
Experiment

Platinum tailings samples were obtained and combined with various organic amendments in a pot experiment.

The treatments in triplicate were irrigated with either tap or process water.

A positive (100% topsoil) and negative (100% tailings) control were also included.

The treatments were:
- 25% compost
- 33% compost
- 33% mulch
**Grass Details**

<table>
<thead>
<tr>
<th>Grass Name</th>
<th>Germination rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teff SA Brown</td>
<td>80 – 89%</td>
</tr>
<tr>
<td><em>Cynodon</em> Unhulled</td>
<td>80 – 89%</td>
</tr>
<tr>
<td><em>Eragrostis</em></td>
<td>80 – 89%</td>
</tr>
<tr>
<td>Rhodesgrass</td>
<td>40 – 49%</td>
</tr>
<tr>
<td>Smutsfinger</td>
<td>20 – 29%</td>
</tr>
<tr>
<td>Borseltjie</td>
<td>20 – 29%</td>
</tr>
</tbody>
</table>

A sowing rate of **25kg/ha** for rehabilitation of impacted land or approximately 6g of seeds per pot.
Laboratory Trial Results

All treatments responded better under process water irrigation.

Temperatures and pH of the growth media did not show significant differences.

The electric conductivity showed significant differences for all treatments irrigated with process water as well as 100% tailings under tap water irrigation.
Laboratory Trial Results

Process water irrigated pots showed better plant growth than tap water irrigated pots.
Results and Discussion: Comparison of controls

CCR: 100% topsoil irrigated with tap water
CNR: 100% tailings irrigated with tap water
WCPR: 100% topsoil irrigated with process water
CNPR: 100% tailings irrigated with process water
Results and Discussion: 25% and 33% compost and 33% mulch under tap and process water irrigation
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Material Costs Comparison Between Organic Amendment and General Capping Method

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Step 1</th>
<th>Step 2</th>
<th>Step 3</th>
<th>Step 4</th>
<th>Step 5</th>
<th>Outcome</th>
<th>Actions in year 2</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topsoil</td>
<td>Truck in topsoil</td>
<td>Bulldozing topsoil</td>
<td>Seeding (Hydro-seeding)</td>
<td>Second seeding (Hydro-seeding)</td>
<td>Erosion control; monitoring</td>
<td>Erosion evident; alien invasive plants</td>
<td>Amend erosion. Plant more seeds. Remove alien invasive plants</td>
<td>Successful plant growth but continued alien plant eradication measures needed</td>
</tr>
<tr>
<td>Compost</td>
<td>Truck in compost</td>
<td>Mix compost with tailings</td>
<td>Seeding</td>
<td>Irrigate seedlings</td>
<td>Erosion control</td>
<td>Little erosion; healthy plant growth</td>
<td>Monitoring</td>
<td>Successful plant growth; sustained monitoring</td>
</tr>
<tr>
<td>Mulch</td>
<td>Truck in mulch</td>
<td>Mix mulch with tailings</td>
<td>Seeding</td>
<td>Irrigate seedlings</td>
<td>Erosion control not needed</td>
<td>Healthy plant growth</td>
<td>Successful rehab</td>
<td>Return of animal life</td>
</tr>
</tbody>
</table>
Discussion

Using process water will reduce the amount of clean water used by the mine.

More focus should be on species diversity.

Indigenous plants should be used during rehabilitation.

Further addition of the amendments during the course of plant growth may further reduce alkaline pH levels and enhance nutrient absorption by plant roots creating a more favourable environment for vegetation establishment.
Transformation Goals:
• Enhance safety standards and mitigate environmental risks.
• Improve operational efficiency and long-term sustainability.

Environmental Considerations:
• Incorporate habitat restoration measures to mitigate ecological impact.
• Implement water management strategies to minimize contamination risks.

Community Engagement:
• Engage local communities in decision-making processes and risk communication.
• Foster partnerships with stakeholders to ensure transparency and trust.
References


Let’s continue the conversation!
Post questions and comments in the IAIA24 app.

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