wsp

SAIMM
THE SOUTHERN AFRICAN INSTITUTE OF MINING AND METALLURGY

EVALUATING MINE TAILINGS REUSE POTENTIAL THROUGH GEOTEXTILE DEWATERING

SAIMM Tailings 2026 – Where to now?

NIKHIEL BUDHAI
MSc candidate (Civil & Environmental Eng.) | PMP ®

3 & 4 March 2026

Overview

- Framing the problem: TSFs
- The Solution: Geotextile Tube Dewatering Systems
- Technical Insights: Geotechnical Properties of Dewatered Tailings
- Global Precedents & Roadmap for Implementation
- Sustainability, Impact & Conclusions

FRAMING THE PROBLEM

While countries like Germany, the US, and China reuse most of their fly ash in construction and infrastructure, South Africa generates 30 million tons annually and buries over 90%.

(Eskom, 2024)

We know how to store mine waste…

But do we know how to transform it?

TFS BRUMADINHO FAILURE

The Impact of Traditional Disposal

The Merriespruit tailings dam failure, 1994

Free State, South Africa

The Mount Polley Mine Disaster, 2014

British Columbia

Environmental	Social	Economic	Geotechnical
Groundwater contamination & dust pollution.	Communities exposed to health risks.	High monitoring & maintenance costs.	Unstable slopes, settlement, and land loss.

GEOTEXTILE DEWATERING SYSTEMS

THE SOLUTION


(Maccaferri, 2024)

Geotextile Dewatering Systems

PHASE 1: Filling phase

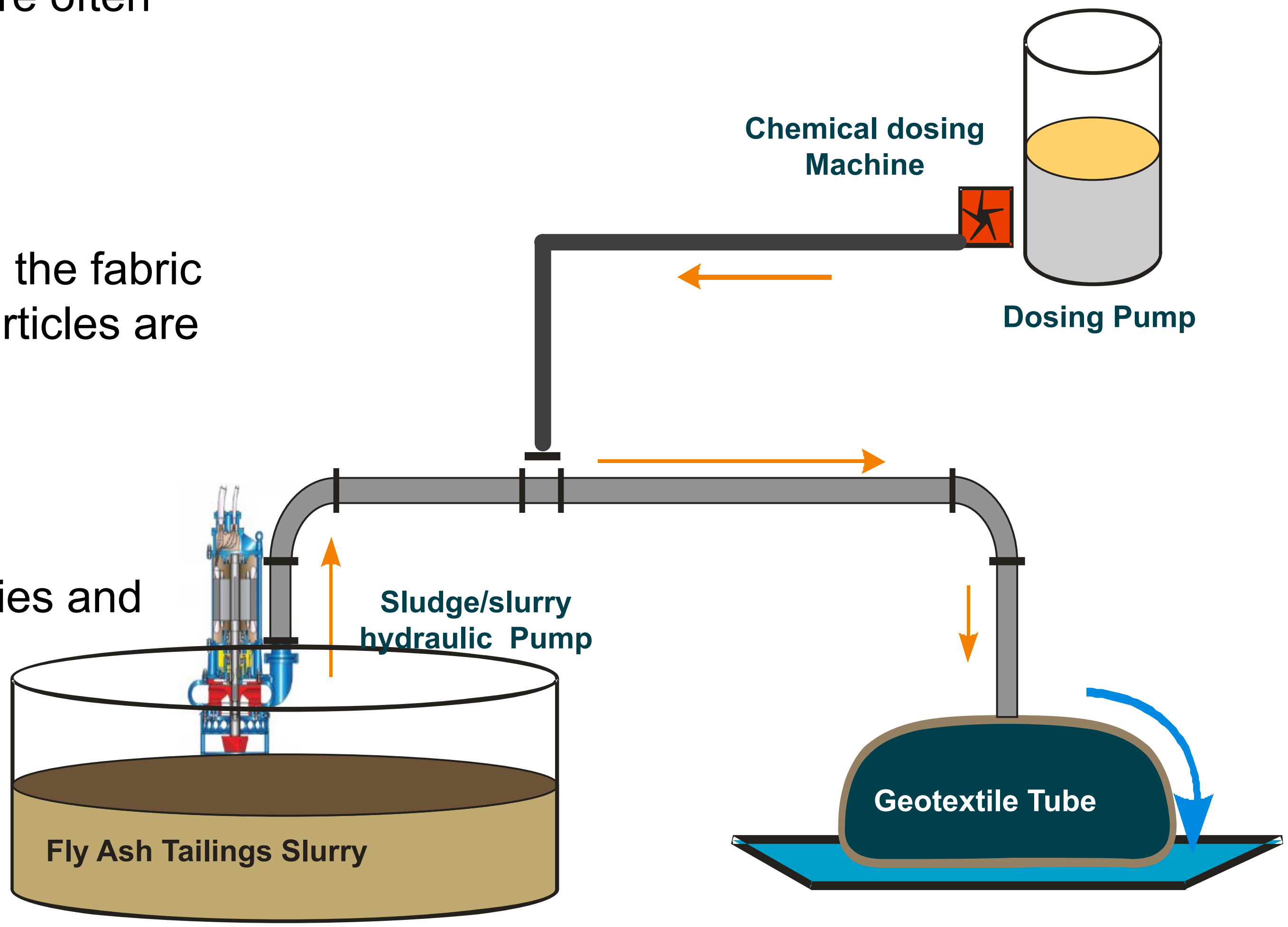
In the filling phase, a tailings slurry is pumped directly into large, high-strength permeable tubes. Polymers are often added to improve particle separation.

PHASE 2: Dewatering phase

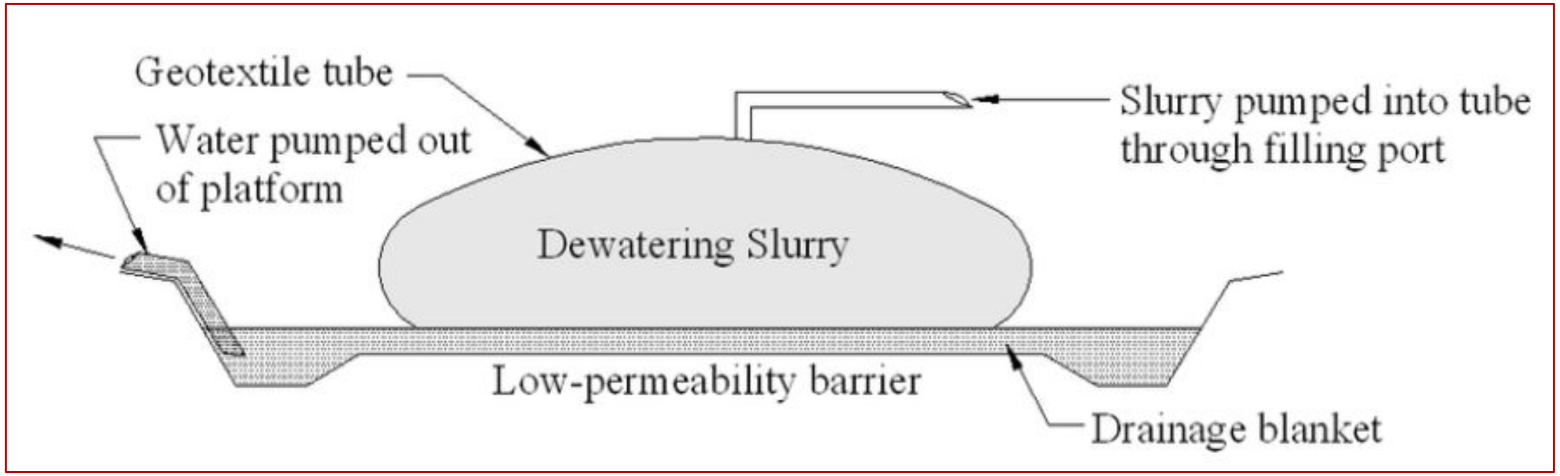
In the dewatering phase, water drains out through the fabric pores by gravity and capillary action, while fine particles are safely retained.

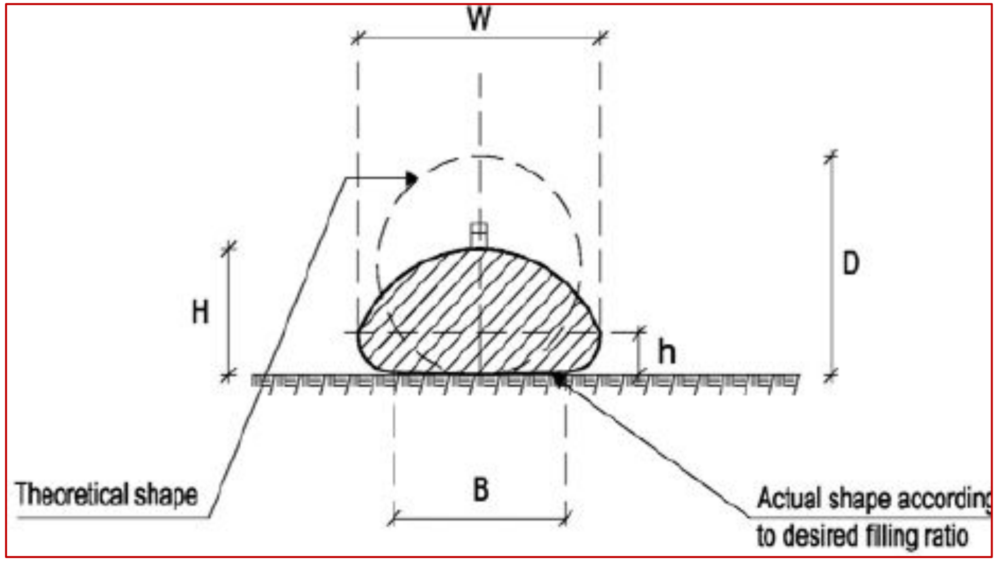
PHASE 3: Consolidation phase

Finally, in the consolidation phase, the material dries and densifies into a stable, compact mass.



Geotextile Dewatering Systems





(Officine Maccaferri, 2020)

TECHNICAL INSIGHTS

GEOTECHNICAL BEHAVIOUR OF DEWATERED TAILINGS

Study objective

To develop a structured, early-stage evaluation methodology for assessing the suitability of mine tailings for geotextile-based dewatering and potential reuse.

Key Outcomes

The study produced a structured classification of eight governing categories that define dewatering feasibility and reuse readiness. The outcome is a decision-support structure that shifts dewatering assessment from reactive trial-and-error to structured early-stage screening.

1. Tailings type and origin
2. Particle size distribution and fines content
3. Mineralogy and surface chemistry
4. Chemical conditioning requirement
5. Geotextile–tailings compatibility
6. Filter cake formation and permeability development
7. Water recovery and clarification performance
8. Handling, stability, and reuse readiness

Geotechnical properties of dewatered fly ash

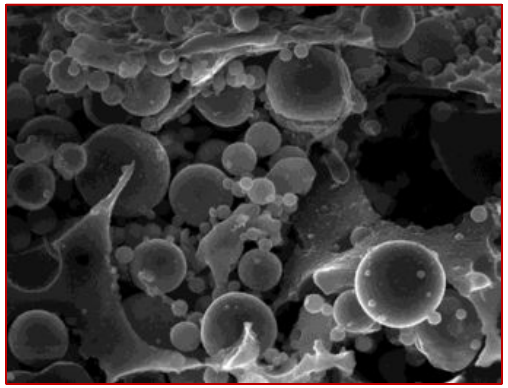
Particle Size Distribution
Fine particles form stable flocs, improving gradation and reducing plasticity.

Compaction
Achieves maximum dry densities of 1200–1600 kg/m³ with optimum moisture of 18–30%.

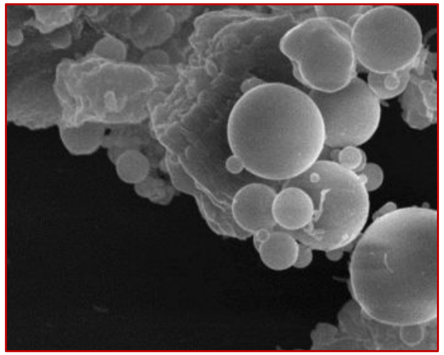
Shear Strength
Shows cohesion of 5–25 kPa and friction angles of 18–30°, similar to marginal soils.

Permeability & Leachability
Exhibits low permeability (10^{-6}–10^{-14} m/s), limiting contaminant migration.

Reuse Potential
Enables reuse in road bases, embankments, cement blends, and flood defences.



SEM Imaging of Class F Fly ash slurries (John Alegbe, 2018).



SEM Imaging of Class F Fly ash slurries (John Alegbe, 2018).

Soil-Geotextile Interaction: How it works

Geotextile tubes with Apparent Opening Sizes of 75–150 µm effectively retain processed mine waste while permitting drainage, achieving up to 90% volume reduction (Gustafson, 2012).

Mechanisms of Action

Mechanism	Description
Filtration & Retention	*Geotextile pore size (75–150 µm) balances retention of fine ash particles with adequate drainage.*
Hydraulic Behaviour	*High permittivity (>1.0 s^{-1}) allows water escape, achieving up to 90% volume reduction.*
Polymer Conditioning	*Cationic/anionic flocculants enlarge particle size, improving retention and reducing clogging.*

(Baum, 2014)

Design & Long-Term Performance

Consolidation

- *Negative pore pressures and capillary suction accelerate settlement compared to open ponds.*

Structural Stability

- *Design must consider hoop tension, inter-tube friction, and uniform foundation preparation.*

Clogging Risks

- *Progressive pore blockage reduces hydraulic performance — mitigated by tailored polymers, staged filling, and monitoring.*

Environmental Safeguards

- *Placement on lined, drained pads prevents leachate migration and supports regulatory compliance.*

Prayer seams

J - seams

Butterfly seams

(Gustafson, 2012)

GLOBAL PRECEDENTS

A ROADMAP FOR IMPLEMENTATION

Germany 🇩🇪

Over 60% of tailings are reused in construction materials, cement blending, and roadworks.

United States 🇺🇸

More than 60% recycled annually; ASTM standards enable safe incorporation into concrete and geotechnical fills.

China 🇨🇳

Reuses ~70% in bricks, lightweight blocks, and soil stabilization for infrastructure.

Implementation Roadmap

- Laboratory Benchmarking
- Pilot Field Demonstration
- Regulatory Integration & Certification
- Public Sector Adoption
- Market Stimulation via Innovation Clusters

SUSTAINABILITY & IMPACT

From waste containment to resource recovery.

This approach aligns most directly with SDG 6, SDG 9, and SDG 12 by improving water efficiency, enabling infrastructure innovation, and supporting circular resource management.

Environmental

Reduced leachate, dust, and land use; water recovered for reuse.

Social

Healthier communities, rehabilitated land, safer environments.

Economic

Lower disposal costs, material recovery, new green jobs.

Thank you.

Q&A

SAIMM Tailings 2026
Where to now?

The future of tailings management is not in containment…

…it is in transformation.

REFERENCES

- Alegbe, J. (2018) *SEM Imaging and Characterization of Class F Fly Ash Slurries.* Pretoria: University of Pretoria.
- Baum, R.L. (2014) 'Geotechnical properties of dewatered fly ash', *Journal of Geotechnical and Geoenvironmental Engineering*, ASCE.
- Eskom (2024) *Fly Ash Characterization and Management Practices in South Africa.* Johannesburg: Eskom Holdings SOC Ltd.
- Gustafson, G. (2012) 'Dewatering of fly ash and tailings using geotextile tubes', in *Proceedings of the 5th International Conference on Geotextiles*.
- Kamal, M. (2016) 'Reuse of dewatered fly ash in construction applications', *Environmental Geotechnics*. London: ICE Publishing.
- Kutay, E. (2008) 'Performance of geotextile dewatering systems for coal combustion residuals', *Geosynthetics International*.
- Manz, O.E. (1996) 'Worldwide production and utilization of fly ash', *Fuel*, 75(4), pp.475–480.
- Officine Maccaferri (2020) *Geotextile Tube Dewatering Technology: Technical Reference Guide.* Bologna: Maccaferri Group.

For enquiries, please contact:

Nikhiel Budhai
Email: Nikhiel.Budhai@wsp.com
Integrating Sustainable Civil Engineering Practices with Mindful Living