ADAPTING TO CHANGE:

Filtered Tailings and the Future of Tailings Management

SAIMM PRESENTATION

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About the Authors

- Tailings storage facility design, monitoring, and operational support, including EOR work, GISTM compliance, spillway design, stage capacity and airspace modelling, and operational monitoring of active TSFs
- Experience in dry stack facilities, including laboratory testing, moisture content optimisation, pump and pipeline exposure, and development of GISTM-aligned operations, monitoring and maintenance documentation

- Tailings storage facility design, surveillance, and monitoring across a wide range of TSF types, including conventional slurry, impoundment, dry stack, and filtered tailings facilities
- Experience working on projects for major mining operations, with strong exposure to both design development and operational performance of tailings facilities

Abstract & Presentation Overview

01 RISKS OF TRADITIONAL SLURRY DEPOSITION

02 INTRODUCTION TO FILTERED TAILINGS (FT)

03 KEY CHALLENGES IN FT OPERATIONS

04 CASE STUDY 1

05 LESSONS LEARNT

06 FUTURE OUTLOOK AND INDUSTRY QUESTIONS

Conventional Slurry Deposition: Key Risks

Brumadinho

Jagersfontein

Merriespruit

The Shift Away from Slurry Deposition

- Rising concerns over Slurry TSF failures
- Industry push for safer alternatives
- Introduction of Filtered Tailings (FT)
- Lower water content = lower risk

What Are Filtered Tailings?

Tailings are mechanically dewatered

Moisture content reduced to ~15% or less

Material is placed in compacted layers

No need for water retention structures

Perceived benefits of Filtered Tailings Deposition

Reduced risk of failure

Lower environmental impact

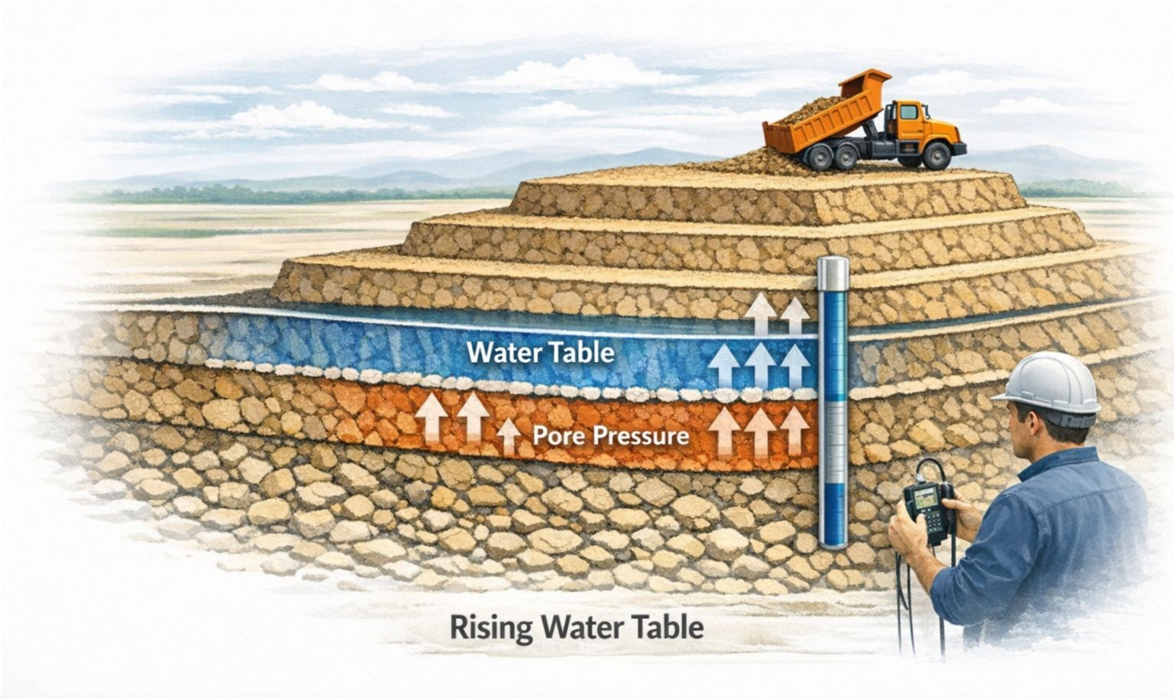
Water conservation

Easier closure and rehabilitation

Generally lower CCS ratings (safer classification)

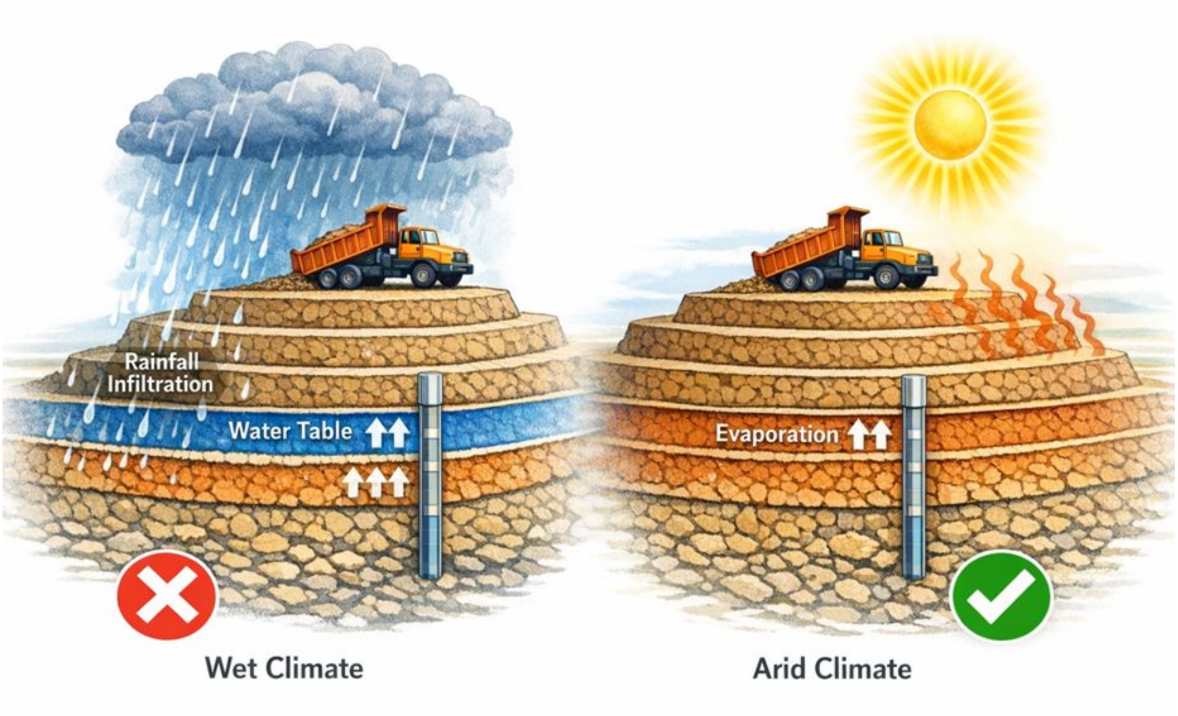
Filtered Tailings – Not a Perfect Solution(1 of 2)

Unlike slurry facilities, which are well-established and extensively studied, FT is still relatively new.

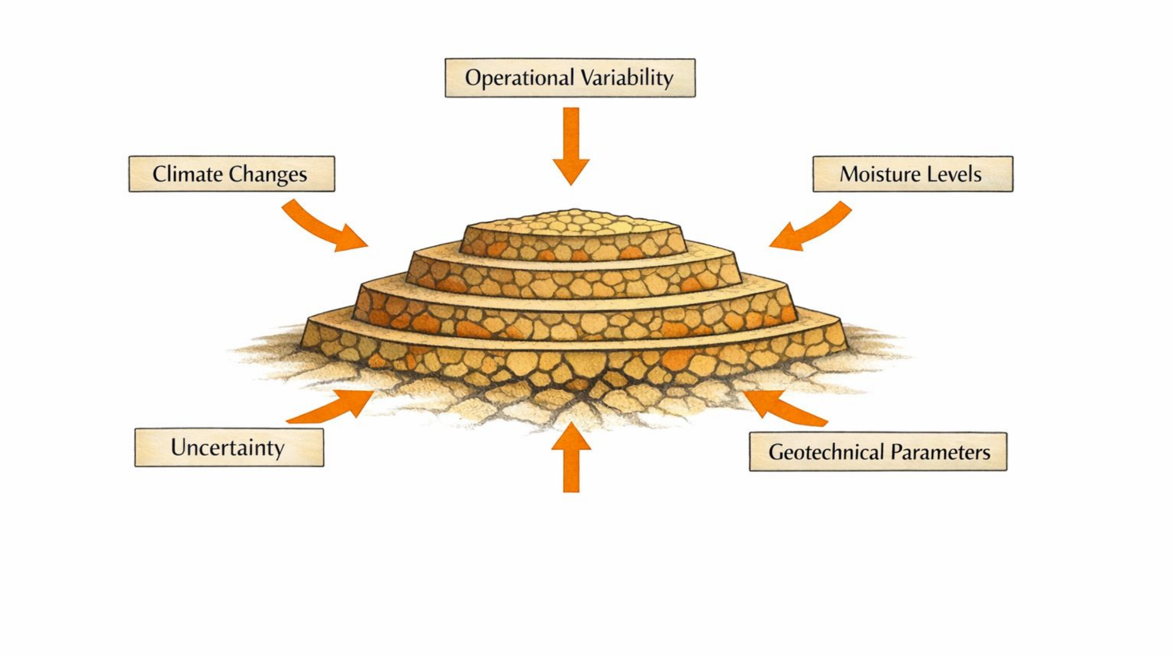


A common misconception is that FT stacks won't develop a water table.

Filtered Tailings – Not a Perfect Solution(2 of 2)



Climate also plays a critical role in FT performance.



Design adaptability is another concern. FT stacks are sensitive in nature.

Case Study – Facility 1

1 **PIONEERING LAYER PLACEMENT**
Construct a 500mm pioneering layer across the entire footprint to protect drainage and barrier works. This should be done within the first two months post-construction.

2 **TRIAL PAD TESTING**
Conduct trial pad testing to determine optimal compaction and lift thickness for tailings deposition.

3 **TAILINGS DEPOSITION IN PORTION 1**
Deposit a 300mm layer of tailings and compact. Continue depositing and compacting 300mm layers until reaching a 5-meter lift. Cut down to a 1V:3H slope and step in for the next 300mm lift. Continue this deposition process until the final elevation of 1,142 mamsl is reached by the end of Year 4, totaling approximately 3 million tons (Mt) of tailings.

4 **CONSTRUCTION OF OPERATIONAL SLOPES**
Construct outer slopes with a 1V:2H slope in 5-meter benches to ensure stability.

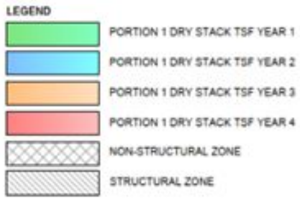
5 **CUTTING BACK COMPLETED LIFTS**
At every 5-meter interval, the operational slope will be cut back to a final slope of 1V:3H to enable rehabilitation and minimize long-term maintenance requirements.

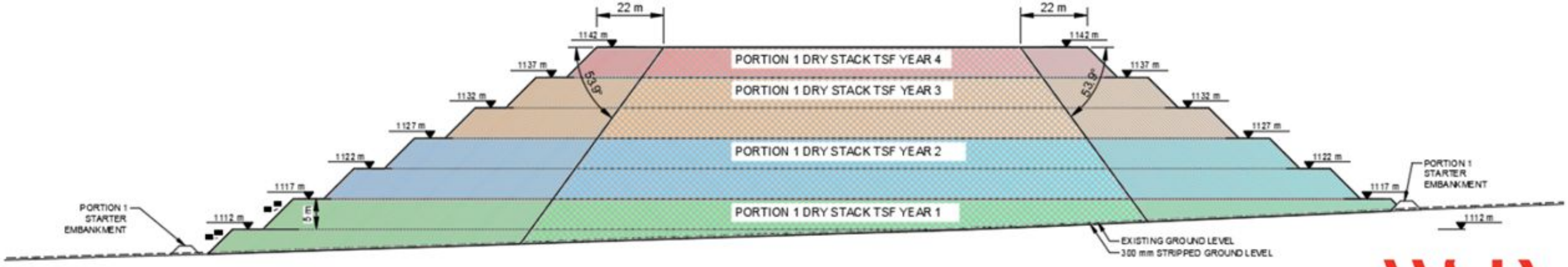
6 **TRANSITION TO PORTION 2A AND 2B**
After completing Portion 1, shift tailings deposition to Portion 2A and 2B over the next five years.

7 **PERIODIC COMPACTION TESTING**
Regularly test compaction to ensure proper compaction of tailings in both structural and non-structural zones.

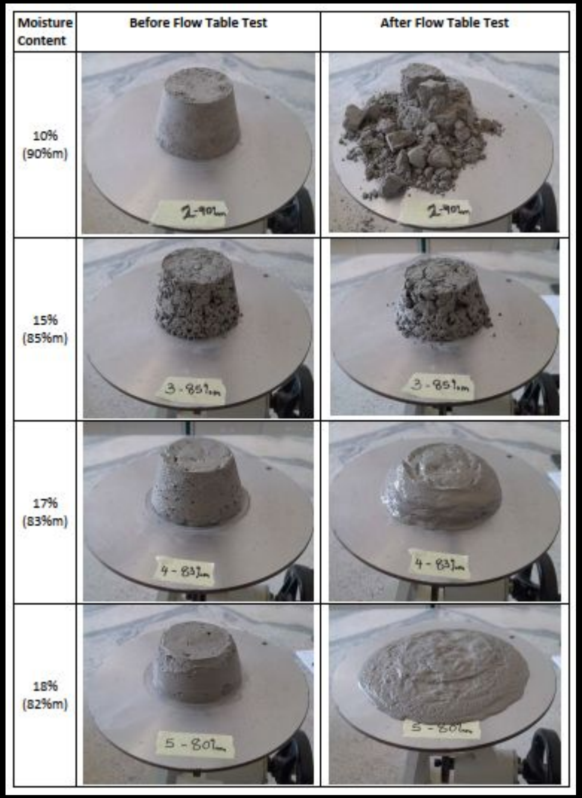
8 **INITIATE CLOSURE DESIGN**
Ensure a closure design is developed within the first year of operations to align with regulatory and operational requirements

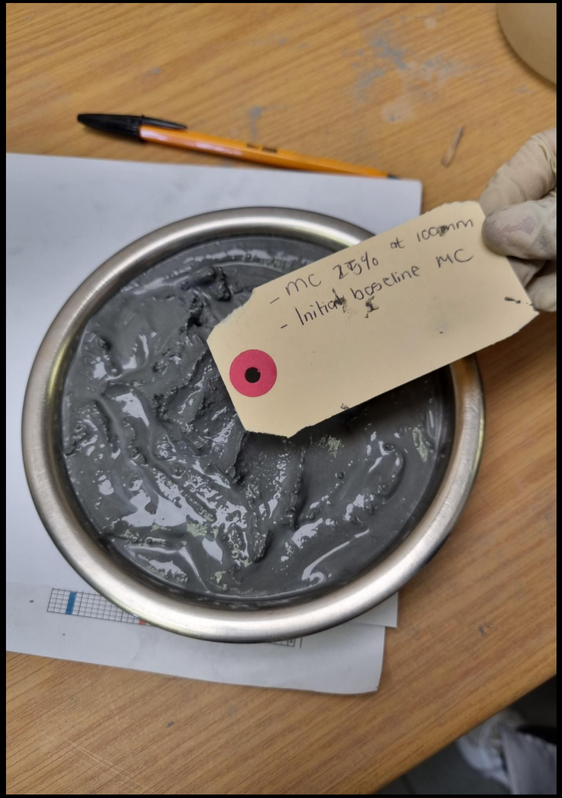
9 **CONTINUOUS REHABILITATION & FINAL COVER**
As each section of the DTSF reaches completion, continuously rehabilitate the outer slopes and apply the final cover according to the facility closure design





Moisture Content – A Critical Operational Constraint





Options assessment

Filter press MC could not be reduced

Strong capital and schedule constraints

Solution needed to address:

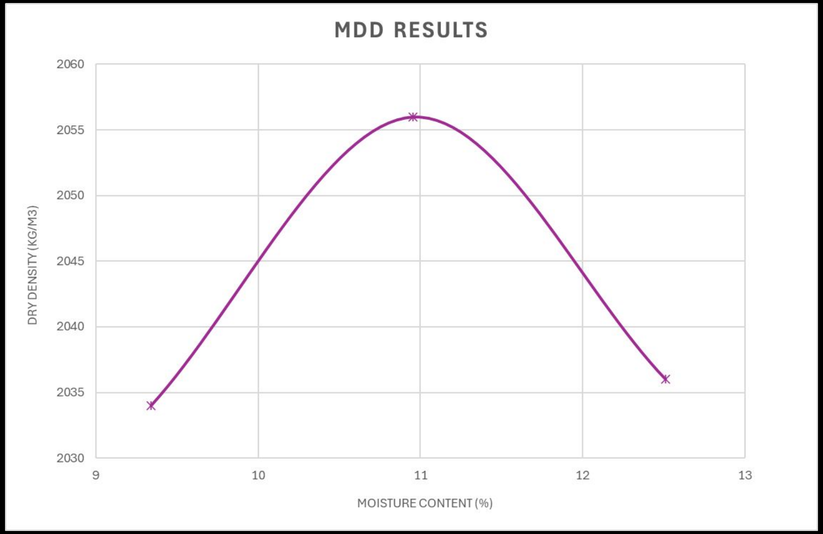
- Transportability (TML)
- DTSF stability & compaction
- Trafficability
- Paste backfill MC requirement
- Limited industry precedent

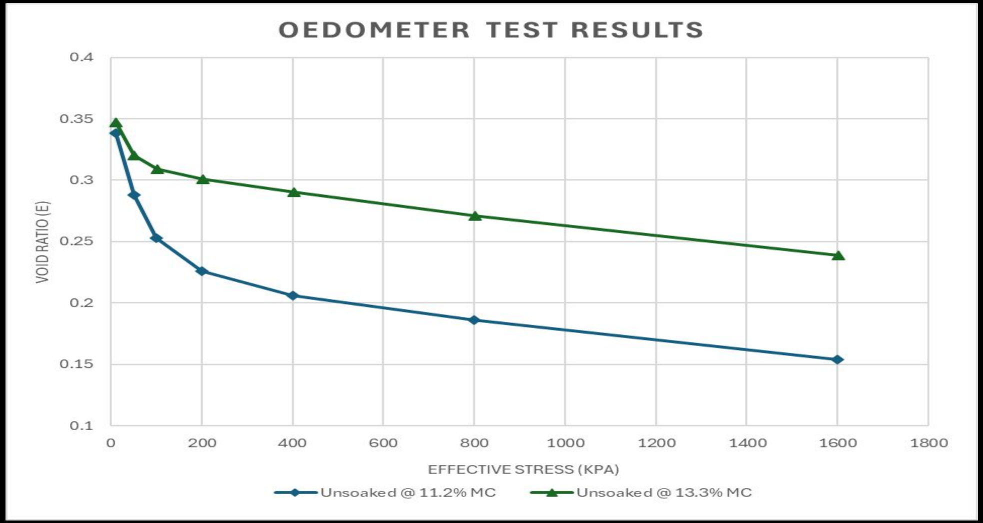
Laboratory Testing – Assessing Trafficability, Compactability and Transportability

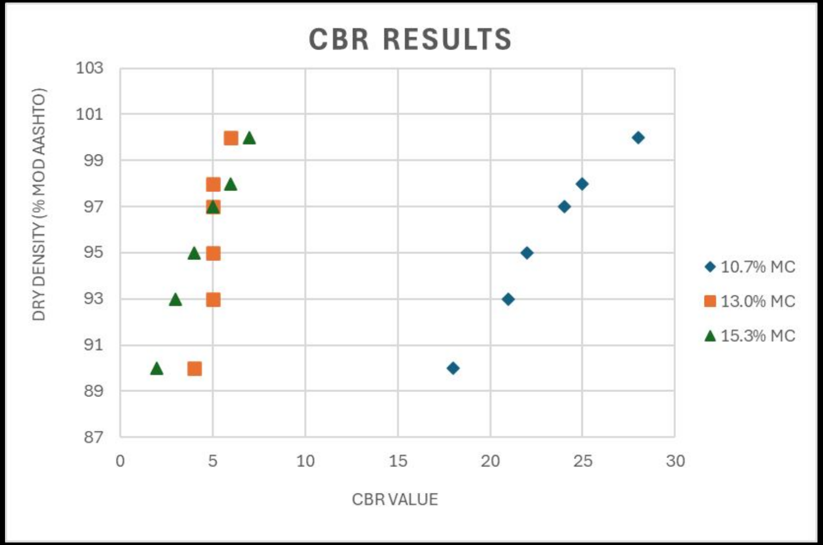
Key questions addressed:	Can the tailings be transported safely?	Can they be placed and compacted effectively for structural integrity?	Can they be trafficked during construction?

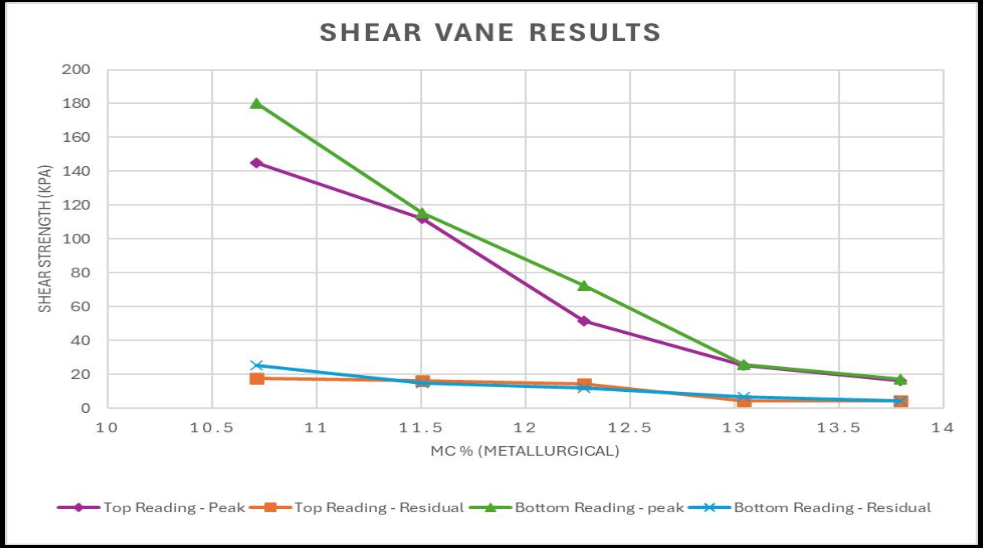
Tests discussed:	Maximum Dry Density (MDD / OMC)	Oedometer testing	California Bearing Ratio (CBR)	Shear Vane Tests	Triaxial testing

Lab Results – MDD, Oedometer, CBR & Shear Vane

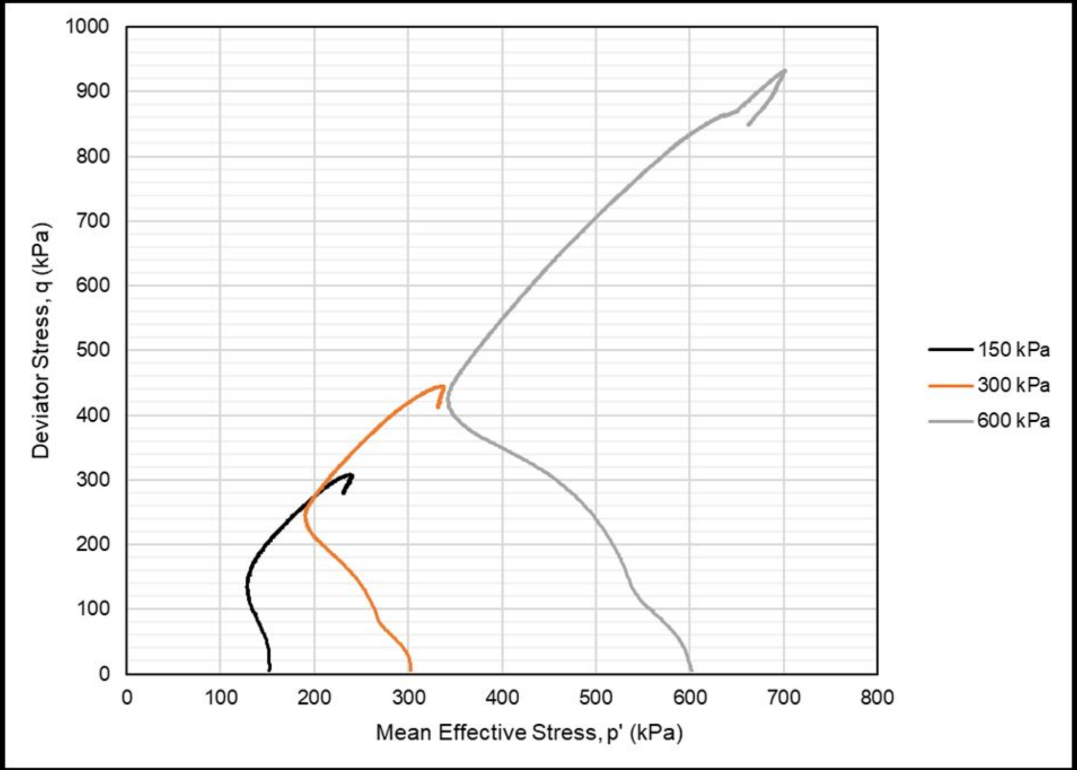




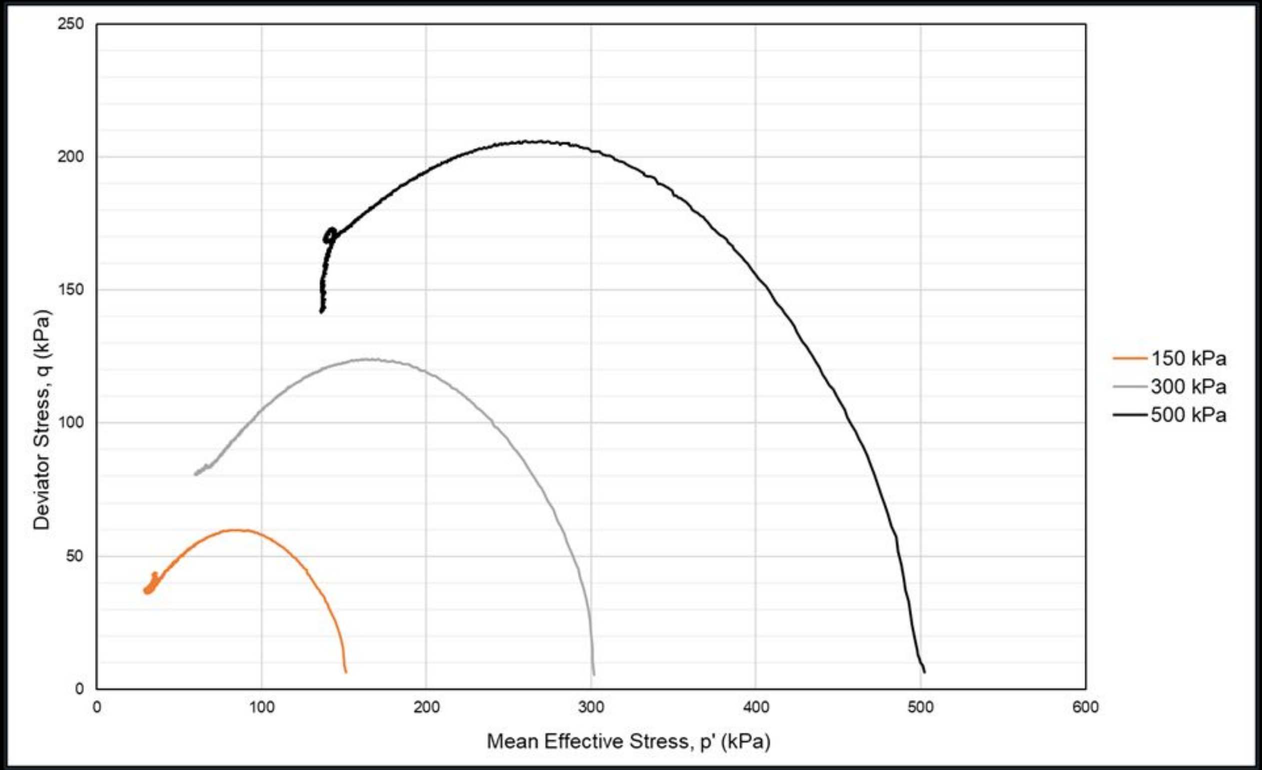




Lab results - Triaxial Tests



Densely Compacted to 13.3% MC



Loosely Compacted to OMC (11%)

Lab Results – Overall Conclusions

High MC Levels

Reduced compatibility

Increased risk of structural instability

Not trafficable/ reduced bearing capacity

Not safely transportable

Testing Procedure

AIR DRYING TAILINGS

OBJECTIVE

Evaluating the effectiveness of air drying tailings to reduce moisture content for better transportation and compaction.

Note: *This is an informal test to inform larger-scale testing and provide recommendations for trial pad testing.*

APPARATUS

- Containers
- Lab scale
- Moisture meters
- Shovels/scoops
- Thermometer
- Stopwatch/timer
- Protective gear
- Data recording tools
- Clear plastic covers
- Markers/labels

METHODOLOGY

1 PREPARATION

- Drill holes at the bottom of each plastic container, ensuring the holes are equally spaced across the bottom surface.
- Place filter paper over each of the holes to prevent sand from escaping.
- Carefully place river sand over the filter paper in medium-sized mounds to weigh down the filter paper and prevent it from shifting.
- Continue filling the container with river sand to a thickness of about 25 millimeters, creating a drainage layer.
- Prepare tailing samples to three initial moisture content levels: 17%, 21%, and 25%.
- Place the prepared tailing samples at thicknesses of 100mm over the drainage layer in each container.
- Stack each container over an empty clear container of the same dimensions to collect and monitor drained water.

2 PLACEMENT

- Place the containers with tailings samples in an open area that simulates natural environmental conditions similar to those expected on-site.
- Arrange the containers to ensure they are exposed to sunlight, wind, and ambient temperature.

3 OBSERVATION

- Monitor the drying process over a period of 5 days.
- Conduct visual inspections of the drying layers through the clear sides of the containers.
- Adjust the observation period, if necessary, based on the visual assessment of the drying progress.

4 MEASUREMENT

- Measure the moisture content at specified intervals (e.g., every 24 hours) to track the reduction in moisture.
- Measure the water levels in the clear containers beneath the samples every 24 hours to monitor the amount of drained water.
- Record the data systematically for analysis.

3 tests at 100 mm thickness prepared to MC of 17%, 21%, and 25%.

5 RECORDING

- Record the weather conditions such as maximum and minimum daily temperatures and rainfall.
- Note any deviations from the test procedure.

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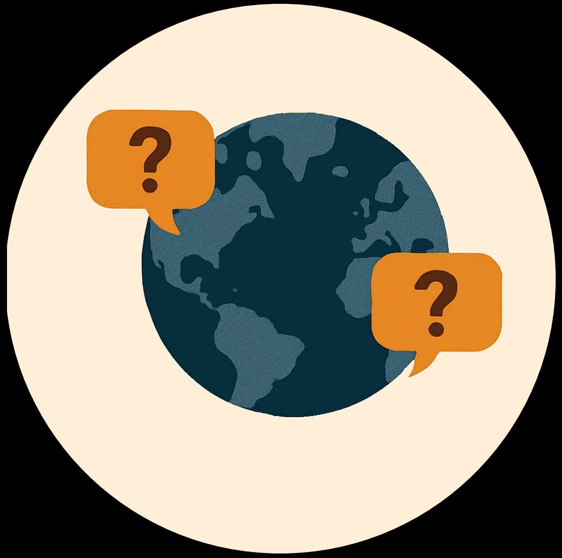
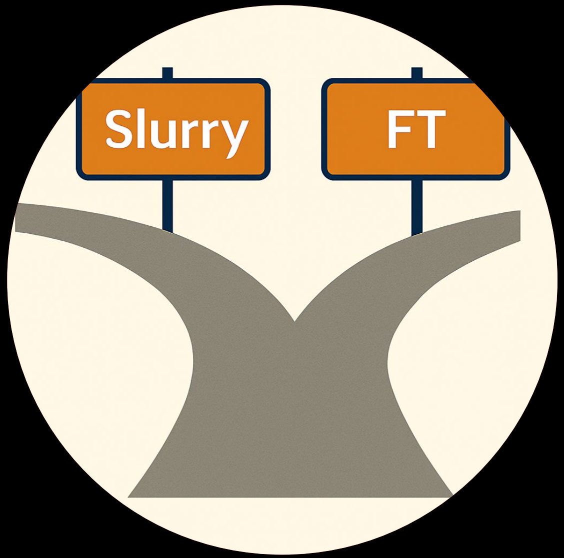
Stack It or Slurry It? - Key Takeaways



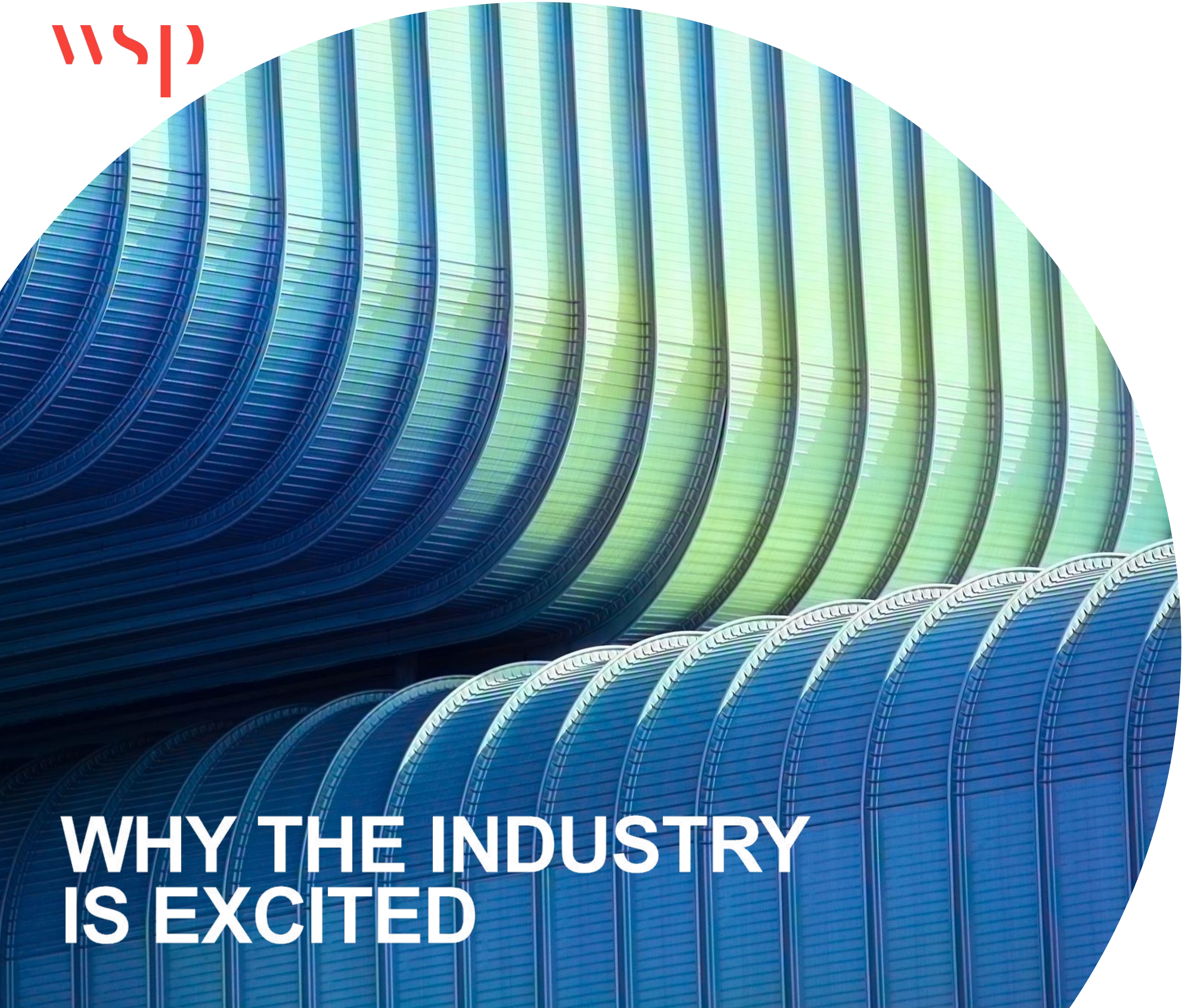
Our Concerns Aren't Isolated—They're Echoed Across the Industry.

Risk Isn't Eliminated—It's Shifted.



Tailings Design Is Not One-Size-Fits-All.

We Need More Research, Not Just More Adoption.



Navigating Rapid Industry Changes