

Surface Placement of Cemented-Paste Tailings: unproven, overkill, or a logical strategy?

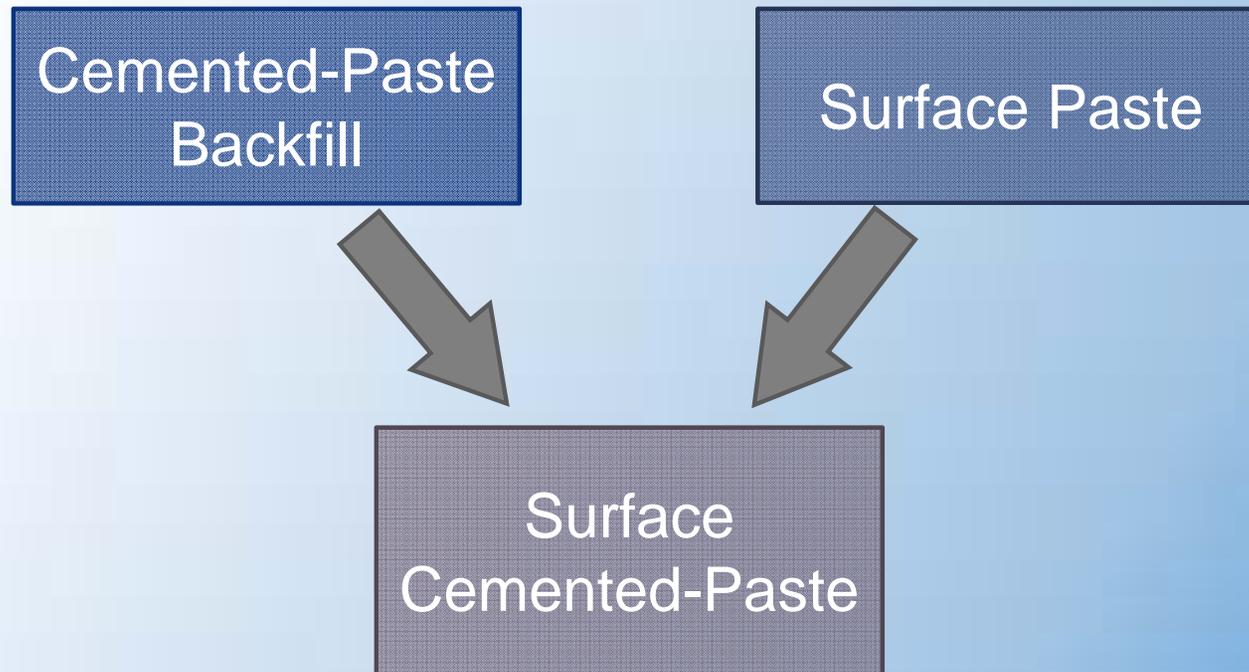
Katharine Seipel, Senior Environmental Scientist
Lisa Kirk, PhD, PG, Principal Biogeochemist
Enviromin Inc.



Water Content	Tailings	Typical Placement Options
	Slurry (25-60% Solids)	Lagoons, Conventional Subaqueous Impoundments
	Thickened (57-67% Solids)	Various Surface Facilities
	Paste (68-75% Solids)	Underground backfill or surface facility
	Filtered (>80% Solids)	Stacked at the surface



Solving by Approximation



Let's use similar existing applications to address questions!



Proven or unproven?

- Decades of *in situ* evidence
 - Extensive geotechnical understanding
 - Confirmation of geochemical advantages
- Current research on highly advanced geotechnical topics and specialized geochemistry



Cemented Paste Backfill

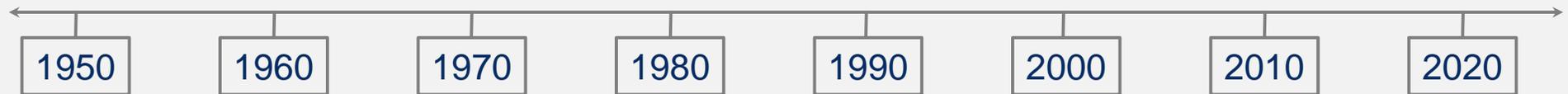
Research

Facility Implementation (1957)

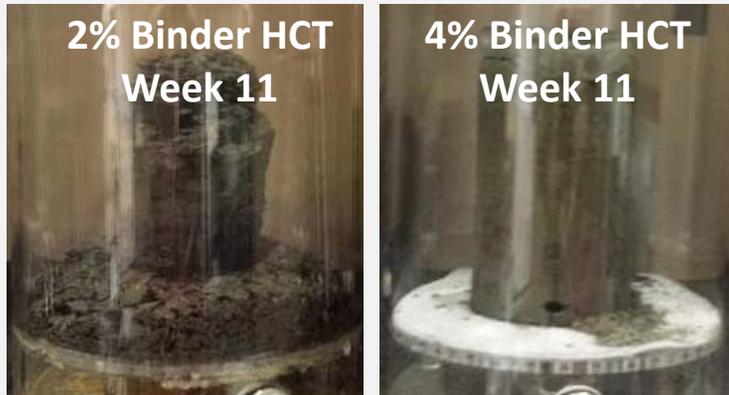


Proven

- Confusion in Terminology...
thickened, paste, and filtered
- Some lab-based published work
- A decade of *in situ* evidence



Surface Cemented-Paste Makes Sense!



Surface Cemented-Paste

Research
→
(No existing facilities*)

Surface Paste

Research
→
Facility Implementation (2003)

Cemented Paste Backfill

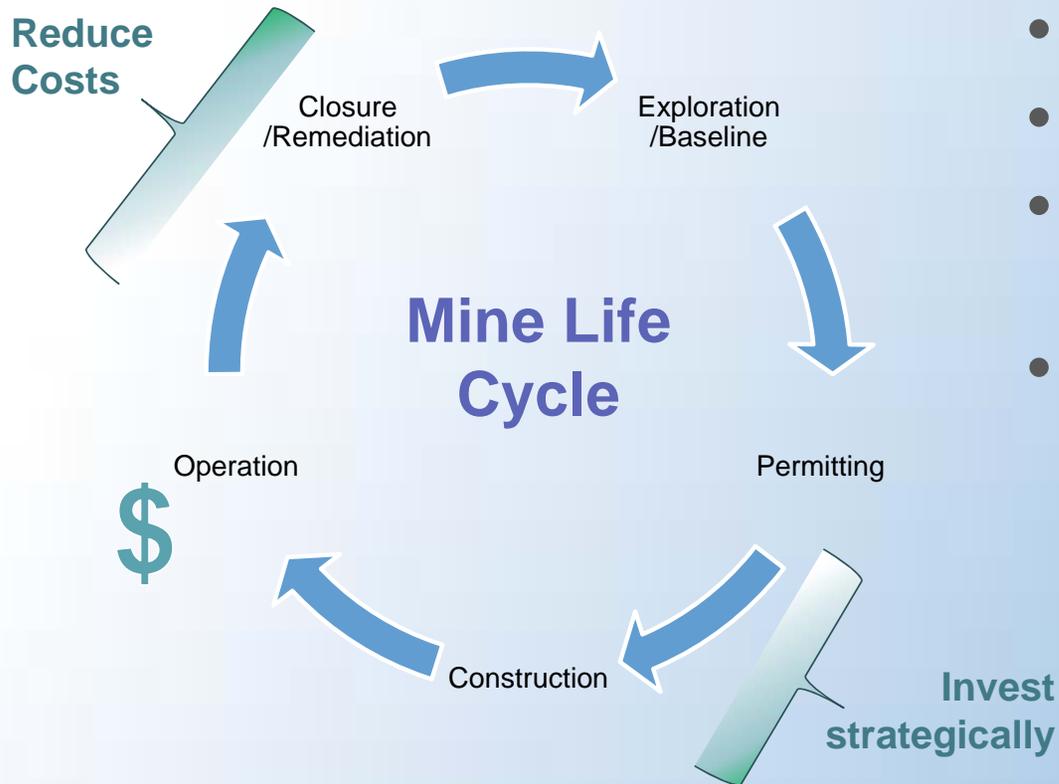
Research
→
Facility Implementation (1957)



*Only one facility is known to have partially implemented surface placement of cemented-paste.



Is Surface Cemented Paste Overkill?



- Cost
- Do benefits outweigh the costs?
- Life Cycle Analysis of cost/benefit
- It is challenging to monetize the value of strategic investment on the life cycle return on investment



Advantages of Paste Tailings Technology

- ✓ *Simplified Process*
 - ✓ *No separation for placement*
- ✓ *Water Conservation*
 - ✓ *Greater reuse of process water*
 - ✓ *Less free water draining from paste*
 - ✓ *Reduced water treatment requirement*
- ✓ *Slows oxidative weathering*
- ✓ *Low hydraulic conductivity*



Advantages

Cemented-Paste
Backfill

Surface Paste

- ✓ Less tailings at surface
- ✓ “Drift and fill” method
- ✓ Reduces operational weathering of natural rock surfaces
- ✓ Extremely low hydraulic conductivity
- ✓ Neutralizing binders may decrease acidity in low-sulfide tailings

Surface
Cemented-Paste



Advantages

Cemented-Paste
Backfill

Surface
Cemented-Paste

Surface Paste



- ✓ Open pit or underground mines
- ✓ Simplified operational water balance
- ✓ Lined facility possible
- ✓ Increased durability compared to conventional tailings



Synergistic Advantages of Surface Cemented-Paste

Cemented-Paste
Backfill

Surface
Cemented-Paste

Surface Paste

- ✓ Requires less strength than backfill placement
- ✓ Binders decrease reactive surface area
- ✓ Low hydraulic conductivity
- ✓ More durable than paste tailings
 - ✓ Reduced risk of dust generation
 - ✓ Low-to-no risk of catastrophic failure
 - ✓ Shortest closure timeframe

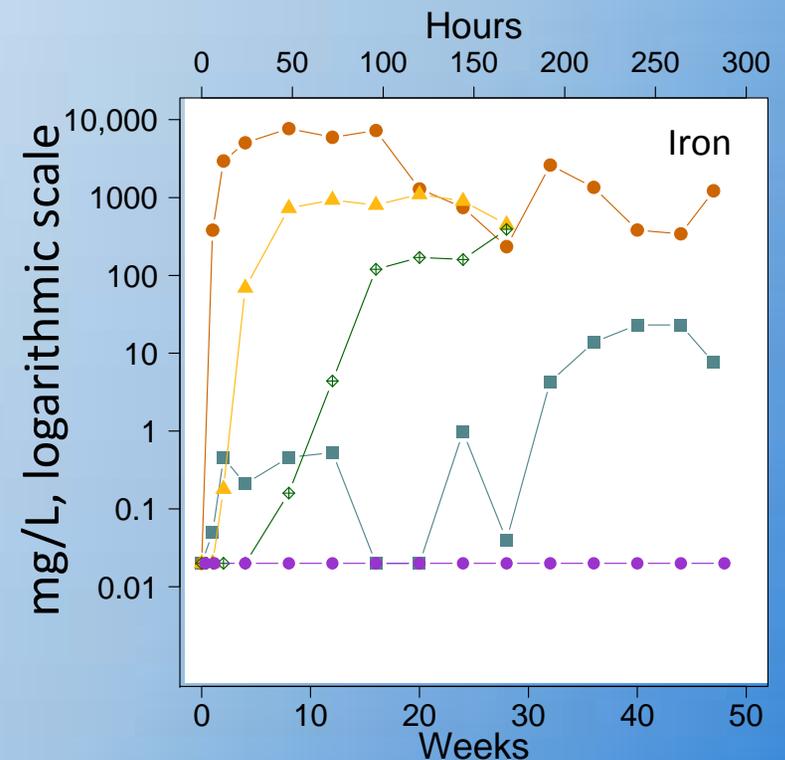


This is a Logical Strategy !

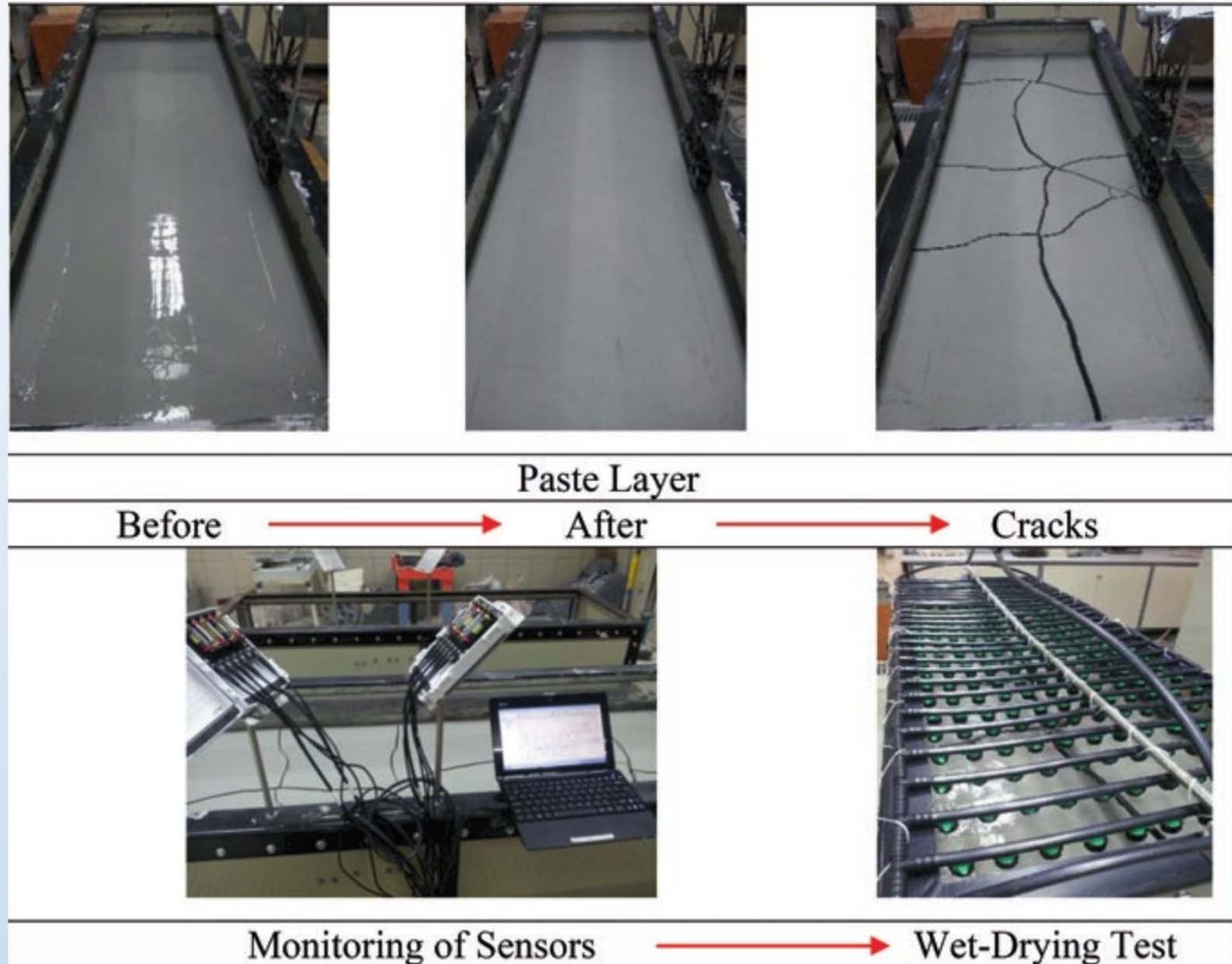
Demonstrated evidence of geochemical benefits

In-house method development to address scale dependence

Seipel K., Sheumaker, D., and Kirk, L. 2017. Kinetic Tests of Non-Amended and Cemented Paste Tailings Weathering in Subaqueous and Subaerial Settings. – In: Wolkersdorfer, C.; Sartz, L.; Sillanpää, M. & Häkkinen, A.: Mine Water & Circular Economy VII p830-836; Lappeenranta, Finland (Lappeenranta University of Technology).



Ongoing international research



From: Bascetin, A., et al, 2017.



More detail is found in the
white paper on
Enviromin's website



www.enviromininc.com