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Metals Watch (05/25/18): Gold $1,304.00 • Silver $16.64 • Copper $3.10 • Lead $1.27 • Zinc $1.37 • Platinum $909.00 • Palladium $971.00 • Molybdenum $11.79 • Lithium $131.24

# In-Pit Tailings Storage – Converting Liabilities Into Assets

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Following the August 2014 Mt. Polly tailings dam breach in British Columbia, Canada, the British Columbia Government, through the Ministry of Energy and Mines, together with the Williams Lake Indian Band and the Soda Creek Indian Band, chartered an independent expert investigation and review panel (the Panel) to investigate and report on the dam breach. In addition to determining the cause of the Mt. Polly dam breach, the Panel (Morgenstern, Van Zyl, and Vick) was requested to make recommendations to government on actions that could be taken to ensure that a similar failure does not occur at other mine sites. One of the Panel's recommendations was, where possible rely on subterranean tailings disposal methods (e.g. exhausted mine pits, underground workings etc.).

While not unprecedented, subterranean tailings disposal in exhausted pits is not as common as one might think for a variety of reasons.

- Alternative tailings storage facilities must be used during open-pit development;
- Segregating mine pits to accommodate tailings disposal in one pit area while mining a separate pit area can be logistically infeasible and cost prohibitive;
- Mining commonly (not always) ends when an open-pit resource is exhausted;
- Compromising access to underground ore via an in-pit portal;
- Although physical stability (containment) is feasible, preventing chemical constituents contained in supernatant (interstitial and free tailings water) from interacting with groundwater can be a challenge; and
- Lining pit walls (using geosynthetics) to prevent tailings interaction with the outside environment (containment) may be technically infeasible or, cost-prohibitive.

Storing "conventional" mine tailings (slurry tailings of 35 – 45% solids by weight) in exhausted pits has been successfully used in remotely populated areas (particularly in Australia) where regulatory compliance is feasible.

At one mine in Latin America, a major Mining Company successfully back-filled an exhausted mine pit using filtered tailings. Filtered tailings were dewatered to a nominal 14% moisture content before being "dry-placed" in a spent mine pit. Once the pit was full the tailings were stacked above ground level serving as a high-wall buttress above the pit. The dry tailings were then vegetated to establish a stable post-mining landform.

In 2013, more than a year before the Mt. Polly tailings dam breach, Tierra Group International, Ltd. (Tierra Group) proposed, to a Canadian mining company doing business in Latin America, using an exhausted mine pit to store the final few years of tailings production from an underground mine (in lieu of constructing an expensive tailings dam raise). The proposed action posed several technical, environmental, and social challenges, such as:

- Conventional slurry (35% solids:water) required managing a large volume of water in a confined, "unlined" basin (pit);
- Geologic faults through the pit posed potential conduits for exfiltrating tailings water to the environment;
- Difficult pit wall lining; and
- Initial public, regulatory and owner skepticism.

The owner's intrigue, desire to advance tailings storage technologies, and an opportunity to minimize end of life tailings disposal costs, permitted Tierra Group to pursue an in-pit tailings storage alternative. Tierra Group embarked on an alternative analysis that evaluated;

- Low-permeability pit wall lining;
- Thickened/filtered tailings;
- Conventional slurry tailings; and
- Zero-head pit boundary.

Tierra Group's alternative analyses included tailings dewatering testing and conceptual design, geological mapping, geotechnical and hydrogeologic field investigations, geochemistry, groundwater modeling, hydrology and water balance modeling. Ultimately it

was determined that by combining a zero-head boundary at the pit wall-tailings interface with an infiltration capture and reclaim system, and a prescriptive tailings deposition plan; conventional, slurry tailings could be safely stored in the pit. Constructing a zero-head pit boundary would prevent tailings supernatant from leaving the pit. An infiltration capture and reclaim system would create a drawdown effect in the pit that not only complimented the zero-head boundary technique, but improved tailings consolidation (increasing storage capacity). A systematic tailings deposition plan optimized water management practices.

Benefits realized from this approach are:

- Economic gold recovery from the remaining ore body;
- Safe tailings containment through the mine's end of life without having to construct an expensive TSF dam raise or develop a new TSF;
- Provides for progressive pit reclamation during operations;
- Removes the potential for an operational or post-closure tailings dam failure; and
- Sets a socio-environmental industry precedent for future mining operations to safely manage their tailings long-term.

Tierra Group is applying the institutional knowledge and lessons-learned from the zero-head concept and applying them to another in-pit conventional tailings disposal concept in Mexico. In this case, a different Canadian mining company intends to re-mine "spent" heap leach ore from a pad that experienced poor recovery during operations. Re-processed spent-ore tailings will be used to backfill an existing pit, providing all the previously listed benefits.

Tierra Group and their forward-looking clients embraced the Mt. Polly Technical Review Panel recommendations and applied them to real-world circumstances. Using a multiple-working-hypothesis approach utilizing all current Best Available Technologies (BAT) Tierra Group is expanding the safe tailings management envelope envisaged by the. In so doing, our clients are implementing safe tailings disposal methods, and converting long-term closure liabilities into useful, and SAFE, operational assets.

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***Matt Fuller, CPG, P.Geo. is a Founding Principal***
***Tierra Group International, Ltd.***
***Tierra Group's Engineering Team has been providing tailings stewardship services throughout the Americas since 1990.***