

Can alternative tailings disposal become the norm in mining?

New technology promises to reduce water, create a smaller environmental footprint and reduce long-term risks for mines

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There is no doubt that the resources extracted from mining are critical to our way of life. Likely, you're reading this on your computer, smartphone, or tablet. Mining touches all our lives daily (in addition to metals used in electronics, think about that can of soda you are drinking, or the aggregate used to pave your driveway). The industry works hard to make sure the net impact is positive. However, the waste associated with mining, both past and present, is an unavoidable result of conventional mineral processing. In the future it may be possible to extract metals like copper and gold without crushing and grinding the ore down to fine particle size and adding considerable quantities of liquid, resulting in conventional tailings. But, at the present

time tailings management is an unavoidable necessity at many mines.

WATER, WATER, WATER

What are the challenges associated with conventional tailings? Well, it is all about water. Managing seepage from the tailings themselves, monitoring pore water pressure within the tailings dams or designing facilities to safely store or pass flood events. Because such a significant quantity of water is added during mineral processing, 'conventional' tailings dams store the tailings as a slurry. Water within the tailing material is either evaporated, migrates as seepage or remains entrained within the tailings impoundment. Removing water prior to disposal through various means is considered 'alternative' disposal.

Mining low grades of ore has resulted in increased water use per unit of production. In some cases, the availability of water is one of the greatest constraints on mine development. By optimizing water recovery, ATD technologies promise to reduce water use at mines. This is of great advantage in some settings, and in others ATD technologies promise a smaller environmental footprint and reduced long-term risks.

ALTERNATIVE TAILING DISPOSAL OPTIONS

When considering alternative tailings disposal there are three major types. Each has advantages and disadvantages.

- **Thickened tailing disposal:** Tailing materials are "thickened" through the use of high-density or ▶

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► deep-cone thickeners to about 60-70% solids so the material does not segregate upon deposition. This can have some benefits with respect to permeability and lower seepage, along with the higher initial water recovery, allowing immediate reuse of a greater fraction of the process water.

Advantages: improved water conservation with lower energy input required (compared to other methods) the equipment is relatively common and easier to procure and it is widely used (there is a lot of experience with the technology) and thickening is a continuous process (as opposed to a batch process).

Disadvantages: the capital cost of the thickeners and, because the tailings is in slurry form, a sizeable dam is still required for containment.

- **Paste disposal:** Produced in specialized paste thickeners, or ultra-high-density thickeners and transported by positive displacement pumps, the paste is generally used for backfill in underground workings or in other situations where gravity helps the flow.

Advantages: paste can be used as backfill, reduced environmental impact and disturbing less land, absence of segregation, limited consolidation and associated seepage, no need for reclaim pond, as the material is partially saturated so no oxidization, higher in place tailings density, therefore, lower embankment needed.

Disadvantages: pumping materials of this consistency is not energy or cost efficient, so when the disposal site is some distance away from the mill it may be beneficial to pump slurry with lower solids content and have the water removal operations close to the disposal site.

- **Filtered tailings disposal:** Tailing materials are dewatered to 85% or greater solids by weight ratio using filters aided by a vacuum or confining pressure. The dewatered tailing materials are transported by conveyor or trucked to a disposal area.

Advantages: reduced environmental risks, improved water conservation, improved compliance, space conservation, better handling in cold condition and fewer topographic limitations.



Disadvantages: potential limitations for filtering at the scale of this project and the large required CAPEX (both a thickener and filter press are required), higher operating costs including the cost of operating the filter plant and the added cost of conveyance and placement (either in trucks or with conveyors/stackers) and the unsaturated filtered tailings may tend toward oxidation which can result in acid generation and drainage in acid generating tailings.

IS ATD RIGHT FOR YOU?

ATD sounds like a win-win opportunity, but it is not always easy. Each mine is unique. The mine's physical setting, the ore body, and the area's climate all greatly impact how the tailings can be handled. Considering that the social setting is even more important, a tailings facility design has to be fit for purpose. While recent failures have increased scrutiny on the selection of conventional options, it remains important that mine owners consider the issues at each mine site and establish what would be best there.

There are many major considerations that limit ATD's use:

- **Topography:** Some technologies lend themselves toward flat topographies and sometimes are not even feasible at sites with moderately steep terrain.
- **Production rates:** Operators seek reliable equipment and stable operations. Removing water using filters or paste thickeners from some tailings can be a challenge at high-production rates. Currently, conventional tailing disposal remains the default technology at high-production mines.
- **Climate:** Although ATD methods have been implemented in wet climates, their successful implemen-

tation is more attractive in, and aided by, a dry climate. It takes time and money to remove water from the tailings and you don't want to be in an environment that will put it right back in.

WHAT WILL IT TAKE TO ADOPT ATD?

Mining is necessary for the technology we use, vehicles we drive, medical devices that save lives, even that can of soda. However, tailings are the result of mining and how we handle tailings today may have a significant impact on the environment and communities in the very long term. We need to plan today to safely manage tailings long into the future.

Pair that future planning with water scarcity and potential dam safety concerns and the case for ATD gets even stronger. Although capital costs for ATD alternatives are typically higher than conventional, if future risk management and long-term liability reduction can be quantified and considered in the decision, the choice can be a lot more attractive. If consideration of total cost (including closure and post-closure) is given greater weight in the tailing disposal alternative selection, ATD can start to become 'the norm'.

THE NEXT STEPS

This is an exciting time to work in the mining industry, especially in support of smart and safe tailings management. Technology is changing the way we work. Stantec brings the whole toolbox with us when we come to a mine. We are experts in tailings design, alternatives assessments, operations support, closure and post-closure management. ▼

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