The rise of water risk

What are some of the key elements of successful water management? *MM's* Donna Schmidt finds out from experts from Veolia and Stantec

Many mines have a shortage of water, others have too much. To complicate it further, there are many ways in which to achieve optimum water management.

MM sought the insights of two experts in water management from Veolia and Stantec about the key elements of a comprehensive programme. Particularly on technology trends and what we can learn from those areas of the world with the best water management guidelines.

According to Veolia Water Technologies North America VP of business development David Oliphant, there are three main elements of a mine water management programme: quantity, quality and closure plans.

When looking at quantity, one needs to identify the amount of available water at the mine site, as it varies depending on the region of the mine.

"For example, in the western United States, water scarcity can play a role where the mine is reusing its pit water, but in parts of Canada, we are seeing the opposite where some mines have a positive water balance and have too much," Oliphant says.

"Another thing to keep in mind is how climate change is going to impact the site's water balance; this must be taken into account when determining the program."

Additionally, he says, there must be a "right balance" between a property's treatment capacity and storage needs, as an increase in active treatment capacity reduces storage capacity, and vice versa.

From a quality perspective, Oliphant explains, the influent quality of the source water should be determined, along with how waste rock and tailings impact the water's quality. It is these factors, along with ►

Climate change is increasingly going to impact a mine site's water balance

Aerial landscape of tailing ponds for mineral waste in rural Utah

environmental regulations for effluent discharge, that become crucial in selecting the appropriate water treatment technology.

EVOLVING REGULATIONS

"It's important to anticipate potential future regulations," Oliphant shares. "For example, in British Columbia, Canada, regulations for selenium are becoming more and more stringent and mining companies are anticipating future regulations that may come into play in the near future, so they are already planning for these tighter regulations when developing their mine water treatment programs."

Finally, when it comes to plans for closure, some often forget this – and thus it should be included in the overall mine water management programme.

"What is needed on a day-to-day operations basis during the actual life of the mine is different from the actual post-closure operations," he explains.

From the viewpoint of Stantec principal geochemist Jim Finley, that most important element – regardless of the water situation of a mine – is to consider conservation and reuse above all.

"The most important element of any mine's water management program is to reduce the amount of water that needs to be treated by using as little water as possible and then reusing that water as often as possible," he says. He adds that closed-loop systems can be very effective in minimising costs and impacts.

"They require a laser focus on keeping water volumes low and alignment across the organisation, so that all aspects of the mine are working towards this one goal."

Veolia's Oliphant says that, because water treatment is a key to social acceptance, it always needs to be taken seriously.

The company's recommendations to its customers, he says, begin with giving someone clear responsibility over this component of the mining process. Then, conduct regular follow-ups of what is coming in regarding wastewater quality, not just what is going out.

"Plot the wastewater quality over time [and] check if you're still within the expected boundaries," Oliphant says. "If the trend seems to be going out of what was expected, do a more detailed review."

Veolia also stresses that operations should not just focus on the four or five heavy metals in the permit. Instead, the goal should be to get a more complete picture of the water quality, including nitrogen species, anions and light metals.

"If you start having effluent toxicity issues that information will be priceless," he explains.

Stantec's Finley says its most-often shared best practice is one that is common and yet innovative approach: a 'fit for use water' strategy.

THE NEED TO TEST

"This allows mining companies to bring water into the water management circuit, recycle the water by upgrading it – just enough – so the water can be used again in the same or a different circuit," he explains. "This strategy allows mining companies to minimise water use while reducing the need for treatment."

Veolia's Oliphant says that, In North America, the regulation usually includes toxicity; it can come from multiple sources, and treatment for its must at times be adapted to the treatment of obscure chemicals as well. The result of this can be interesting: sometimes forcing the development of new technologies or even the use of existing technologies in new contexts.

"Straight precipitation is no longer sufficient to meet current regulations," he explains. "Surface complexation is required.

"Surface complexation is exceedingly important when dealing with criteria in ug/L. Many modern treatment plants include some biological component in addition to classical chemical treatment."

Stantec's Finley likens mine water management to the fable of Goldilocks and the Three Bears. In other words, from his perspective, mining operations expend significant amounts of time and money to get just the right amount of water needed to support their operation.

"In water surplus environments (net positive water balance), the challenge is to accurately forecast potential water inputs and to limit entry of that water into the mine water management system," he says.

"The same need for forecasting water needs holds for mines located in dry areas where the mine has a negative water balance. Continuous development of sophisticated water balance models that can incorporate probabilistic representations of climate are important since they can make a meaningful difference in achieving the mine's overall water goals."

He noted that, as there is an emphasis on water conservation and also on water recycling, there is a possibility that constituents in the circulating water could at some point impact recovery of target metals.

Because of this potential, water management systems should also have the capability to accurately track the system's water balance and the circulating chemical load.

"Water management systems that are designed (or reconfigured) to limit additions of chemical compounds (for instance, lime) and systems that substitute other more effective compounds improve the overall efficiency and efficacy of the mine water management system," Finley says.

"Optimisation efforts like these are ongoing at most mines."

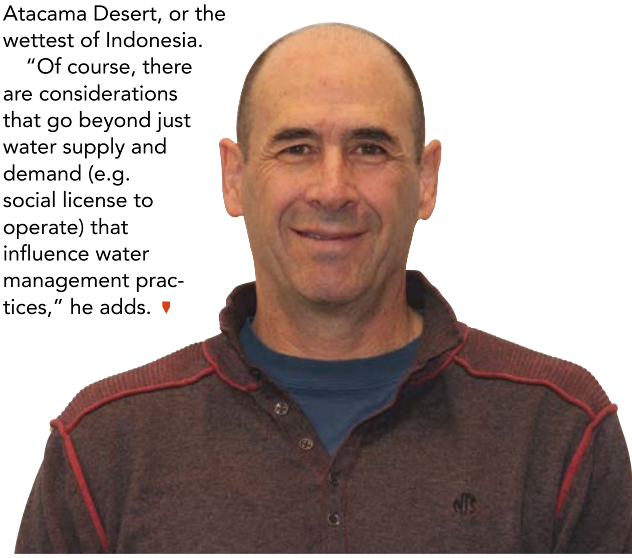
REGIONAL DIFFERENCES

"Speaking specifically from a North American perspective, the mining sector is highly regulated," Veolia's Oliphant says. "As such, mines in North America place a huge emphasis on their water management practices."

Stantec's Finley added: "[Location] is an eye of the beholder question in that every operation, by necessity, has optimised, and continues to improve optimisation, of their water management system."

The most highly efficiency water management systems are in the most extreme locations, he adds. Think, for example, the driest climate conditions of the Atacama Desert, or the wettest of Indonesia.

"Of course, there are considerations that go beyond just water supply and demand (e.g. social license to operate) that influence water management practices," he adds.



Stantec principal geochemist Jim Finley

Clean TeQ case study

Another water management group, Australia-based Clean TeQ, has been putting its technology into action in the field, with its most recent case being from the Kirkland Lake Gold Fosterville gold operation in Bendigo, Victoria, Australia, where it implemented a miner water treatment plant.

According to the company, its plant installed at Fosterville is the largest implementation of Clean TeQ Water's DESALX technology to date. It is a 2MLD continuous ion exchange plant which selectively removes hardness, metals and sulphate from mining water and has been designed to meet environmental quality indicators.

The client, it explains, had identified a risk of reduced mine water storage capacity due to surface run-off from adverse rainfall events as well as increased dewatering of the underground mine at depth.

Clean TeQ Water, which stepped in to partner with the operator on the project, carried out the project management, process design, procurement and commissioning for the facility, which has been running continuously since February 2020.

"The plant uses Clean TeQ Water's DESALX technology, a 2-stage CIF (continuous ionic filtration) process to selectively remove metals, hardness and sulphate in a robust membrane-free process," company officials say of its solution for Fosterville.

"Each CIF module contains ion exchange resin that is cycled between columns using air lifts, allowing for continuous operation and regeneration of the system. By using a moving packed bed of resin, suspended solids can be filtered while contaminants are simultaneously removed using ion exchange chemistry."

Clean TeQ provided equipment to the mine that included a precipitation package to remove antimony and arsenic. Effluent from the clarifiers is treated by the DESALX plant to remove sulphate, calcium and magnesium with gypsum as the only by-product.

The effluent from DESALX is then fed to a reverse osmosis plant, which provides further treatment to the water for recycling through the processing facility.

"Higher recovery and longer membrane life are achieved by the RO, as the species that scale or foul membranes are greatly reduced," Clean TeQ says. "The water produced by a Clean TeQ Water DESALX plant can produce a water quality that meets the quality indicators required by the State Environment Protection Policy for Waters, thereby potentially allowing the mine site to consider other water management best practices such as Managed Aquifer Recharge (MAR).

"Processes such as MAR can assist in minimising treatment costs and more importantly minimise risk to the environment through improved saline brine management which can arise from reverse osmosis treatment."

Water treatment at Fosterville