STAYING ON TOP OF tailings

Keith Gibbs, Nalco Water, Australia, outlines the economic and environmental benefits of an optimised tailings programme at mines in North America and Australia.

Tailings can create many challenges for mine operators that impact everything from environmental compliance to capital planning. However, mining specialists at Nalco Water believe that a tailings dam can deliver several benefits with proper management. When leveraged as an asset, an optimised tailings programme can reduce operational costs and recover more water while maximising the existing footprint of a storage facility.

Tailings challenges

If there is a universal challenge across all mining operations, it is tailings. There are approximately 7000 tailings dams at mine sites across the globe. Also called tailings ponds or tailings storage facilities (TSF), almost every mine has one or more to handle the waste from their mineral processing operations. When managed properly, tailings have an opportunity to be leveraged as a resource rather than a cost. But recent failures highlight the risks that they can pose if left to operate without a strong, water-focused management programme.

The failure of the Córrego do Feijão iron ore tailings dam in Brazil – which was one of more than 70 major incidents of tailings dam failures since 1970 – has drawn international attention to the composition, construction and management of tailings storage facilities. The majority store a mixture of solids and liquids (in the range of 50% of

each) behind a wall of earth and rock waste obtained from the mining operation. These construction methods can limit the opportunity for structural drainage – water seeping into the wall can saturate it, creating the risk of wall collapse and/or complete dam failure.

The company believes the water in a TSF is a resource. An Ecolab firm, the company works with hundreds of mining and minerals processing customers around the world to improve water management, reduce operational costs and lower the risks associated with water.

With growing demand for mineral resources and exhaustion of more easily accessible reserves, much of today's mining activity takes place in inhospitable regions near communities and environmentally sensitive water sources. Unsurprisingly, the International Council on Mining and Metals warns: "Water is one of the most significant issues facing the mining and metals industry and is a critical resource not only for all our members' operations, but also for other industries, communities and the natural environment." The water in tailings is no exception.

WaterShed programme

The company offers a programme called WaterShed, which focuses on rapid water recovery. It removes approximately 65% of water from the tailings as they enter the dam, and then returns the water to the plant for reuse.

Figure 1. A tailings storage facility that uses Nalco Water's WaterShed programme – shown post treatment.

Figure 2. WaterShed infrastructure, which is stored in a containerised system for ease of implementation.

Reducing the water not only allows a plant to reuse it, but also reduces the total mass of the TSF, which ultimately helps to improve the safety and stability of the TSF infrastructure. Additionally, removing the water creates a significant increase in available volume within a TSF, allowing the operational lifespan to be extended (typically doubled). This extension can defer the capital expense and regulatory requirements that exist when upgrading dams or developing additional facilities.

The recovered reusable water (65% on average for a typical TSF) equates to thousands of litres of process water a year. This creates savings on the cost of buy-in water and reduces the drain on freshwater resources from the surrounding community.

In practice, WaterShed – a polymer programme developed to facilitate solid/liquid separation – is dosed at the end of the slurry line where the tailings are discharged into the TSF. The separation of the tailings slurry into process water and viscous solids is virtually immediate: the solids form a beach at the entry point and the water finds its way by gravity to the predetermined decant point.

The solids, with remnant residual water content of approximately 40%, continue to dry and consolidate. Subsequent overlaying of solids further compresses the underlying solids, releasing more water. Ultimately, the solids densify and are ready for further treatment or closure of the facility.

Case study: North America

In one case, WaterShed technology was used to help extend the operating capacity of an alumina processing plant by 5 years. Located in North America and owned by a bauxite mining company, the plant faced serious challenges with its tailings storage capacity. It had enough storage capacity for only 2 years, and it was approaching its limit.

The company potentially faced building a new storage facility, which would have cost approximately US$30 million and taken several years to complete. Instead, they turned to Nalco Water for help. The company collaborated with an Australian environmental technology business and combined WaterShed technology with advanced mechanics to enhance a process called 'mud farming.' Mud farming involves the removal of excess water from the tailings, which reduces its volume and allows it to be consolidated. WaterShed accelerated that process by allowing for faster moisture release. By using the technology, the company was able to speed up the process of consolidating the mud and save 30% within the current capacity per year. The solution helped enable the plant to build additional storage on the consolidated tailings if needed, thereby expanding storage without physically increasing its footprint.

Case study: Australia

In another case at an iron ore operation in South Australia, the programme helped to achieve 60% water recovery from tailings, creating savings for the customer. The need for the

programme was identified in 2012, when a hematite ore beneficiation plant was commissioned at an existing iron ore operation. The operation relied on decommissioned mines as tailing storage facilities, while the new hematite plant planned to use the same tailings strategy.

The company had designed the site to operate with clean water, expecting to recover up to 50% of the water from the onsite TSF. However, after operating for 12 months, there was no evidence of solid/liquid separation and no clear water to recover for the processing plant. The operation needed a sustainable dewatering and water recovery system.

In March 2013, Nalco Water introduced the WaterShed programme. Within 2 days, clear water was present at the decants and the dewatered solids started to form a well-defined beach. The facility now had a viable source of process water as the solids settled and compacted.

The programme has now been expanded to two additional operations for the mining company within the same region. It enabled the company to convert one of the storage facilities from an above-ground dam to a perimeter discharge central decant configuration. Across all three operations, the mining company has achieved up to 60% water recovery and increased storage capacity, ultimately extending the life of all three tailings storage facilities.

Results in the coal sector

3 years ago, a rapidly filling TSF was a reality for one of Southeast Queensland's thermal coal miners. To add to their challenges, the detrimental effect of migrating tailings slimes (bentonite clays) were negatively impacting the volume and quality of recovered water. The tailings strategy at the time was co-disposal – a mix of thickened underflow and coarse rejects pumped to the TSF. That strategy has since changed and the TSF is now used for fine tailings only.

A site tailings study identified the programme as a suitable dewatering solution to the site's water recovery and quality problems. According to the miner, within hours of commissioning the WaterShed programme, the difference in the quantity and clarity of water available became obvious. Additionally, testing confirmed the recovered water was suitable for the processing circuit.

The site's capital investment in the programme – approximately US$65 000 – has been returned through water savings. The coal processing plant is now using around 50% recovered water and is set to achieve an extension to the service life of the TSF. Treated solids are now consolidated to 60% solids, and the TSF is considered a more stable facility.

Planning ahead

Gaining a full perspective of the characteristics and behaviour of the tailings is important for maximising the programme's potential. A lack of understanding and inadequate planning for tailings management can lead to negligible water recovery, poor consolidation, significant shortening of TSF life expectancy and the development of operational issues including saturation and instability, which can increase the potential for wall or complete dam failure.

Problems can be aggravated further by not implementing effective treatment and management from the start when a new tailings storage facility is commissioned. Often, even if issues are identified early, a mine does not implement a plan until TSF space becomes an issue or other problems arise to impact the integrity or efficiency of the dam.

Too often, Nalco Water does not get involved until issues are well apparent, which can result in an expensive corrective action approach rather than implementation of a preventative programme that combines WaterShed treatment with other accelerated means, such as mechanical consolidation (mud farming). Implementing WaterShed earlier can result in lower operational costs along with a lower risk of failure or environmental issues.

Conclusion

The WaterShed programme is unrestricted by ore type. With a low start-up cost – typically less than US$100 000 – the programme offers an economically viable solution for tailings water recovery and facility management. Furthermore, the capital and operating costs associated with the programme are less than traditional tailings management approaches.

All WaterShed treatment equipment can be containerised with no infrastructure requirement other than a flat earthen pad and supply of the appropriate pipework to the dosing point. Power for the system can be delivered by mains supply or diesel-powered pumps and gensets, which is often easier in remote TSF locations. GMR

Nalco Water, an Ecolab Company

North America: 1601 West Diehl Road • Naperville, Illinois 60563 • USA
Europe: Richtistrasse 7 • 8304 Wallisellen • Switzerland
Asia Pacific: 52 Jurong Gateway Road, #16-01 Jem Office Tower, Singapore 608550
Greater China: 18G • Lane 168 • Da Du He Road • Shanghai China • 200062
Latin America: Av. Francisco Matarazzo • nº 1350 • Sao Paulo – SP Brazil • CEP: 05001-100
Middle East and Africa: Street 1010, Near Container Terminal 3, Jebel Ali Free Zone, PO BOX 262015, Dubai UAE

ecolab.com/nalco-water

NALCO Water
An Ecolab Company