Sustainable water use

Eric Wasmund, and Jose Concha, Eriez, Canada and Peru, weigh the growing importance of technologies in water management, and how they are crucial in achieving sustainable operations.

The world is facing an existential global climate crisis; and miners and their technology partners have an essential role to play. In Canada, it is being recognised that climate change is changing many aspects of society. Warmer weather has led to major changes in patterns of rainfall, leading to flooding and water shortages, as well as unforeseen consequences such as the proliferation of pests. The pine beetle, for instance, although native to the Canadian boreal forest ecosystem, had been kept in check for thousands of years by occasional cold snaps that are now happening less frequently, which has led to forest and habitat damage, and combining with drier conditions to create forest fires. In other parts of the world, the consequences are much worse. The solution to climate change that is being accepted is the massive adoption of new scalable renewable energy generation systems (predominantly wind and solar farms), upgraded electrical transmission infrastructure, and large format energy storage systems such as lithium-ion batteries.

All of this new infrastructure requires significant increases in mined materials, including the base metals nickel, cobalt and copper, as well as lithium, graphite, and rare earth metals. Recent forecasts from credible industry players suggest that global production of both copper and nickel will have to increase by 40 – 50% between now and 2030, in order to meet the green-demand. In the long-term, there will be a focus on sourcing these materials by a combination of improvements in the efficiency of metallurgical extraction and recycling. But in the short-term, the demand will be mainly satisfied by opening and expanding world-scale mines on an unprecedented level. Miners have been very responsive to the sustainability concerns of institutional investors and companies, such as Teck and Anglo American, which have made laudable announcements that they are sourcing electrical energy for some of their mines and concentrators from renewable sources.

Water is the key

Besides energy, the other major mining input is water. Unlike an energy source, which is easier to re-locate and interchange, water cannot be easily moved or diverted, and supply is finite. One of the consequences of global climate change is not just a change in the amount of available water in a particular region, but higher temperatures also encourage higher evaporation rates. The precise locations and seasons at which the rains fall is changing significantly and becoming less dependable. This has a significant impact on water storage and harvesting, and it does not help that many of the largest mining districts are in very dry regions with local populations and farming activity that compete for a limited supply. A recent article in the Economist explained that part of the negotiation and development of the social license for the US$5.5 billion Quellaveco project in Peru came from the construction of a water reservoir, where more than 90% of the output is allotted to local farmers.

The key to mining developments in many crucial parts of the world will depend on how the proponents plan to use and share water, and this trend will increase greatly as demand and climate trends change. The companies that are successful will be those who can agree and demonstrate that they are water-conservationists. Others will simply not be allowed to operate, since permitting and regulation – rather than a true price of water – will likely control new mine development in many countries with a scarce supply of water.

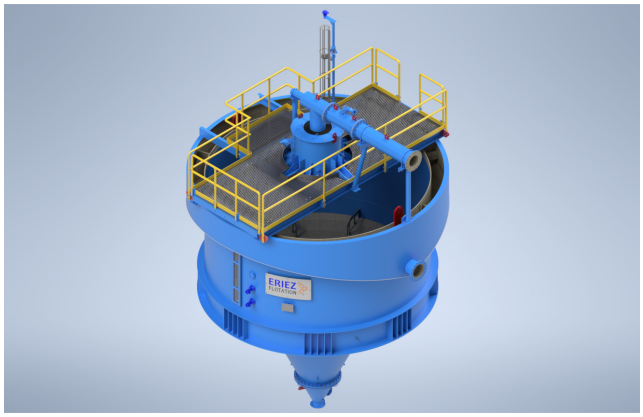

Figure 1. Eriez® HydroFloat® CPF technology is contributing to the development of net-zero water operations.

Figure 2. Mining companies and technology providers are working together to improve sustainability of mining around the world.

Net-zero water

At this point, some explanation is warranted to define what is meant by water-conservationists. Water inside the envelope of a concentrator plant is a key part of the mass transport, flow-sheets, and mass balances of the operations. Metallurgists are nowhere near being able to eliminate water use in this sense. The key is how much water leaves the envelope of an operation, and therefore the rate of new water that is required to run the operation. A plant that can recycle 100% of the water that it needs could be a 'net-zero' water user, and that should be the ultimate target that the industry is aiming for. 'Net-zero' water implicitly puts a price on water, since it requires cleaning up used water so it can be recycled, rather than discharging contaminated water into the environment and making up the difference with fresh water.

Right now, many mining operations are not focused on water efficiency. Organisations such as the Coalition for Minerals Efficiency (CEEC), which years ago developed mining energy curves as a way for miners to benchmark energy efficiency, now have a comparable initiative to develop water curves. Measuring, benchmarking and comparing water use and best practises is the first step in moving towards the target of net-zero water. To show that the continuous improvement via technology is possible, the commercial aviation business can be used as an example. In 1960, the carbon intensity of a passenger km was approximately 1.4 kg of carbon dioxide. By 2018, mainly due to technological innovation, that metric has been reduced to 0.1 kg. Similar breakthrough improvements in water consumption are now underway.

Coarse particle floatation

This is where Eriez fits in. Eriez is a world leader in developing and commercialising innovative flotation technologies. Froth flotation using water is the major unit operation in most base metal concentrators. With existing concentrators, the technology responsible for more than 90% of flotation is the stirred tank mechanical flotation cell. Stirred tank mechanical cells only work with

high efficiency in a narrow size range of particles. As a result, mine output is over-ground to compensate for this weakness. Eriez has developed and introduced into the market the HydroFloat® CPF, the first commercial coarse particle flotation machine. This device is a fluidised-bed coarse particle flotation machine that overcomes buoyancy and froth recovery restrictions, through up current water velocity and plug flow conditions.

Anglo American recently published results from its"HydroFloat Coarse Particle Recovery" Demonstration plant at El Soldado, showing that this technology could be implemented on a commercial plant-scale, reducing the amount of grinding, and producing a substantially non-metals tail with an average particle size of 2 – 3 times conventional tailings.

Using CPF to drive water conservation

How does this process support 'net-zero' water? Substantially coarser particles will de-water much more quickly, with less energy and capital than current practice. It also helps that the coarse particle flotation (CPF) process also produces a tail that is closer to being monodisperse, since finer size fractions of the tail have been removed by pre-treatment, as well as classification that is inherent in a fluidised bed. A number of companies, including Weir Minerals and Anglo American, are developing unique and novel engineered systems to combine conventional and HydroFloat coarse tails, in order to create safe long-term impoundments that can return water back to the operation, rather than getting lost through evaporation.

Anglo American has recently published information about its technology, called Hydraulic Dry Stacking (HDS). This system uses interleaved layers of coarse and conventional tailings, with the coarse layers 'wicking away' water from the fine layers. HDS has also been piloted at El Soldado with a 250 000 m^3 impoundment, taking advantage of feed from Eriez' HydroFloat tail. Using a 3D network of alternating coarse and fine deposits with drainage channels, early results have already achieved 80% water recovery, and the target is to reach 85%.

Not only do these systems have the ability to efficiently recover water from the most significant concentrator out-flow, they also have the potential to create safer, waterless tailing impoundments that can be reclaimed much more safely, economically, and quickly than conventional water impoundments. In the same manner as water, tailings management is another major topic that miners must address, especially with the movement towards the green-economy and demand for metals increasing.

Conclusion

Water stewardship is a key topic for miners and the world. Adoption of new technologies and paradigms will be a key success factor in making necessary improvements. The Eriez HydroFloat has made a key contribution in this arena, and now mining companies and other technology providers are combining their talents and expertise to transform water use and the sustainability of mining. GMR