This year marks consulting engineering firm Knight Piésold's 100th year of existence. The practice was started by a water engineer and now offers a broad range of expertise to assist with industrial effluent and mine water. **Kirsten Kelly** talks to a few members from the team.

Andrew Copeland (AC)
Technical Director: Mining Division

Leon Naude (LN)
Section Manager: Water Division

Neal Neervoort (NN)
Senior Environmental Scientist: Environmental Section

Holistic approach to mine and industrial water management

What is one of the biggest components of mine water management?

AC Tailings can consume up to 70% of a mine's total water consumption. Therefore, if a mine can dewater its tailings, it will drastically reduce its water losses and, hence, consumption. Minimising water storage and improving operations of the tailings dam can also decrease the mine's water consumption. Furthermore, by changing the deposition method of tailings – from a spigoted system to a cyclone system – one can reduce water consumption by about 10%.

The design of tailings dams is important because that determines whether water can escape as surface water or groundwater. Water released from a tailings facility is typically not clean; the level of contamination will depend on the type of mine and process used on the ore itself.

There has been a drive in South Africa to protect groundwater by installing barrier systems into new tailings dams, as well as into any return water or pollution control

facilities. Return water dams must be sized sufficiently to handle excess stormwater and minimise surface water pollution.

What other water issues do mines need to consider?

LN Stormwater management will ensure that there is no contamination with dirty water.

Dirty water must be treated using technologies like reverse osmosis and ultrafiltration before it is released.

Mines need potable water supply for their operations and employees. This can be difficult to obtain in rural areas without some purification process.

AC When treating water on a mine, one must consider the geochemistry of the ore body, as this will determine whether the water is acidic, or has a high dissolved solids or metal content. The geochemistry will establish pollution control requirements and methods used to manage mine water. Sometimes, a process plant will change its chemistry due to the addition of acid, lime and reagents like cyanide used in the plant.

What can mines do to make sure they use as little water as possible?

AC This would start with the mine design. A tailings dewatering system would have to be considered in the mine's process plant. The cheapest way to dewater and transport tailings is the use of a standard or high-rate thickener, where the slurry would be pumped out to a tailings facility. There has been a trend towards dry disposal, which will produce slurry with a toothpaste consistency that still has to be pumped. With dry disposal, around 60% of water in the process plant will be recovered and 40% will be lost to the tailings facility. To achieve dry disposal, mines need to use a filtration-type system (vacuum filters, filter presses, disc filters).

But it must be noted that the dewatering and transport process becomes significantly more expensive as the moisture content decreases. The cost of water and environmental impact have historically been far less than the dewatering process. However, due to a large number of tailings dam failures around the world, many mines are considering drier tailings disposal because the potential cost and consequences of a tailings dam failure outweigh the capital and operating costs that result in safer tailings facilities that use less water.

Is switching to a wastewater reuse strategy a viable option for mining and industrial processes?

LN All mines and factories need to treat water before it is released, and this is an expensive exercise. Therefore, instead of always using new water, many mines and factories try to reuse their water wherever possible.

Water treatment can be a complex process and requires constant water testing and specialised skills. For example, phosphates found in wastewater can affect some industrial processes, while it will not affect others. A lot of mines can use treated wastewater, but need to use better quality water in certain processes. If mines can use wastewater, they often find that they need bigger quantities than those available.

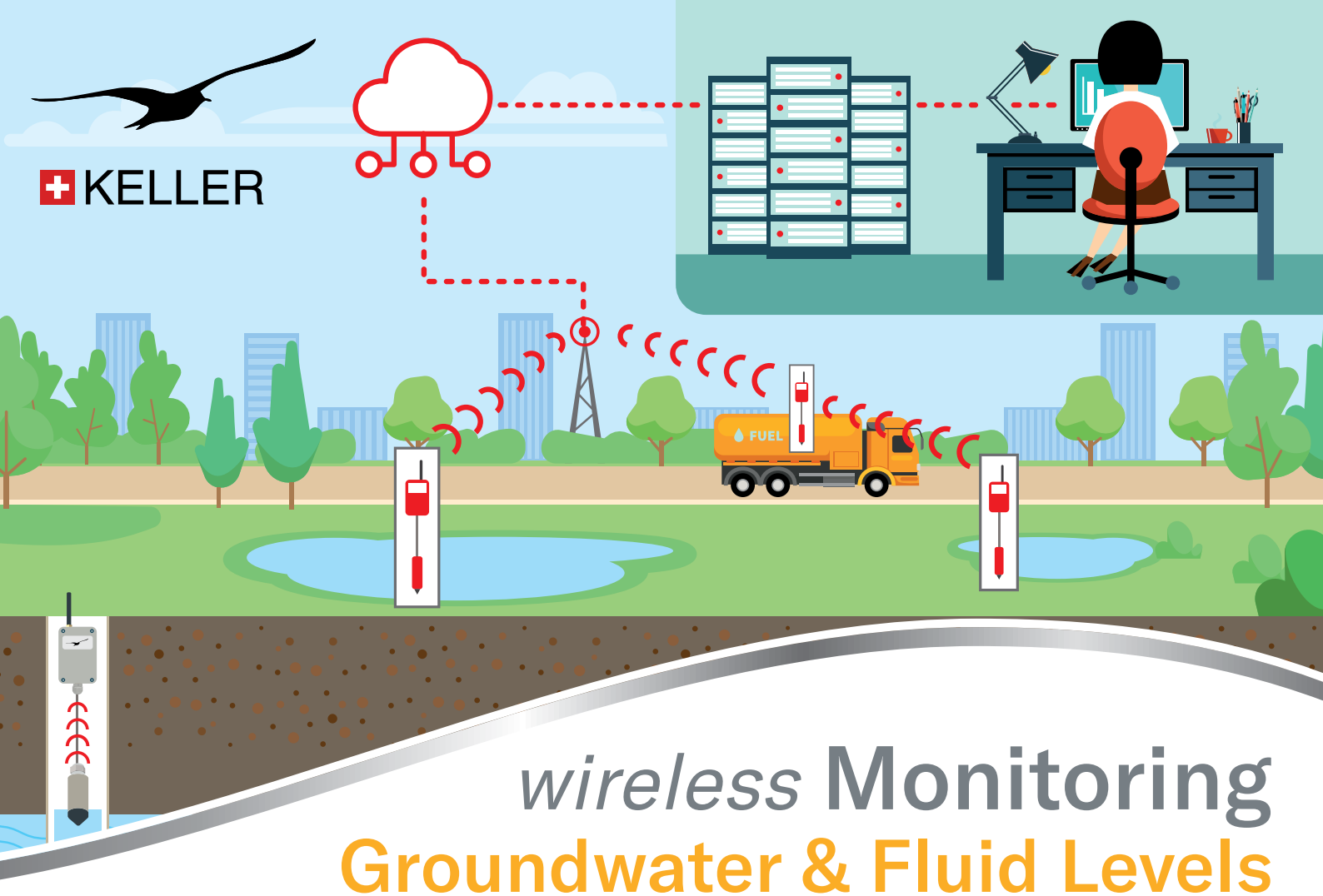
Every mine and factory is faced with its own unique challenges with regard to water security and creating zero discharge at a feasible cost.

AC In many cases, the process plant can reuse mine water that is either from underground or the tailings facility itself. Water from wastewater treatment plants can also be reused. There are even cases where sea water can be used in processing. This can be expensive if desalination is required.

How can a mine or factory reduce the cost of water treatment?

LN The more contaminant in the water, the greater the cost to treat before discharge or reuse. First, I would suggest stormwater be separated from all other water as far as possible. You have to avoid increasing the volume of contaminated water. The cost of

KELLER



wireless Monitoring
Groundwater & Fluid Levels

Serie 36XiW
level sensor

ARC-1
3G / NB-IoT module

ADT-1
LoRa module

- Swiss precision: Accuracy 0,05%FS TEB*
- Internal datalogger for backup (ARC-1)
- NB-IoT, LoRa, 2G / 3G / 4G
- Optionally: conductivity, other materials (Hastelloy of Titanium), ATEX
- KELLER Kolibri Cloud : **no monthly paid subscription**

* TEB = Total Error Band, thus the maximum possible error

2G 3G 4G NB-IoT LoRa

keller-pressure.co.za
kolibricloud.com

treatment is directly related to the type and volume of contaminants in the water.

AC The cost of treatment can also be impacted by how a mine deals with its waste material – waste rock or tailings. As soon as the waste rock or tailings have contact with water or oxygen, there is a potential for acid mine drainage (AMD) that is found in some coal and gold mines. Every time there is rain, there is potential for pollution. If mines can reduce the contact between water and acid generating waste, they can reduce the amount of dirty water produced and the cost of treating it.

How do you treat AMD?

AC If tailings are kept underwater, they cannot oxidise and convert to acid. However, this is not always practical and can be risky.

Acid-generating waste rock should be encapsulated with non-acid-generating waste rock. This creates a protective layer of non-reactive material around reactive material – minimising the contact the acid-generating rock has with water. This means that you have to manage your waste rock facility so that non-reactive material is readily available as cover material.

Lime can also be added to neutralise the acid, building up a buffer system that generates neutral instead of acidic run-off. This still needs to be treated prior to release.

LN The adage 'prevention is better than cure' applies here because AMD treatment can be a very expensive chemical process. It generates sludges that must be dealt with using processes like ultrafiltration and reverse osmosis. This is typically a hazardous waste requiring landfill containment.

What is the environmental process that a mine or factory goes through when obtaining a water-use licence (WUL)?

NN A WUL is needed to abstract water from a river or borehole or to build a dam. The process is handled by the Department of Water and Sanitation (DWS). It is a tedious process that requires proper engineering and environmental input.

Designs have to be done in accordance with legislation. All potential negative environmental impacts should be mitigated. The DWS must also establish if it is viable to grant a WUL in that catchment or water management area. The department evaluates the amount of available water and the amount that can be extracted.

A WUL is often amended if the volume of water extracted exceeds the volume of water present in the groundwater or surface water resource. A WUL also requires a thorough public participation process with communities that utilise or depend on the water resource and may be negatively impacted.

When can a mine or a factory discharge water?

NN A WUL is also needed to discharge water. Here, the DWS will assess the quantity and quality of effluent discharged. If water is discharged into a stressed catchment, very specific water quality parameters will be added over and above the wastewater standards. There will be baseline monitoring of the industrial effluent and then there is biomonitoring to evaluate the health of the river systems.

There is a wide range of water quality guidelines that must be met, depending on the type of industry and processes used.

For example, looking at the aquatic environment (rivers) and mines that discharge water into rivers, the Guidelines for Aquatic Ecosystem will be used as a guide. This is more stringent than drinking water guidelines because there are organisms in the river systems that are more sensitive to a human drinking that water.

Should standards and legislation be updated?

NN I believe that the quality standards should be updated taking the current environmental situation into account. I do not believe that it should be less easy to discharge water, but most of our catchments and rivers are in an altered state. It makes little sense to make a mine discharge pristine water that surpasses the quality of water received from our taps.

This is why it is important to do baseline water quality monitoring for WULs so that recommendations can be made to the DWS with regard to the water quality that should be adhered to as a special condition. This will then supersede all other water quality guidelines.

What are the challenges experienced by the mining and industrial sector with regard to water?

AC The cost of water is rising and the availability of water is a concern, as is pollution.

LN The availability of quality water is of huge concern to the mining industry, because it influences productive and profitable mining, industrial processes, workers, and communities. 3S