

Current mining industry players are faced with the challenge of who should be responsible for and deal with the subsequent financial impact of the legacy issue of acid mine drainage (AMD).

The mining industry has been a significant driver of the country's economy, dating back many years; however, as many of the mining houses that pioneered the industry in South Africa have moved on to other areas, or have evolved into other companies or consortiums, the challenge of assigning responsibility for current issues is a real concern, says minerals industry consultancy Venmyn Deloitte environmental industry adviser Sarah Dyke.

As South Africa's water systems are interconnected, AMD, if not treated, could potentially decrease the country's water supply quality, which will impact on industries, such as agriculture and manufacturing, Deloitte strategy and innovation consultant Sabatha Mhlanga says.

Out of the 120 mining companies that once mined in the Witwatersrand, only six remain, and there are about 6 000 ownerless and abandoned mines, as well as about 270 tailings dams in the area containing six-billion tons of pyrite – a catalyst for AMD. Therefore, there is going to be AMD production over the next couple of centuries, The Environmental Law Consultancy business development director Peter Flynn tells *Mining Weekly*.

"Currently, there are about 20 proven technologies that can deal effectively with AMD, but the problem is the cost of implementing these technologies. The mining industry is resistant to being held accountable for the entire problem, as government and by extension, the people of South Africa, have also made money from mining for the last 120 years," he explains.

Flynn adds that, as the mining companies were legally allowed to mine in that manner, a complex situation has ensued.

Meanwhile, Water Stewardship Council trustee Dr Anthony Turton states that progress in the roll-out of technical solutions for AMD has been impaired by nongovernmental organisation (NGO) activity relating to assigning liability.

"In essence, NGOs have argued that the 'polluter pays' principle must apply and have launched a range of legal actions to enforce this. This has now gone through various courts and, in general, the apportionment of liability has been a failure as the cause of the problem is not current negligence by mining companies, but rather the historical failure of our predemocratic government to put in place the relevant governance structures that could ringfence capital for rehabilitation and develop a viable closure strategy to manage the transition to a postmining economy and the technology for mitigation purposes.

"This historic failing cannot be remedied

## MINING &amp; THE ENVIRONMENT

## ACID TEST

Shift from 'blame seeking' will aid efforts to tackle SA's acid mine drainage challenge

LEANDI KOLVER | SENIOR STAFF WRITER



ANDY CLAY

Through historical mining, large voids were created that have now become natural reservoirs



PETER FLYNN

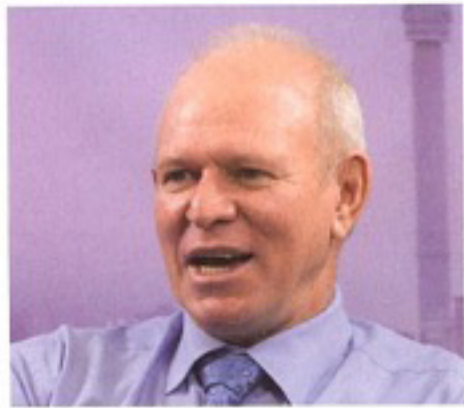
There are about 20 technologies that can deal effectively with AMD, but the problem is the cost

through litigation against current players, but this quest has introduced such high levels of risk into the AMD space, that most technical solutions have been developed in secret, simply to avoid the risk of becoming embroiled in the intense contestation between NGOs and an embattled industry and regulator," Turton says.

"There is an urgent need to shift from blame-seeking to solution-seeking behaviour," he adds.

Venmyn Deloitte MD Andy Clay points out that through historical mining, large voids were created that have now become natural reservoirs, which could be valuable as South Africa is short of water.

"We should be using that water to benefit



ANTHONY TURTON

There is an urgent need to shift from blame-seeking to solution-seeking behaviour



SABATHA MHLANGA

Of the 120 mining companies that once mined in the Witwatersrand, only six remain

the nation. If the cost of pumping and treatment to get the water to a potable level is less than or equal to the retail price at which bulk water is supplied to municipalities, it is a natural solution that we should be considering," Clay states.

Consulting engineering group Aurecon has been appointed by government to investigate the issue and there are a few companies that have developed water-treatment solutions, which include reselling the water to government, Dyke says.

Clay adds that he believes the mining industry would be willing to treat the affected water if government committed to buying it back.

"We would then move towards a model of



independent water producers, much like the current independent power producers," he says.

Turton divides the potential treatment options for AMD in South Africa into two categories – the legacy model and the public-private partnership (PPP) model.

The legacy model is based on the logic that society benefited from a century of mining, so that society is now responsible for the historical externalisation of costs. This model regards AMD as being a perpetual problem to be managed for near infinity. Various technologies are emerging, with different cost and benefit structures, but in essence, the taxpayer will have to foot the bill, he explains.

The PPP model is based on the logic that AMD is a manifestation of the lack of a formal closure strategy to manage the transition to a postmining economy. Therefore, a partnership should be negotiated with rehabilitation companies capable of removing all surface tailings and thus releasing the 5 445 ha of land occupied by mine residue areas (MRAs) for safe economic use.

This model could potentially close the void created by historical mining completely and thus prevent all future ingress of surface water and the subsurface generation of new AMD. This can extend the life of mining and sustain jobs for another 20 years, while dumps are consolidated and land is cleared.

This model regards AMD as being a short-term manifestation only, with the permanent closure of the void spaces being technically possible and many benefits arising, including the prevention of future AMD, the restoration of geotechnical stability at surface and the permanent closure of stopes to deny illegal miners, who are often linked to crime syndi-



#### SIGNIFICANT CONCERN

As South Africa's water systems are interconnected, AMD, if not treated, could potentially decrease the country's water supply quality, which will have an impact on industries, such as agriculture and manufacturing

icates, access.

"Only once these two models are fully understood by the regulatory authority and the taxpaying public can we answer the question of who should carry the costs," Turton says.

"While the war against the unintended consequences of a century of largely self-regulated mining has not been won, it is safe to say that we are, in fact, winning local

battles on numerous fronts, so there is reason for cautious optimism," Turton says.

He believes the most significant development in the AMD space has been the evolution of a sophisticated risk assessment method that has characterised every MRA in Gauteng in terms of hazard/risk classification.

"As a result of this process, we currently have a sophisticated understanding of the hazard rating of all known MRAs in Gauteng. It is also known, with increased confidence, that the risks arising from AMD in the Witwatersrand goldfields are not those being portrayed in the popular media," Turton emphasises.

Meanwhile, government, in association with the Trans-Caledon Tunnel Authority (TCTA) is implementing what is referred to as a short-term solution to deal with AMD in the Witwatersrand.

In the Western basin of the Witwatersrand, there was a decant of AMD and the TCTA has implemented an immediate solution, which comprises the upgrading of South African miner Rand Uranium's water treatment plant, in Randfontein, through the building of two new trains and upgrading the old Rand Uranium train to bring it to the same standard, TCTA AMD project manager Craig Hasenjager tells *Mining Weekly*.

Commissioning of this plant started at the end of last month, and 30 M<sup>3</sup>/d of AMD is currently being treated. Uncontrolled decant has stopped in the Western basin, except for a few isolated instances, although the decant on these occasions have not been more than 0.6 M<sup>3</sup>/d, he explains.

"We are working towards drawing the water in the Western basin down to the environmental critical level (ECL), the highest level that the water can reach within the mine void without AMD flowing out of the mine workings and into the surrounding environmental systems. This can only be achieved after the new pumps on order have been delivered in early 2014, enabling the upgraded Rand Uranium plant to pump 36 M<sup>3</sup>/d of AMD," Hasenjager says.

Meanwhile, TCTA awarded a contract to construction company Group Five in December last year to implement the short-term AMD solution in the Central basin. The TCTA also reached an agreement with gold mining company Central Rand Gold, which resulted in its donating pumps to the project. These pumps and shaft pipe stacks will arrive on site next month, to coincide with the civil construction programme.

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#### CENTRAL BASIN TREATMENT

The short-term solution for the Central basin is currently under construction and the TCTA believes that it will be able to start pumping AMD before the water level breaches the environmental critical level

To watch a video in which Venryn Deloitte MD Andy Clay discusses acid mine drainage in South Africa, scan the barcode with TagReader (at [www.gettag.mobi](http://www.gettag.mobi)) on your cellphone, or go to 'Video Clips' on [www.miningweekly.com](http://www.miningweekly.com).





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"We believe that we will be able to start pumping AMD before the water level breaches the ECL level," Hasenjager says.

Further, the TCTA is currently out on tender for the construction of the AMD treatment plant in the Eastern basin. Plant construction is expected to start in November and be completed by the end of next year, he adds.

The ECL in the Eastern basin is estimated to be breached by November 2014.

"While the short-term AMD solution is government funded, the long-term solution, which is currently in feasibility stage, does consider ways in which money could be recovered from the mining industry," says Hasenjager.

However, South Africa's AMD problem is not only contained to the Witwatersrand basins, Dyke points out.

"The potential for AMD to affect river systems has also been identified in areas such as Mpumalanga, the Free State, Limpopo, the North West and the Northern Cape. This is not a centralised issue and has the potential to affect the entire country," she says.

The order of magnitude of the situation in coal mining areas is worse, as South Africa's coal is high in sulphur and the mines are generally shallow, says Clay.

"In addition, our coal mining industry has been functioning since the turn of the last century and many communities are affected by the contaminated water," he says.

In the Mpumalanga coalfields, South Africa has, in effect, lost its agricultural capacity in what used to be one of the most productive areas of land in the country, Turton adds.

"This is caused by diffuse AMD that comes from multiple sources, which is difficult to contain. The same situation is occurring in the Upper Vaal Water Management Area that is 100% underlain by coal."

#### Sustainable Technologies

The techniques of pumping and neutralisation currently used to treat AMD on the Witwatersrand is mainly a reactive solution and

is not sustainable, Mhlanga says.

"The neutralisation removes the heavy metals from the water, but the sulphates remain, which means that the water has a high salt content," Flynn adds.

The salt content of the treated water is about 3 500 mg/l, compared with the World Health Organisation's drinking water standard of only 200 mg/l, he says.

"Therefore, the salt content of the water that is being redirected into the Vaal river system is dramatically higher than what is regarded as safe for human consumption.

"Currently the Vaal river system can still dilute the concentration of sulphates to such an extent that it is safe for human consumption. However, once pumping in the Eastern basin starts the volume of neutralised water redirected into the Vaal river system will be too high for the system to effectively dilute," Flynn explains.

Dyke adds that, in seeking a sustainable solution, the trade-off between aspects, such as capital expenditure, operational costs, the quality of the water delivered and the resulting economic viability, has to be considered.

Mining solutions company Fraser Alexander and water treatment company Mine Water Treatment Technologies (Miwatek) believe that they have found a solution that addresses these aspects.

"Unlike traditional AMD treatments, which generate high volumes of sludge and brine, the Miwatek technology offers a total solution and allows for the production of reusable waste, rendering it more cost effective than other technologies," says Miwatek cofounder Pieter Jansen.

The Miwatek water-treatment solution also offers the benefit of about 50% less solids, compared with the industry average.

The solution incorporates sophisticated modelling, based on the chemical analysis of the specific water to be treated, the locally developed Abrimix Mixer technology and reverse osmosis membranes from US-based stakeholder Jalema Technologies, which enables optimal plant

design and, therefore, an optimal water-treatment solution.

The Miwatek solution can also integrate a type of evaporation and crystallisation technology into an overall process proposal, which can deliver zero liquid discharge with all of the crystal products in the form of industrial quality reagents, rather than a mixed crystal mass that has to be disposed of.

Chemical and waste expert and consultant Dr Richard Paxton points out that, as the technology offers the benefit of an analysis-based design, it can be adjusted according to the requirements of each client to ensure an optimum AMD treatment solution.

Fraser Alexander water treatment division head Ken Bouch says the Miwatek plants will not be sold to clients, but that they will be designed and built by Miwatek. The plants will be owned and operated by Fraser Alexander during and beyond the life of the mine.

"Effectively, clients will only pay for clean water, which means no process risk for the client,"

he noted.

Meanwhile, water company Prentec recently developed the new-generation mine water treatment process, LoRO, which builds on the latest knowledge to provide a solution with low capital cost, energy consumption, chemical use and waste generation, as well as low operating cost, Prentec process manager Martin Pryor tells *Mining Weekly*.

"We have been awarded the contract to design, build and operate the 10M€/d mine water plant at Matla Coal, in Mpumalanga. We were awarded the contract in April and the plant will be commissioned in December. This demonstrates our capacity to deliver this type of plant on tight schedules.

"We have applied Prentec's unique modular design to achieve this quick turnaround and other benefits such as expandability, portability, economy and operability. This is a crucial project for the ongoing operations of Matla Coal, and by inference, Matla Power Station," Pryor adds.

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