

From Toxic to Tap: Mine-



A historic project to convert polluted mine-water into quality drinking water is moving ahead in Emalahleni (Witbank), Mpumalanga. The R300-million joint initiative between Anglo Coal and Ingwe Collieries will see the treatment of 20 Ml/day of acid mine drainage (AMD) from three collieries for sale to the Emalahleni Local Municipality. Lani Holtzhausen reports.

When travelling through the Highveld in Mpumalanga, there is no doubt why South Africa is the third-biggest coal producer in the world. Mine after mine tells of the legacy of this area, in which up to 90% of the country's saleable coal is mined.

However, more than a century of open-cast and underground mining has impacted on the surrounding environment. Coal mining has a significant effect on the hydrological cycle, with surface water working its way into underground voids and becoming polluted as it comes into contact with exposed sulphur-bearing pyrite.

It is reported that the accumulation of water in active mines has already increased to the extent that it hampers mining activities and poses a

potential safety risk. Where mining activities have ceased, the underground workings are filling with water.

Collieries exploiting the Northern Witbank Coalfields have to continuously pump out this water to reach the coal seams. According to South African environmental law, this water has to be suitable for release back into the environment, and may need to be managed and treated before being released so as to reduce pollution of the country's scarce water resources. This has become even more important in the Upper Olifants catchment, where many of these mines are situated, as the area suffers from a chronic shortage of water.

With future mining developments earmarked for the short to medium term in the Middle Olifants and Steel-

poort catchments, which are situated downstream of the Upper Olifants catchment, it has been recognised that the water that is available requires crucial management.

A NEW APPROACH

A few years ago, having exhausted all other water management options Anglo Coal and Ingwe Collieries agreed to cooperate to find a long-term solution. The result of years of research and development is the Emalahleni Water Reclamation Project which, for the first time in South Africa, will see the abstraction and treatment of mine-water from existing and old mines to a level that is fit for use by the local municipality. It is anticipated that water will be treated from Anglo Coal's Kleinkopje and Greenside collieries, as well as Ingwe's South

-Water Becomes a Commodity



Witbank Colliery, a defunct operation where mining stopped in 1969.

While the sale of the water will allow the mining companies to offset some of the costs of treating the water, it seems this project has come just at the right time for the Emalahleni Local Municipality. According to Emalahleni head of department: water services Lindela Tshwete the municipality, which is the water services authority for the Witbank area is already exceeding its allocated amount of water from the Witbank Dam, its sole bulk water resource, drawing some 80 to 90 Ml/day at present.

Tshwete reports that the municipality has decided to buy into the Emalahleni Reclamation Project rather than the Vaal River Eastern Sub-System Augmentation Project (VRESAP), which is also being constructed at present, for a number of reasons. "Buying bulk water from the VRESAP pipeline would have cost about twice as much as water from the mines. In addition, we would have received raw water from the pipeline, which would then first have to be treated. The water received from the reclamation project,

on the other hand, will already be of good drinking water quality."

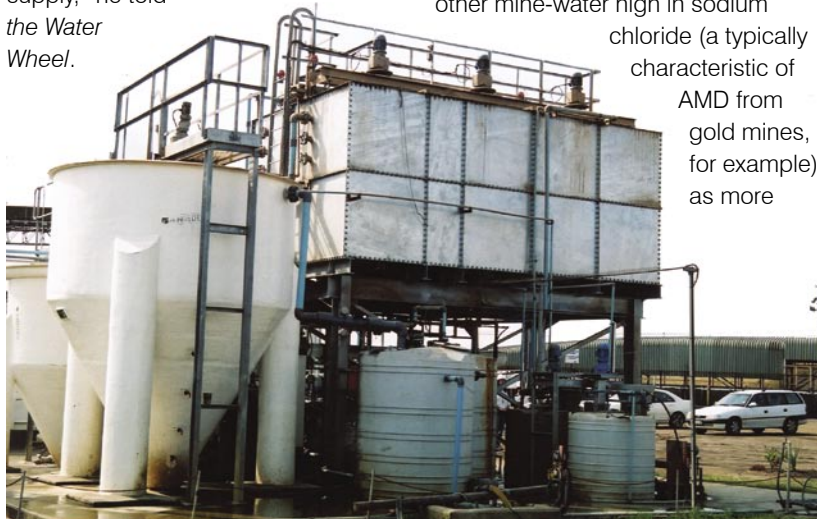
Anglo Coal senior project manager Peter Gunther reports that the municipality requires an additional 20 Ml/day of water which the mining companies can easily provide with this project. "Studies have shown that the mined out voids in the area could hold more water than the Witbank Dam, resulting in the mines being a huge potential source of water supply," he told *the Water Wheel*.

Above: The construction site of the first 20 Ml/day mine-water to tap water reclamation plant being constructed outside Emalahleni (Witbank), Mpumalanga at present.

THE TREATMENT PROCESS

Most mines in this catchment area have a water quality associated with calcium-magnesium-sulphate. This makes the water more treatable than other mine-water high in sodium

chloride (a typically characteristic of AMD from gold mines, for example), as more



Flows of 120 m³/day were achieved at the demonstration plant.

treatment processes can be used to desalinate the waters.

Following the evaluation of a number of possible water treatment technologies, Johannesburg firm Keyplan's design was selected. A 120 m³/day demonstration plant was established at Landau Colliery to prove the efficacy of the technology over a trial period of three months. One of the most important criteria was to achieve a high yield. "We were initially aiming for a yield of 95%, but actually succeeded in achieving a yield of 98% during our trials," reports Gunther. This not only increases the output from the plant, but minimises the volume of waste that has to be dealt with.

Following approval in September, construction of the main plant started in November last year. Water will be collected at the

three mines and conveyed via three separate pipelines to two storage facilities at the treatment site. To cater for seasonal fluctuations the two storage dams will have a combined capacity of 46 Mℓ. The acidic water will firstly undergo a neutralisation process using CSIR's lime/limestone treatment process. This increases the pH

allowing metals such as iron, aluminium and manganese to precipitate out.

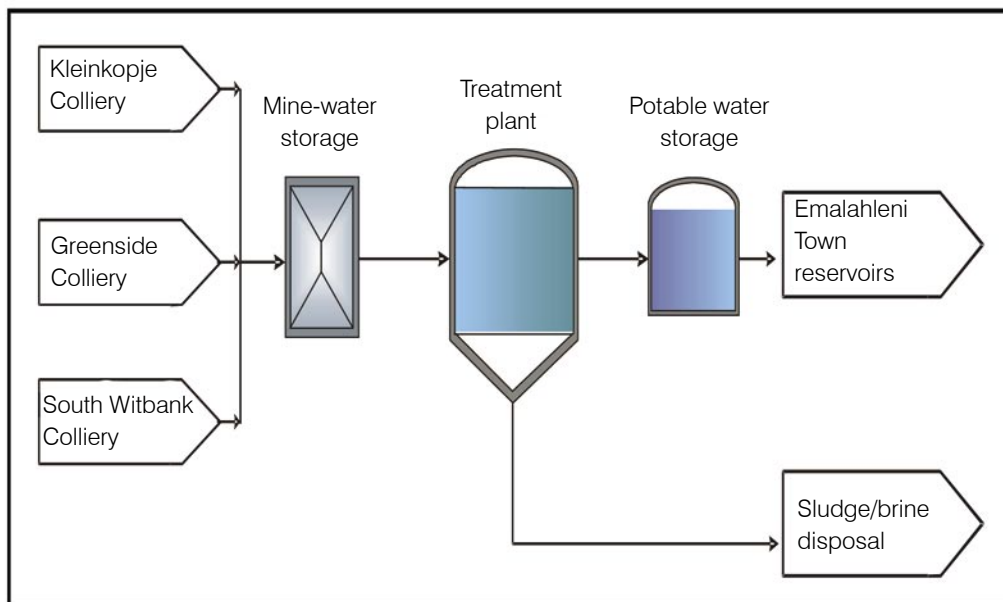
Following clarification, the water will be treated using ultrafiltration (UF) to remove any remaining metals. This process will also remove any bacteria that might be in the water. About 500 UF membranes will be installed. This will be followed by reverse osmosis using spiral membranes to remove remaining salinity. Just under 1 200 RO membranes will be used. The membrane treatment process is repeated three times to ensure maximum yield and maximum brine concentration. Two identical process trains are being established, each capable of producing a minimum of 14 Mℓ/day.

The treated water will be stored in two 10 Mℓ/day dome-shaped concrete reservoirs before being pumped to an Emalahleni municipal reservoir about 9 km away for distribution to consumers. To ensure an uninterrupted supply all critical mechanical and electrical components required to keep the plant at full capacity must have an installed standby.

The process will produce about 100 m³/day of brine and 100 t/day of gypsiferous waste. The brine will be

exposed of in evaporation ponds with a capacity of 330 000 m³. All necessary regulatory steps have been followed to establish these hazardous ponds which will be double plastic-lined to eliminate any seepage.

An on-site laboratory will provide analyses of the water for process purposes that will also be used to check for some basic parameters of the potable water before it is pumped to the municipality.



Main components of the Emalahleni Mine-water Reclamation Project.



The CSIR lime/limestone process is used to increase the pH of the water prior to ultrafiltration.



Results from the demonstration plant indicated that the pH levels of the water was boosted from 2,9 to between 6,5 and 7,5. The total dissolved solids count was reduced from as high as 4 500 mg/l to 135 mg/l while the sulphate content was reduced from 3 500 mg/l to 80 mg/l. The treated water is within the SABS 241 Class 0 drinking water quality limit.

FIRST FOR SOUTH AFRICA

It has been a long and interesting journey for the two mining companies since the signing of their cooperation agreement. Ingwe project engineer Wendy Mey says the fact that two competing mining companies have cooperated to find a solution that will not only benefit the environment, but also surrounding communities, is a milestone in itself.

At the time of writing the reclamation plant was 20% complete. It is hoped to complete construction before the end of 2006, with commissioning starting in early 2007. By the third quarter of that year, the plant should be fully operational.

Meanwhile negotiations are being finalised with the Emalahleni Local Municipality, with the final I's being dotted and T's being crossed on the water supply contract. Gunther notes that throughout the project regular consultation has ensured that the local authority's interests have been recognised. Tshwete confirms that the municipality has been part of the process from the start, and has praised the mining companies' efforts in establishing a good relationship with its prospective client.

In addition, a series of community meetings have been held to appease any fears the people of Emalahleni might have with regard to drinking treated mine-water. Tshwete says communities have been well informed, and a regular newsletter, in



After the pre-treatment process the water is clarified before being sent through the ultrafiltration membranes.



Spiral reverse osmosis (RO) membranes are used to remove salinity in the water. Up to 500 RO membranes will be installed on the main plant.

which people can comment on the project, and where queries can be answered, has been suggested to allay any future concerns.

Getting all the regulatory requirements in place has been quite a challenge. A water supply licence has never been issued for treated mine-water in South Africa before, for example. According to Gunther, all the relevant authorities have been represented on the project steering committee to ensure the process goes as smoothly as possible.

A similar project is now in the pipeline for the Steve Tshwete (Middelburg) area, where similar mine-water

management issues are being experienced. Mey notes, however, that it will not merely be a case of replicating the technology. The area faces different challenges, for example, there are more open-cast mines, and the water will have to be piped further. Studies are ongoing to find the best solution for this area.

It is anticipated that a regional water supply company may eventually be established to manage the distribution of the water treated by the water reclamation projects. It is hoped that these projects, as well as similar future initiatives, will provide a long-term solution to South Africa's mine-water problems. 