Consider This

A nature-based solution for water treatment in South African coal mining

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When coal mining comes to mind, water is typically not the first element that is associated with the industry. However, in South Africa, particularly in regions like Mpumalanga, coal mining operations face an ongoing and complex challenge with water management. High water tables in these mining areas lead to an influx of water into mine workings, and this water—often laden with sulphur, iron, and other contaminants—presents environmental and operational concerns that require long-term, sustainable solutions.

From an Environmental, Social, and Governance (ESG) perspective, understanding how mining companies are addressing these challenges is critical. Not only does it impact environmental sustainability, but also regulatory compliance, operational costs, and long-term risk management. Our ESG team visited coal-mining company, Thungela, to find out about its innovative, nature-based approach to treat acidic, sulphur-rich water from its mining operations.

The water challenge in mining

In South African coal mines, it is the presence of pyrite ore (iron sulphide) that exacerbates the environmental impact. When water comes into contact with pyrite, a chemical reaction occurs, producing acidic water rich in sulphates, iron, and other heavy metals. This water, if not properly treated, poses a significant environmental hazard. Acid mine drainage, as it's known, can lead to the contamination of nearby rivers, streams, and groundwater and thus affecting ecosystems, agriculture, and communities that rely on these water sources.

In South Africa's coal mining areas, the challenge is compounded by the fact that water management is a long-term concern. Managing water from both ongoing operations and legacy mine sites requires sustainable, cost-effective, and environmentally friendly solutions.

A nature-based solution: passive anaerobic treatment

At the forefront of Thungela's efforts to address acid mine drainage is an innovative water treatment project at its Emalahleni Water Reclamation Plant in Mpumalanga. In collaboration with the Technology Innovation Agency, Mintek, the Moss Group, and the University of Pretoria, Thungela is testing the potential of "passive anaerobic treatment" to treat the sulphur-rich, acidic waters produced by its mining operations.

But what does this mean, and why is it significant? Anaerobic bacteria, which thrive in environments devoid of oxygen, play a pivotal role in this process. These microorganisms are incredibly efficient at breaking down organic compounds and other minerals, even in extreme conditions - such as those found in acid mine drainage. Through a natural process, these bacteria can reduce the acidity of water and remove harmful heavy metals and sulphur, converting them into more environmentally benign forms.

The system works by slowly moving water through organic substrates, where anaerobic bacteria "digest" the contaminants. The process is akin to the way fish tank filters work, where water is slowly moved through gravel, allowing bacteria to break down waste into less harmful substances. However, in Thungela's system, this process is scaled up considerably to handle the large volumes of water produced by the mines.

The two-stage treatment process

The treatment system consists of two stages:

1. Anaerobic stage (First Pool):

Water from the mine, rich in iron, sulphates, and acidity, is passed slowly through an organic substrate in the first tank. The bacteria in the substrate "feed" on the sulphates and other compounds, reducing their acidity and producing bicarbonates, which neutralize the water. This also creates hydrogen sulphide (H_2S), which has a characteristic rotten-egg smell, but is also a critical intermediate in the treatment process.

2. Sulphur oxidation stage (Second Pool):

The water then moves to a second tank where it undergoes a sulphur oxidation process. Here, sulphur-oxidising bacteria oxidise the sulphides, converting them into biogenic sulphur that can be precipitated and captured. The resulting byproducts can be used in agriculture - particularly as a soil additive or fertiliser. The treated water, while not potable, is suitable for agricultural irrigation.

This two-stage process effectively reduces the acidity of the water, removes heavy metals, and creates useful byproducts for agricultural use. Notably, the system operates with minimal energy input, relying on gravity to move the water through the system, and solar power to run the pilot plant. This makes it a far more energy-efficient alternative to traditional methods like lime neutralisation or reverse osmosis, both of which are energy-intensive and generate their own waste.

From an ESG perspective, the importance of Thungela's innovative water treatment initiative cannot be overstated. This nature-based technology not only demonstrates a commitment to environmental sustainability but also aligns with the growing need for mining companies to adopt responsible water management practices. In a world where stakeholders are increasingly demanding transparency and accountability on environmental impacts, Thungela's approach offers a potential solution that could reshape how mining companies handle water pollution.

While the technology is not yet a "radical game-changer," it represents a significant step forward in the mining sector's ongoing battle with acid mine drainage. Scaling up such systems will be challenging, particularly as large pools and careful control over environmental factors like temperature and substrate types are required. Nonetheless, this demonstration project, treating 50 000 litres of water per day, is the largest of its kind in South Africa and could serve as a model for future applications in both mining and other industries. The potential synergies with other local industry in terms of the carbon feed is also being explored, using potential abattoir or dairy waste which is in itself difficult to dispose.

Supporting the development and scaling of such technologies is critical. It is in the scaling of pilots that they can be better tested for efficiency and future implementation at full size. Beyond the potential for reducing environmental damage, these innovations also have broader implications for corporate sustainability and risk management. As mining companies increasingly face pressure from regulators, investors, and local communities to minimise their environmental footprint, Thungela's approach to passive anaerobic water treatment is a compelling example of how the industry can drive positive change.

At M&G Investments, we recognise the urgent need for sustainable water management solutions in the mining sector. This challenge requires the immediate attention of investors, companies, and government bodies. By understanding the complexities involved and backing organisations that prioritise sustainable water practices, we can help mitigate the environmental risks associated with mining, ultimately creating a lasting positive impact on both the environment and local communities.