CSIR IN MINING: EXTRACTING VALUE FROM ACID MINE WATER

Acid mine drainage

The CSIR has developed magnesite softening reverse osmosis and valorisation technology in response to the persistent challenges posed by acid mine drainage (AMD) in South Africa. This zero-liquid discharge technology minimises the ecological footprint associated with AMD, a longstanding issue that results in the contamination of freshwater sources and the environment.

CSIR expertise in the AMD space

The CSIR has developed significant expertise in addressing AMD, a critical environmental issue in South Africa. The expertise of the CSIR in AMD can be outlined as follows:

Innovative technology development:
The CSIR has pioneered the development of zero-liquid discharge technology to tackle AMD effectively. This innovative approach involves magnesite softening, reverse osmosis and valorisation technology.

Understanding AMD challenges:
The CSIR understands the intricate challenges associated with AMD, which is a direct consequence of the weathering of sulphide-bearing minerals during and after mining valuable minerals like coal and gold.

Alternative to conventional treatment:
Recognising the limitations of conventional AMD treatment methods, such as lime and filtration, the CSIR focused on providing alternative technologies with minimal or zero ecological footprints.

Robust treatment technology:
The magnesite softening reverse osmosis technology developed by the CSIR has been rigorously tested and validated in

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laboratory and pilot plant settings. The pilot plant, with a 20 000 litre per day capacity, demonstrates the robustness of the technology against effluents from coal and gold mines.

Scalability and modular plant construction:

The CSIR is advancing technology by constructing a modular and mobile pilot plant with a capacity of 0.5 million litres daily. This showcases scalability and adaptability to different scales of AMD treatment.

Circular economy and waste valorisation:

The CSIR's initiative emphasises the concept of a circular economy, waste valorisation, and beneficiation. The aim is to create a self-sustainable system where revenue generated from the resale of recovered minerals offsets running costs.

CSIR Water Resource Management Research Centre:

The CSIR's Water Resource Management Research Centre is actively involved in the research and development of technologies to address water-related challenges, including AMD. The centre serves as a hub for expertise and collaboration.

Patented process:

The magnesite softening reverse osmosis technology has been patented, highlighting the uniqueness and intellectual property associated with the CSIR's approach to AMD treatment.

Demonstrated efficiency over time:

The CSIR's AMD treatment technology has been in development and validation for over five years, demonstrating its efficiency and reliability in converting waste streams into environmentally friendly resources.

The CSIR's commitment to innovation, scalability, sustainability, and collaboration positions it as a key player in addressing AMD issues in the mining industry.

Advantages for municipalities in mining zones

The technology improves the quality of affected water by removing contaminants and impurities, making it safe for various uses such as drinking, agriculture and industry.

The zero-liquid discharge feature ensures no harmful wastewater or by-products are released into the environment, protecting local ecosystems and water bodies.

Valorisation also allows municipalities to extract value from treated AMD, promoting sustainable resource management practices and potentially creating economic opportunities for communities. Furthermore, implementing this technology leads to long-term cost savings by preventing further degradation of water sources and avoiding costly cleanup efforts.

By effectively addressing AMD, municipalities can improve the health and well-being of local communities reliant on clean water sources. Overall, the CSIR's technology offers a sustainable solution for managing AMD while safeguarding the environment and community health in mining zones.

Environmental impact mitigation:

Mining companies: Reduced ecological footprint and environmental impact of AMD, contributing to sustainable mining practices.

Municipalities: Preserving freshwater sources and protecting the environment from AMD contamination.

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Innovative AMD treatment:

Mining companies: Access to an innovative, eco-friendly alternative to conventional AMD treatment methods, minimising risks associated with toxic sludge generation.

Municipalities: Integrating cutting-edge technology for effective AMD treatment, enhancing water quality management practices.

Resource recovery and valorisation:

Mining companies: Opportunities to recover valuable minerals from the AMD treatment process, creating potential revenue streams and reducing waste.

Municipalities: Valorisation of waste through a circular economy approach, promoting sustainability and resource optimisation.

Scalable solutions:

Mining companies: Scalable technology adaptable to different mining operations and types of effluents, providing flexibility and customisation.

Municipalities: Versatile application for various wastewater treatment needs, addressing diverse environmental challenges.

Financial sustainability:

Mining companies: Revenue generated from the resale of recovered minerals can offset the system's running and water costs, making it a financially sustainable solution.

Municipalities: Potential for financial sustainability through the resale of recovered minerals, reducing reliance on external funding for wastewater treatment.

Quality water production:

Mining companies: Production of high-grade water by installing reverse osmosis membranes, enhancing water quality for industrial processes.

Municipalities: Treated AMD can significantly contribute to South Africa's water mix. Groundwater usage will increase, and overreliance on surface water will be reduced.

Industry collaboration and support:

Mining companies: Participation in collaborative research and development partnerships, fostering industry-wide support, and showcasing commitment to sustainable practices.

Municipalities: Integration of technology supported by leading mining companies, ensuring credibility and reliability in wastewater treatment.

Regulatory compliance:

Mining companies: Adherence to environmental regulations and standards, reducing the risk of regulatory fines and penalties.

Municipalities: Fulfilment of regulatory requirements for wastewater treatment, ensuring compliance with environmental laws.

Positive public perception:

Mining companies: Demonstrating commitment to environmental stewardship, fostering positive public perception, and corporate social responsibility.

Municipalities: Implementation of innovative solutions aligning with environmental sustainability goals, enhancing public trust and support.

MINIMUM VIABLE PRODUCT

Identifying core features:

The minimum viable product approach for addressing AMD involves identifying and implementing essential core features or functionalities to mitigate or treat acid mine water. This might

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include key treatment processes, monitoring capabilities, and sustainable practices.

Quick deployment:

The goal is to deploy a functional solution quickly. For AMD, this means implementing a basic treatment system or technology in a specific mining site to demonstrate feasibility and effectiveness.

Iterative development:

The AMD solution would undergo an iterative development based on feedback and lessons learned from its initial deployment. This allows for our continuous improvement and optimisation of the AMD treatment process.

Testing and validation:

AMD is designed for testing and validation under real-world conditions. This entails monitoring its performance, assessing its impact on water quality, and evaluating its sustainability within the mining environment.

Scalability considerations:

AMD's effectiveness in treatment solutions is proven to be able to expand or adapt to more extensive mining operations or different geographical locations.

Cost-effectiveness:

Emphasis is on cost-effectiveness. In our initial implementation of the AMD solution, we strive to ensure affordability, making AMD a viable option for mining companies with varying budgets.

Community engagement:

AMD implementation ensures engagement, interaction and informing local communities about the AMD treatment efforts. This might involve community outreach programmes, educational initiatives, or transparent communication about the project goals and impact.

Regulatory compliance:

We address minimum regulatory requirements for AMD treatment. This ensures that the solution aligns with environmental standards and can be seamlessly integrated into the regulatory framework.

Adaptable technology:

We ensure both demonstration and adaptability to different mining contexts. This adaptability allows the technology to be fine-tuned based on the unique characteristics of various mining operations.

Measurable outcomes:

We have defined measurable outcomes, including improvements in water quality, reduction in environmental impact, or other key performance indicators that demonstrate the success of the AMD treatment solution.

By adopting the minimum viable product approach, the CSIR ensures that the development and implementation of solutions for AMD become more agile, allowing for quicker learning, refinement, and scalability based on real-world feedback and requirements.

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POWERING POSSIBILITY

Discover the advantages of partnering with the CSIR Water Centre

The CSIR Water Research Centre focuses on improving water and wastewater service delivery for economic development. It addresses challenges such as dwindling water resources, deteriorating water quality and limited access to alternative water sources. The centre aims to enhance water resilience and address climate change impacts by developing technology, software and tools to improve water resources and management systems. The CSIR Water Centre also offers bursary and internship programmes for human capital development in the water sector.

CSIR experts provide solutions under two pillars: Smart Water Use and Smart Water Infrastructure, including low-cost technology solutions for water quality challenges and lifecycle solutions for water infrastructure. Here, researchers leverage advanced technologies for water resource management and decision-making support.

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