



Clean & Recover

ElectroClear Water Treatment
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ELECTROCLEAR PRODUCT & PROCESS OVERVIEW



WE TREAT AMD

To make process water for reuse onsite at the mine's preferred pH, or treat water to a standard suitable for discharge.

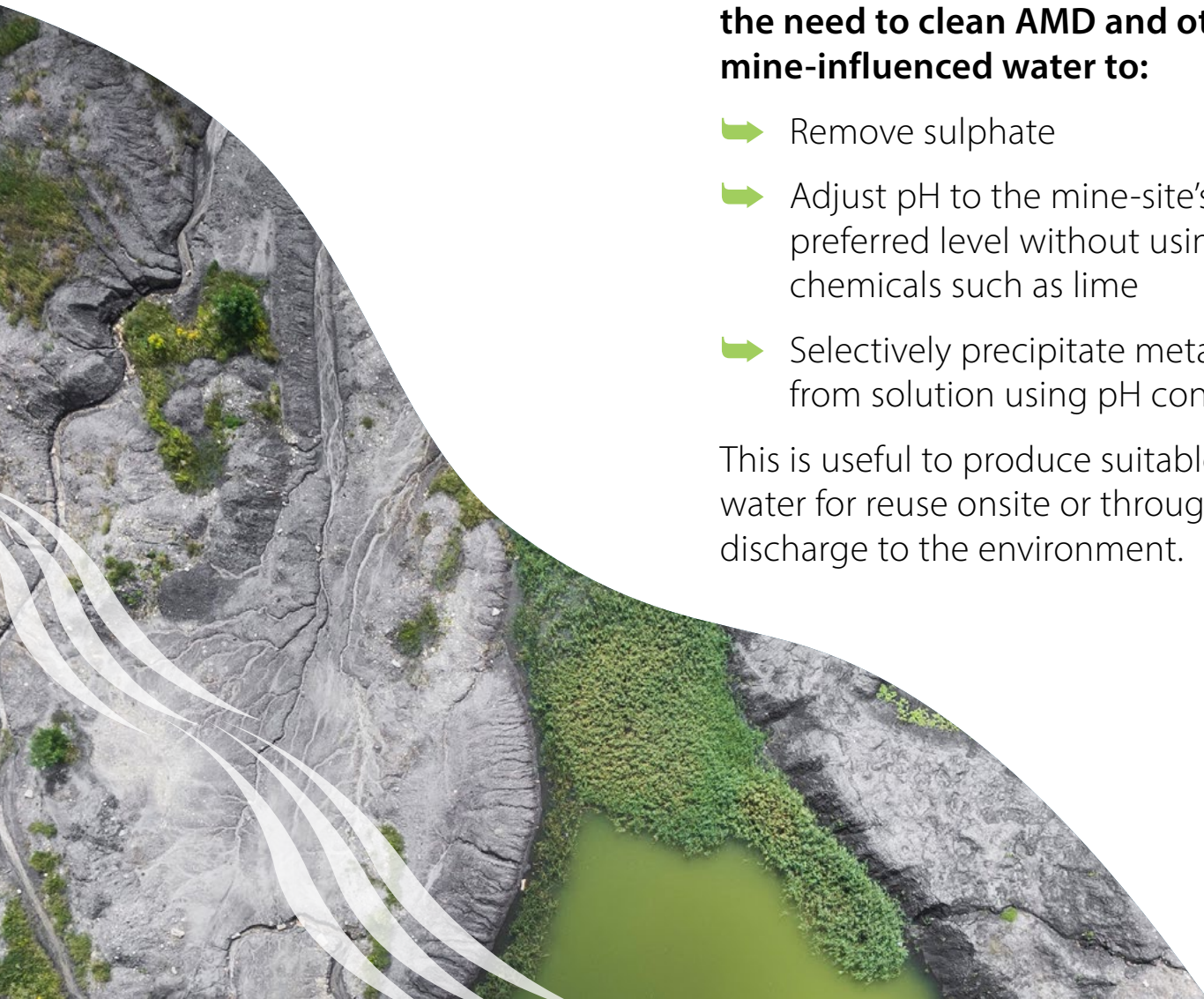
ELECTROCLEAR – a cost effective option for treating mine water

Mining uses water for a range of purposes, including minerals processing, ore washing, dust suppression, and general site purposes. As part of these processes, there is a need to deal with contaminated water. One of the big challenges for mine sites is water that becomes acidic and sulphidic through exposure of sulphate-rich soil to air and water, especially in the form of acid mine drainage (AMD).

Clean&Recover has responded to the need to clean AMD and other mine-influenced water to:

- ➡ Remove sulphate
- ➡ Adjust pH to the mine-site's preferred level without using chemicals such as lime
- ➡ Selectively precipitate metals from solution using pH control

This is useful to produce suitable water for reuse onsite or through discharge to the environment.



BENEFITS

ElectroClear transforms the problem of AMD into multiple value streams for users.

The process yields:

- ➡ Clean water
- ➡ Sulphuric acid concentrated from the sulphates in the AMD
- ➡ Metals precipitated from the AMD as metal hydroxides

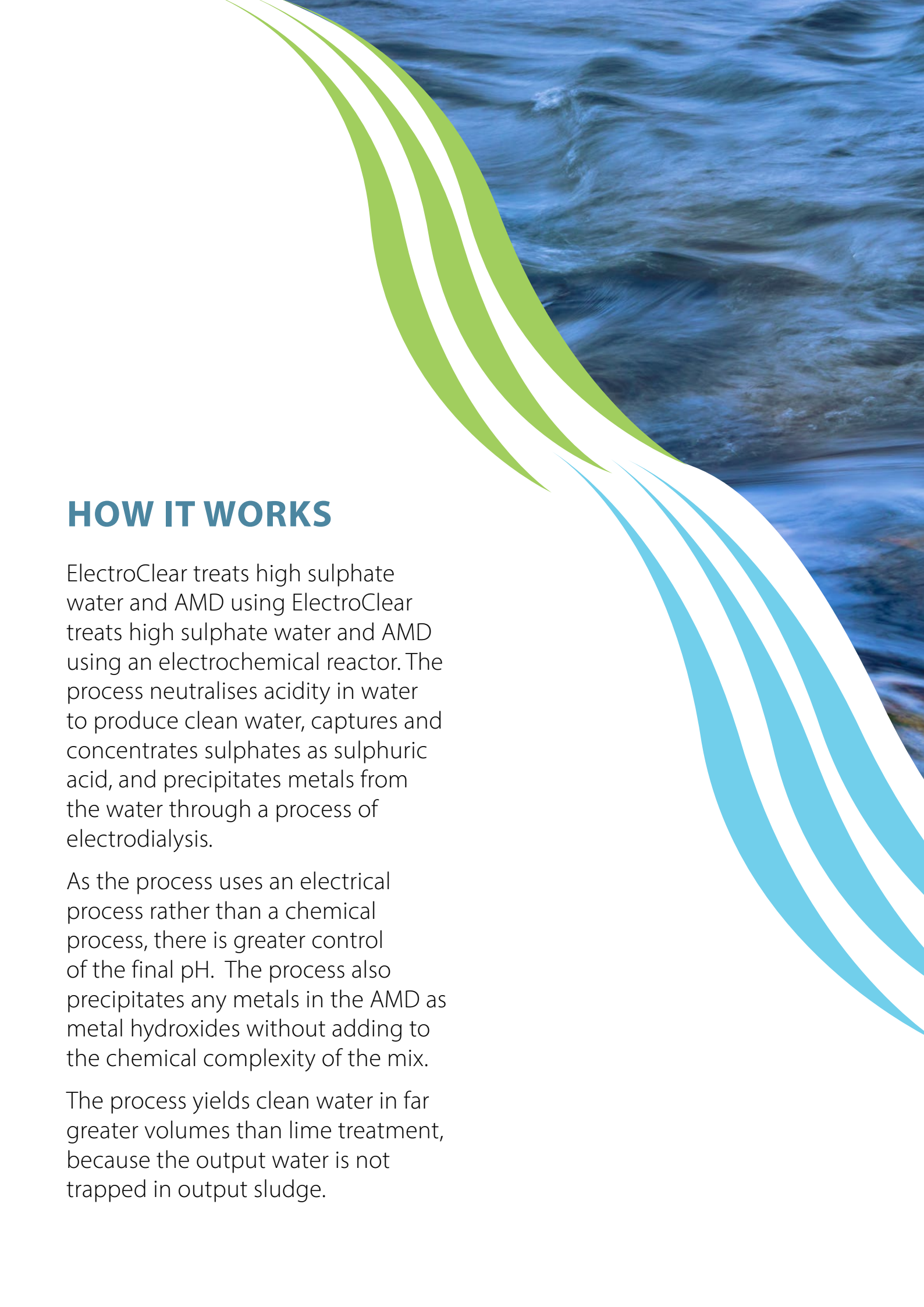
Additional benefits include:

- ➡ Meeting environmental rehabilitation obligations
- ➡ Reducing rehabilitation costs and environmental bonds
- ➡ No toxic sludge to manage
- ➡ No added chemicals
- ➡ Does not require large volumes of water to make hydrated lime
- ➡ Does not produce carbon dioxide emissions from calcination of limestone to make lime
- ➡ Simple to operate, including remote, automated operation
- ➡ Option to use off-grid solar power, or on-grid supply for the treatment plant
- ➡ Treatment and emptying of open cut mine pits to allow for mining of the pit

The ElectroClear technology has demonstrated its success in cleaning AMD from multiple mine sites to produce water suitable for discharge to the environment. The process removes more sulphates from water than lime treatment and is able to precipitate the metals dissolved in AMD and capture them for commercialisation.

ElectroClear provides a highly cost-effective way to produce process water that is suitable for specific purposes on-site such as minerals processing at high pHs.

The ElectroClear process has won two worldwide mining challenges for the best solution in water treatment.



HOW IT WORKS

ElectroClear treats high sulphate water and AMD using ElectroClear treats high sulphate water and AMD using an electrochemical reactor. The process neutralises acidity in water to produce clean water, captures and concentrates sulphates as sulphuric acid, and precipitates metals from the water through a process of electrodialysis.

As the process uses an electrical process rather than a chemical process, there is greater control of the final pH. The process also precipitates any metals in the AMD as metal hydroxides without adding to the chemical complexity of the mix.

The process yields clean water in far greater volumes than lime treatment, because the output water is not trapped in output sludge.

THE PROCESS

The patented ElectroClear process pumps the water to be treated into the cathodic chamber of an electrochemical cell. Electricity is then applied to draw sulphate anions from the water across an anion exchange membrane into the anodic chamber where the sulphate anions form as sulphuric acid. As the sulphate is drawn away, the pH of the cathodic chamber rises, causing the metals in the AMD to precipitate .

Certain metals, such as aluminium and iron, precipitate at a low pH while others, such as manganese, precipitate at a high pH. The ElectroClear treatment process can be used to separate metals through precise control of the pH.

As the metals precipitate and the sulphate anions are drawn off, clean water is produced. The metal precipitates settle quickly and into a much smaller volume than the sludge produced by lime treatment.



The ElectroClear module: creating value while treating sulphidic water

ELECTROCLEAR SIMPLIFIED OPERATING DIAGRAM

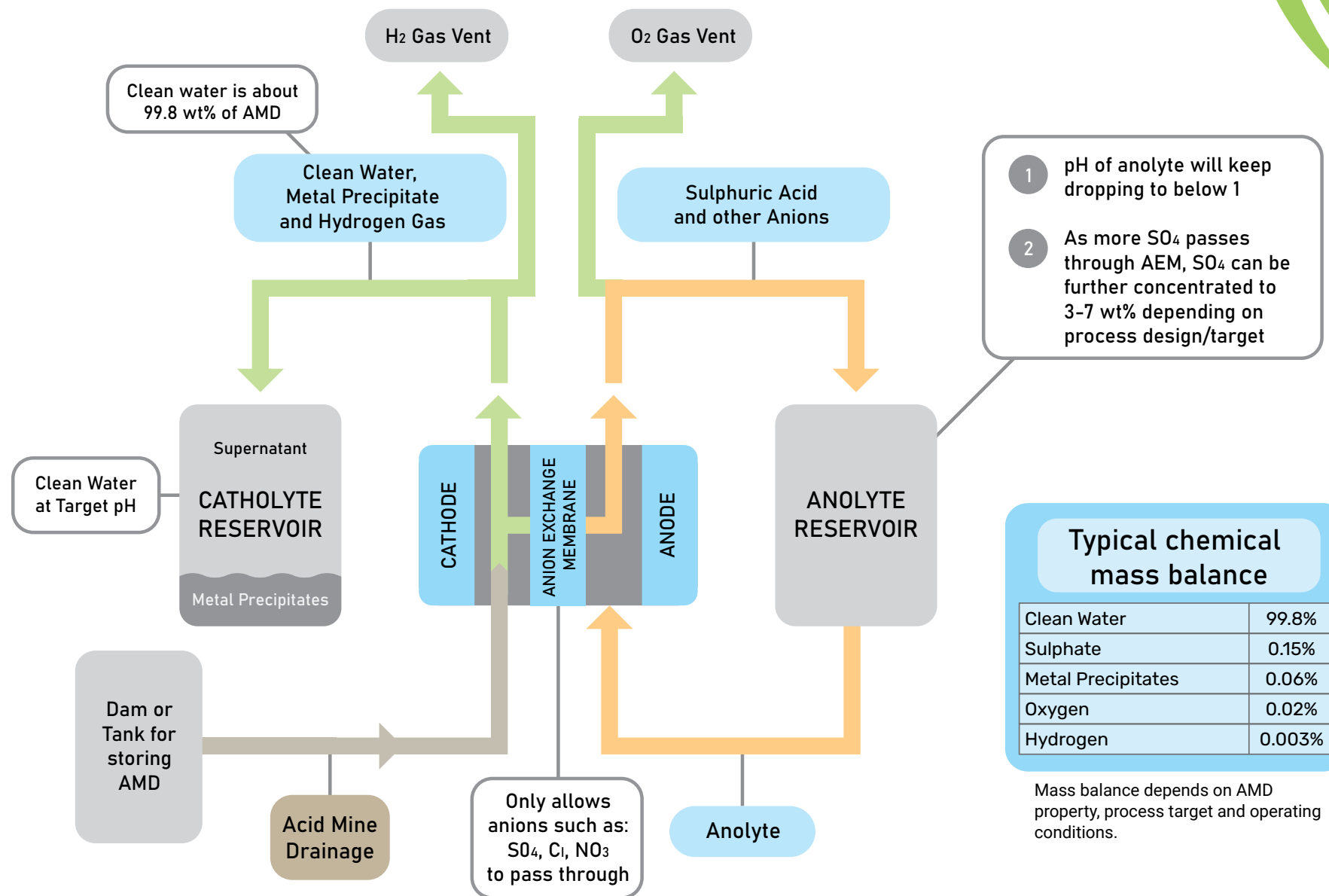


Diagram 1: Summary of process

THE BUSINESS CASE FOR ELECTROCLEAR

Lime or caustic soda dosing are typically expensive due to the cost of reagents, input water, operator costs, and sludge disposal costs. On top of this, chemical treatment produces large volumes of carbon dioxide. The water from the process can be returned at a preferred pH for reuse in minerals processing.

ElectroClear is lower cost than lime treatment and can be powered by grid power or solar panels and batteries – in which case, the treatment cost will continue to decline as the cost of solar panels and batteries decreases.

In addition, sulphuric acid and metal precipitates can be precipitated from the AMD and processed for value.

SCIENTIFIC PAPER

Brewster, Emma Thompson, Stefano Freguia, Mansour Edraki, Luke Berry, Pablo Ledezma, Staged electrochemical treatment guided by modelling allows for targeted recovery of metals and rare earth elements from acid mine drainage. *Journal of Environmental Management* 275 (2020) 11 1266

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