



WATERCARE MINING

Case Study: Acid Mine Drainage: Solid-Liquid Separation

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Decades of mining in the Witwatersrand basin has created an enormous, interconnected, subterranean void from Randfontein in the west to Nigel in the east, in some places as deep as 3000 meters. During mining operations, water is constantly pumped from the mine to prevent flooding, but when the mine is abandoned or closed, pumping ceases and the voids start filling with ground water.

Metal sulphides (pyrites) oxidise when the ore is exposed to ground water and oxygen, generating sulphuric acid, which leaches minerals such as iron, arsenic and cadmium from the ore body. The chemical oxidation reactions deplete the water of oxygen, making it uninhabitable for aquatic life. The contaminated underground mine water is referred to as acid mine drainage (AMD), and when the AMD decants to the surface, it may pose a risk to the ecological environment due to its low pH, dissolved mineral content and depleted oxygen levels. In a 2010 incident, AMD decanted to the surface on the West

FIGURE 1: TWO 7.6m DIAMETER HIGH-RATE CLARIFIERS



Rand, polluting the Tweelopiespruit, which ultimately flows into Hartbeespoort Dam. At this point, the government-owned, bulk raw water infrastructure company, Trans-Caledon Tunnel Authority (TCTA), was mandated to effectively stop the decant of AMD on the West Rand and in the Central and Eastern Basins.

Watercare Mining, a specialist in clarifier design and operations, was a service provider to the mine at the time, and partnered with the existing, operational mine in the

FIGURE 2: REACTOR FEED PIPES



Western Basin to develop a solution to stop the decanting of AMD to the surface.

- Two key challenges associated with the project included:
- The volume of AMD water pumped from underground, required the installation of a large diameter clarifier (typically 40 - 50 meters in diameter).
 - The suspended solids were very fine, creating a flocculant bed that was light and very unstable.

Watercare Mining recognised the benefits of a new and unique clarifier design in the optimisation of the AMD treatment process. Their patented High-rate Clarifier was designed for effective solid-liquid separation at the volume and flow rate provided by the AMD pumping station, all within a drastically reduced footprint.

A 2-phase treatment process was developed to achieve the objectives of treating the AMD to standards acceptable for release back into the natural waterway, while maintaining the

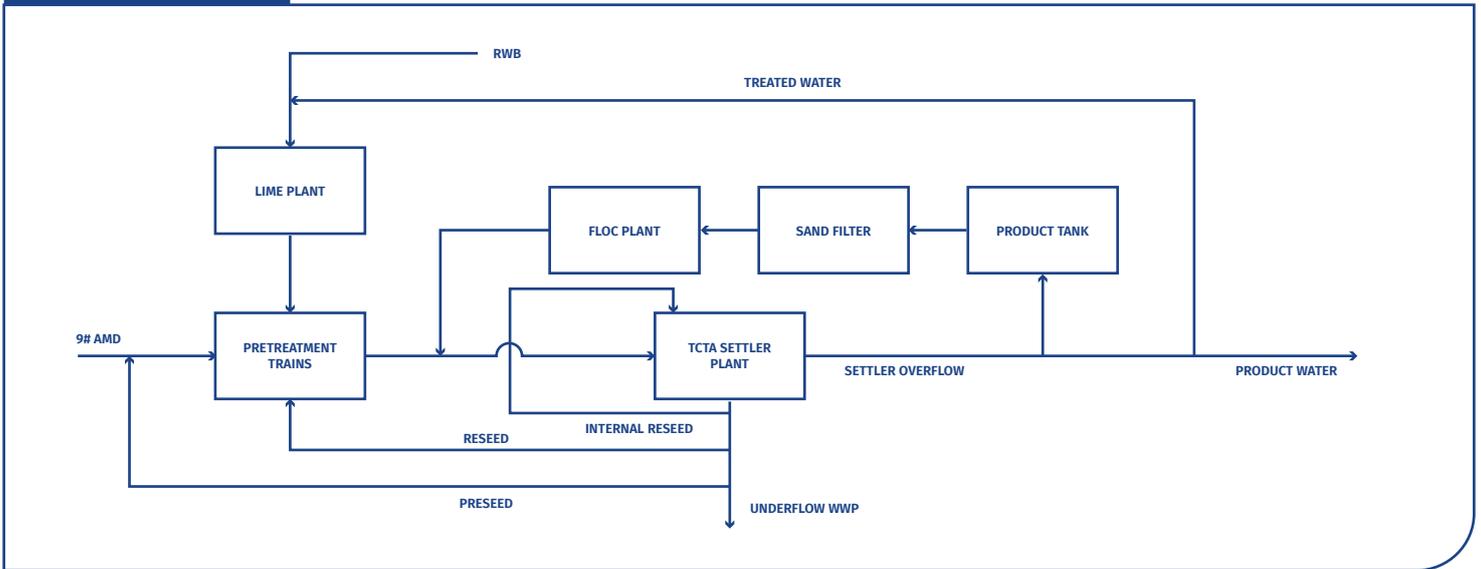


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FIGURE 3: PLANT LAYOUT



volume of AMD in the underground dam at specified levels (Figure 3):

- i. The first phase aerates, and neutralises the AMD. Underflow from the High-rate Clarifier (phase 2) is fed to the aerated and neutralised AMD to “seed” the suspended solids, increasing the size and density of the suspension in preparation for the 2nd phase of the process. The product flowing from phase 1 is called High Density Sludge (HDS). HDS forms the feed to the High-rate Clarifier at the TCTA plant, phase 2.
- ii. In phase 2, the HDS enters the patented technology High-rate Clarifier. The neutralised, seeded suspended solids are settled and removed during this phase. The quality of the clean water overflow is acceptable for release into the Tweelopiespruit (less than 10ppm total suspended solids), while the sludge is either sent back to the HDS plant (phase 1), or to a designated waste pit.

The HDS plant currently treats approximately 33ML/day AMD, feeding the neutralised HDS to the High-rate Clarifier for the removal of toxic metals through solid-liquid separation. As much as 43ML/day HDS has been treated by the High-rate Clarifier.

Watercare Mining’s installation at TCTA consists of two x 7.6 meter diameter High-rate Clarifiers. The plant is designed for a total volume inflow of 1520m3/hour or 36.5 ML/day. The rise

FIGURE 4: HDS ENTERING THE FEED LAUNDER OF THE HIGH-RATE CLARIFIER



rate achieved is as high as 25,4 m/hr. Inlet total suspended solids is typically 3000 ppm, and the overflow total suspended solids ranges between 5-20 ppm.

The successful treatment and management of AMD at the TCTA plant has ensured conservation of the natural biodiversity of the Tweelopiespruit water system. Watercare Mining’s technical expertise was key in the optimisation of the processes required to treat the AMD to the standards required for release to the natural water system, and their patented High-rate Clarifier has been instrumental in the continuous and consistent treatment of the high volumes of AMD.