

Aquatic acumen

John Chadwick looks at, among other trends, the growing use of seawater and desalination plants, clean up of waste waters and recovery of valuable metals where practical, water management and water delivery



Mining companies are making great efforts to contain, control and clear up contaminated water from operations. As a result, mining has become “one of the most dynamic” markets for water and wastewater treatment, according to a recent report by industry analysts Frost & Sullivan. By 2016, the industry’s demand for water-treatment equipment and services is expected to be worth \$3.6 billion.

More interesting statistics are provided in Polypipe’s new mining brochure:

- Mining uses between 7 and 9 billion m³/y of water, which is about as much water as a country like Nigeria or Malaysia uses in total in a year
- Mining and burning coal accounts for half of all water withdrawals in the USA, which is the same amount of water that pours over Niagara Falls in five months
- An estimated 18.28 billion litres of water is withdrawn for mining a year in the USA
- Demand for water by the mining sector is likely to increase, with annual projections ranging from 810 billion litres of water used to 940 billion litres of water used by 2020 for Western Australia alone.

The vast northern region of Chile encompassing the Atacama Desert, the driest, non-polar desert in the world, is an important mining region being home to the world’s biggest known copper reserves. Not so dry, but nevertheless pretty arid, Western Australia is

another very important region to world mining. These and other important mining regions have little alternative but to turn to the sea for water resources to solve one of the major constraints to mine development. Indeed, making it mandatory for mining companies to install desalination plants is being considered in Chile.

According to figures from the Consejo Minero de Chile, the mining industry’s water demand was 12.6 m³/s in 2011 – less than 5% of total Chilean demand. Between 2012 and 2020, that demand was projected to total up to 360 million m³ and then 500 million m³. So, with Chile’s deserved reputation for innovation, it is no wonder that it leads the world in the use of desalination and other ways of finding sustainable sources of water and water retreatment and management.

The use of seawater is not only a solution for mining companies, but is also a way of freeing up fresh water for other uses and allowing the restoration of damaged ecosystems.

The first big major company to use seawater only in its processes was Minera Esperanza, a joint venture between Antofagasta Minerals and Marubeni Corp. This copper mine uses untreated seawater, transported via a 145-km-long pipeline, in all of its processes. Seawater currently accounts for 30% of all of the water it uses.

State-owned Codelco will use seawater for the first time to extract copper from the sulphide reserves of the Radomiro Tomic mine. In this

Rio Tinto, like its peers, recognises the importance of water and, thus, works to improve its management, “adopting innovative approaches and considering energy aspects, climate change and biodiversity to preserve water.” Its aim for La Granja is for the project to be recognised “by the communities, the government, NGOs and peers, as a leader in integrated and responsible water management in the national mining industry. La Granja is a copper project located in the region of Cajamarca, in northeast Peru

case, the use of seawater means that no extra pressure will be placed on the freshwater resources of the Andes or other inland surface water reserves, in an area where no new water resources are thought to be available.

The RT Sulphides project is another line of copper concentrate production, which involves greater consumption of water per tonne of copper produced than the mine’s current treatment of oxide ore.

RT Sulphides will extract seawater and desalinate by a reverse osmosis process that uses pressure to force water through a membrane which retains the dissolved solids. The treated water will be transported to the mine’s facilities, located 3,000 m above sea level, via a 160-km pipeline. The operation will entail an expenditure of \$2.6/m³, according to Codelco.

According to studies, the costs associated with a seawater supply system can represent 20 to 30% of the total costs of a project located more than 150 km from the coast and between



AREVA, inaugurated the very first sea water desalination plant in Namibia, located 30 km north of Swakopmund on the Atlantic coast. The plant will produce 20 million m³ of potable water per annum, which is enough to allow AREVA to operate the Trekkopje mine without pumping any water from boreholes. Excess production serve local communities and industrial activities

3,000 and 4,000 m above sea level. There is research ongoing to find more efficient ways to supply seawater to mining companies. And of course the best solution is to use untreated seawater as Minera Esperanza does because desalination requires a lot of energy and can cause damage to the environment, but this cannot always be achieved. The research is working to produce water of different qualities from seawater, since different processes and minerals require different types of water.

For Codelco, desalinated seawater “is not a harmless solution, because it implies greater energy consumption both for its treatment and, above all, for moving it through the pipeline to where the mines are located. It is also not economically viable for projects with narrower profit margins, or for projects that do not have a guaranteed energy supply,” explained a Codelco source.

Samuel Leiva, the campaign coordinator at Greenpeace Chile, has warned of the potential long-term environmental impact of the desalination process. Desalination plants require energy in a region where there is no water, “so the alternative is to implement projects that use fossil fuels and increase atmospheric emissions and cause environmental damage all along the coast” by releasing higher-temperature water back into the ocean, he told Tierramérica.

There are currently 14 desalination projects of this kind underway in Chile, 11 of them connected to mining.

Esperanza plant area – seawater pipeline

In late July last year, Minera Escondida announced plans to invest \$3.43 billion dollars in the construction of Chile's biggest desalination plant.

By 2022, an estimated \$10 billion will have been invested by the private sector in 16 new seawater treatment plants.

Esperanza's water

Minera Esperanza's operation is located 180 km from the city of Antofagasta in the Sierra Gorda district in northern Chile. During the first ten years of operations, it is expected to average some 190,000 t/y of payable copper in concentrate and 230,000 oz of payable gold. The mine life is anticipated to be 15–20 years.

Copper concentrate containing gold and silver byproducts is processed by a conventional milling and flotation process. The process plant capacity is about 97,000 t/d of ore, with tailings reporting to an innovative thickened-tailings facility (see ICMM report *Water management in mining: a selection of case studies*). The mine, located in an area of the Atacama Desert, needs some 20 million m³ annually to operate.

From an early design stage, Minera Esperanza considered the expectations of surrounding communities. To do this, the company developed a community relations plan that focused on its areas of influence – namely Sierra Gorda, Baquedano, Mejillones and Caleta Michilla. The plan follows the sustainability principles of Antofagasta Minerals, Minera Esperanza's parent holding company, which calls for consideration of people, the environment and applicable legal regulations.

Studies were carried out in laboratory

conditions and then through a pilot project to determine optimum operating conditions for the primary flotation process using seawater. Once the process was proved, a supply pipe network was constructed to transport seawater 145 km from the Pacific coast to the mine site.

The seawater intake is located at Caleta Michilla in Mejillones at the site of Minera Esperanza's port facilities.

At the beginning of the water pumping cycle, the seawater is conditioned by filtering to remove suspended solids and a corrosion inhibitor reagent is added to ensure a longer working life of the pipelines. The seawater is then transported to the mine via a pipeline that climbs 2,300 m and passes through four intermediate pumping stations to reach the concentrator plant. The power consumption of the pumping system is on the order of 20 MWh, which comes from the regional electric grid.

The greatest demand for seawater in the operation is the concentrator plant, which requires around 600 litres/s of the total mine consumption of approximately 630 litres/s. Some processes both at the port facility and at the mine site require fresh water for drinking, sanitation, cooling and concentrate washing. This is obtained from seawater desalination plants using reverse osmosis at both locations. This accounts for approximately 8% of the total seawater usage.

The thickened tailings disposal system is another way of saving water. It employs high-torque thickeners that produce up to 67% solids. The thickened tailings are pumped through a pipeline system that distributes it in sectors inside the tailings deposit. Once the mix is solidified, it is possible to continue depositing more tailings in the same area. There are three 60 m diameter and two 45 m thickeners.

Esperanza lists the competitive advantages of



thickened tailings as:

- High operational safety
- Seismic stability
- Low particulate matter emissions
- Minimal seepage of water into subsoil layers.

For the operation's potable water needs, Koch Membrane Systems (KMS) was selected to develop an innovative seawater reverse osmosis (RO) system. The system uses MegaMagnum® high capacity seawater membranes, made from a unique thin film composite developed specifically for seawater applications.

The constructor Nicolaides S.A. chose MegaMagnum seawater elements to take advantage of the significantly reduced footprint, project costs, and installation time. The large diameter RO systems use one-seventh the number of elements compared to standard 203 mm elements and also contain far fewer of the O-ring seals that prevent mixing between the seawater and product water. This results in significantly lower maintenance costs over the life of the plant.

The water supplied to the mine begins with seawater drawn from the Pacific Ocean. This is pumped for about 1.5 km to a water treatment unit that includes a pre-filtration system. From there, the water is pumped through the RO system, which consists of two skids, each comprised of two MegaMagnum RO vessels with a combined effective membrane surface area of some 2,835 m².

The final permeate is disinfected with chlorine, making it acceptable for drinking water. The permeate capacity is 80 m³/h given a maximum feed total dissolved solids (TDS) of 40,000 ppm and the required chloride concentration is less than 250 ppm in the finished water. The system operates at a rate of 20 m³/h.

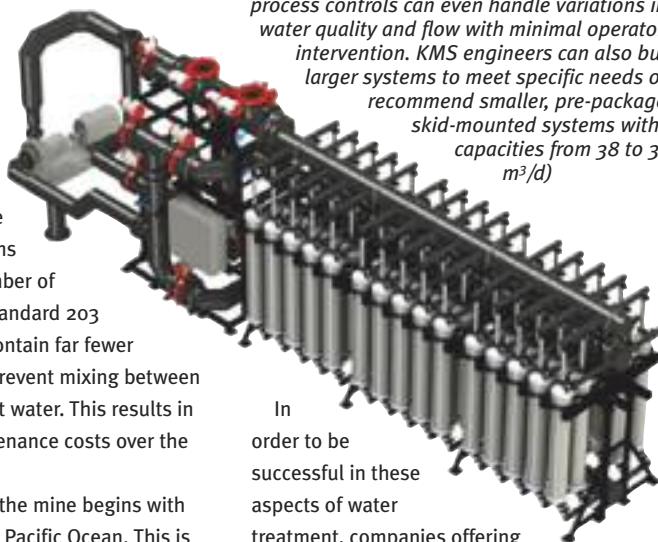
KMS offers a wide range of RO elements suitable for a variety of separation requirements. Its pre-engineered, packaged water treatment systems using RO and nanofiltration (NF) technology offer optimum water treatment for brackish and seawater applications within a compact, skid-mounted package. For larger systems, KMS engineers can design and build a custom system.

Outotec and sulphate management

Outotec states: "The way of perceiving water in the mining industry has changed from thinking of it only in terms of water treatment to actually seeing it as a valuable resource, a resource that needs proper management. This resource management needs to involve aspects such as

optimising usage on the whole mine or concentrator site level, minimising fresh water usage, minimising waste generated by water treatment and implementing water reuse and water recycling practices."

The Koch Membrane Systems' TARGA II hollow fibre system offers a cost-effective water solution for a variety of UF applications. It features a robust PES membrane which, combined with an optimised cartridge and rack design, results in one of the smallest footprints on the market, the company says. Ideally suited to meet drinking water requirements, it ensures 4-log virus removal. Its highly intelligent process controls can even handle variations in water quality and flow with minimal operator intervention. KMS engineers can also build larger systems to meet specific needs or recommend smaller, pre-packaged, skid-mounted systems with capacities from 38 to 380 m³/d)



In order to be successful in these aspects of water treatment, companies offering water management solutions for the mining industry must have a deep understanding of mining and mineral processes. Just being good in water treatment technologies is not enough. Outotec says its Industrial Water Treatment offering "combines mineral processing know-how built up over several decades with water treatment expertise to develop optimised and tailor-made solutions for customers.

"Waters in the mining industry are very complex and always site specific, as the composition of impurities is related to the ore itself and to the processing of the ore. Typical impurities in the waste waters of the metals and mining industry are metals, arsenic, sulphate, chloride and cyanide. Due to the complexity of the waste waters and the high concentration of sometimes toxic impurities, expertise is needed

not only in water treatment technologies but also in mineral processing technologies when developing water management solutions."

In developing process solutions for water treatment, it is best to keep in mind two targets. The treated water should be of high enough quality so that it can be recycled back to the mineral processing and therefore reduce fresh water consumption. Secondly, the selected water treatment process should be efficient and reliable so that the mining company can securely meet the requirements of environmental permits. To meet these two targets, there is a constant need for new treatment technologies that are not only efficient but also feasible.

Outotec has developed several solutions for managing the aforementioned challenges in the metals and mining industry. They consist of proprietary and patented process technical solutions combined with Outotec's equipment offerings for reactors and dewatering. These elements together with high-quality engineering and automation systems enable reliable and safe water treatment processes.

As an example Outotec has developed a process for managing sulphate, which is a common and growing challenge in the industry. The Outotec Ettringite process precipitates sulphate and calcium, thereby lowering the scaling potential and total dissolved solids (TDS) content in the treated water while also removing within the two to three step process many other impurities, such as metals. With this process companies that struggle with sulphate within their processes or in their environmental discharge streams are able to control flexibly the sulphate content and thereby affect the TDS content in their waters.

The Outotec® Ettringite process is a solution for managing sulphate and calcium in process streams for the production of water that meets discharge water quality requirements and allows the recycling of treated water for reuse. The process consists of an ettringite precipitation stage at pH 11-13 using lime milk and aluminium, followed by a final neutralisation stage using carbon dioxide. Gypsum precipitation can be included before the ettringite stage, when required



Desalination technologies

Late last year, BP Ventures completed an investment in Saltworks Technologies, a specialist water treatment company based in Vancouver, Canada, as part of its ongoing commitment to developing and supporting leading-edge technologies. Saltworks is an advanced water treatment solutions provider. It has developed cost effective and robust desalination systems for the world's most demanding applications which require freshwater from highly impaired saline water sources.

Saltworks' product line offers a number of technology solutions that help address and manage global water scarcity issues, either by using saline water sources instead of freshwater sources, or by recycling waste water, including produced waters.

Specifically, Saltworks develops new desalination processes that lower the cost and energy of making freshwater from saline water sources. Saltworks focuses on challenging water sources found in industrial settings such as mining.

BP's investment in Saltworks follows investments made by other leading resource companies, including Cenovus Energy, ConocoPhillips, and Teck Resources. The investment also comes after successful bench and pilot scale tests between BP and Saltworks.

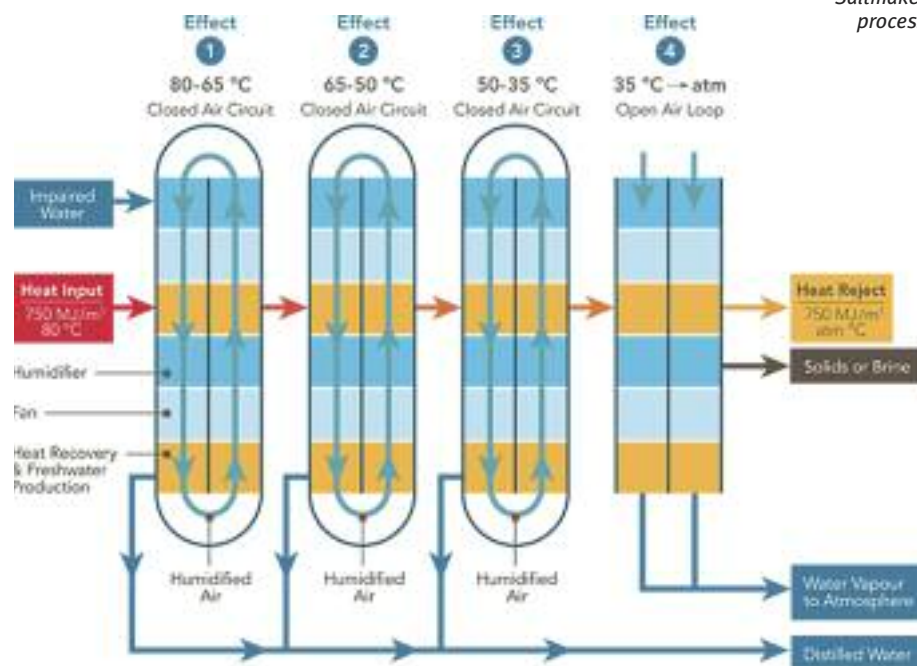
Saltworks' CEO, Benjamin Sparrow, notes "BP's investment will immediately go to work as we construct our new manufacturing facility and further grow our field operations team. After successful product uptake in Australia, California, Texas, and Pennsylvania, we are extremely pleased to welcome BP to our shareholder base. BP's investment will increase our scale and our reach."

Bauer International Corp is experienced in using RO, ultrafiltration (UF), NF and membrane bioreactors. The company provides innovative and efficient solutions using the full spectrum of water treatment technologies.

Bauer's experience in brackish and seawater desalination incorporates the latest in technology, including chemical and mechanical pretreatment, brackish and seawater membrane systems, energy recovery; all employing advanced control and instrumentation.

In water and waste water treatment, the company says that "regardless of the source – surface, well, seawater or wastewater – [its] engineers can develop a system to make it suitable for your use incorporating one or more of the following processes, filtration, clarification, chemical feed, oxidation, ion exchange [or] membrane.

Bauer offers various industrial media filters – fibreglass, reinforced, plastic, designed specifically for the application environment:



Saltmaker process

Resistant to saltwater, changes in pH and electrolytic chemical reactions.

Based in Spain, BEL is involved in many mega-size desalination projects, providing a total solution of detailed design, production and installation of large-scale composite products for the process industry, water treatment industry and more. One of its mining references is the Trekkopje 55,000 m³/d desalination plant in Namibia where AVENG Water (Keyplan) was the contractor.

Cadagua with more than 40 years of experience is well known both in Spain and abroad as a pioneer and leading company in the field of water treatment and seawater desalination. One of its references is El Morro facility for Goldcorp in Chile. This 64,000 m³/d facility uses RO and UF to produce industrial and drinking water.

UGL supported CITIC Pacific Mining in the delivery of a number of essential pieces of infrastructure for the Sino iron ore project including a desalination plant, the first large desalination plant for a resources project in Western Australia.

The challenge for CITIC Pacific was to find a supplier who could deliver a comprehensive mining infrastructure solution to provide a platform for its immediate and future growth objectives. It required an integrated solution from a desalination plant transmission lines to the construction of a complete power station.

CITIC Pacific wanted a large-scale desalination plant to provide process water for use in transporting iron ore slurry from the mine site to the load out facility. For the 140 megalitre/d plant to be successful, it would require sophisticated filtration technology.

This was the world's first desalination plant of

its size to be constructed from precast modular sub-elements which included:

- 5,000 m³ of concrete
- 3.5 km of underground piping
- 60,000 man hours
- The installation of 450 precast elements.

UGL was engaged in a number of capacities including the construction and commissioning of a 51 gigalitre desalination plant which has a similar capacity to Perth's seawater desalination plant. UGL's scope of work in achieving this solution included construction services, and management of the site which included the responsibility of safety, quality and environment and industrial relations, commissioning and performance testing.

UGL also constructed the desalination plant concrete foundations, designed and built an operations workshop and installed underground Glass-fibre Reinforced Plastic (GRP) pipes.

Ausenco provided management of EPC services for the desalination plant, including preparation of plant performance specifications, preparation of construction packages, management of design and procurement activities, site selection, intake and outfall location selection and brine dispersion modelling for environmental permits.

The management team coordinated the services of multiple engineering consultants and contractors who provided complete plant design and construction.

The desalination plant incorporates an intake pump well with two-stage screening, a 2.5 km intake pipeline, four-stage pretreatment plant, RO plant, energy recovery system, post treatment water stabilisation plant, and a 3 km outfall pipeline and diffuser.

RWL Water was awarded the order for the

design, manufacture, supply, construction, and commissioning of a water treatment plant for the Sino iron ore power station, which supplies its various water requirements. The scope of supply for the project also included large water tanks, full assembly, and project management.

The system is fed by desalinated seawater. There is further treatment of the water to meet the stringent quality requirements of the power station with the following processes and equipment:

- First-pass BWRO membranes for supply of permeate for cooling and other uses. Capacity: two x 1,000 m³/d
- Second-pass BWRO and EDI demineralisation for supply of water to high-pressure steam boilers. Capacity: two x 450 m³/d
- Conditioning of first pass RO permeate for potable use according to Australian Standards, including remineralisation by calcite filter and disinfection. Capacity: 120 m³/d.

Due to delays in construction of the seawater desalination plant, the RWL Water system was adapted accordingly and was commissioned and operated with borewater feed. Throughout this period, the RWL Water system supplied water capacity and quality as per requirements and expectations. After an initial period of operation, the feed water was changed to desalinated seawater as per the original design.

Ecoagua is one of the main engineering and consulting companies in Spain specialising in desalination and water reuse. It has been particularly active in the Chilean mining industry with clients like Antofagasta, Minera Candelaria, Minera Escondida and Minera Mantoverde.

Ecoagua develops the design, undertakes basic engineering and supervises construction and implementation of installations using RO, Multi-Stage Flash Distillation (MSF), Multiple Effect Distillation (MED) and UF processes.

Most recently, Codelco contracted Ecoagua to carry out a technical study to determine the best strategy for both the operation and maintenance of the desalination plant to supply water for the Radomiro Tomic Sulphides project. It is to be a 170,000 m³/d Seawater Reverse Osmosis (SWRO) plant for the 200,000 t/d mine near Caleta Viuda, south of Tocopilla. Engineering services for phase 2 of the mine project, which includes the SWRO plant, a 160 km pipeline and five pump stations, are being provided by Jacobs Engineering, and are to be delivered under an EPC arrangement with an operating services contract. The desalination plant is planned to be operational by October 2016.

Past work has included basic and detailed design for the bidding process for Cadagua on Minera Candelaria's 30,000 m³/d (three units) seawater RO desalination plant.

Ecoagua has been very involved with the

Minera Mantoverde seawater RO desalination plant for Anglo American Chile, Mantoverde division; capacity: 10,368 m³/d (two units); future expansion to 25,920 m³/d (five units). Ecoagua drew up the technical requirements for the bidding process and revision of the commercial requirements for the bidding process, provided technical advice during the Environmental Impact Assessment and during the contract award process. Valoriza Agua and Sacyr Chile Consortium built the desalination plant.

Anglo American notes that "water is fundamental to our business. So it's our responsibility to ensure that, within the regions that we operate, disruption to local water supply is minimal. Our investment of over \$100 million to build the Mantoverde desalination plant demonstrates that.

The plant frees the Mantoverde copper mine from using the freshwater of the river Copiapó, the main water supply for local residents of the Atacama region. Chile's mining minister Aurora Williams was present at the inauguration last November, as were representatives of local authorities and fishery unions. The mine is located in Region III, 56 km from the city of Chañaral and 900 m above sea level.

Giancarlo Bruno, head of operations, Mantoverde and Mantos Blancos, said: "The inauguration of Mantoverde's desalination plant is great news. Not only because it demonstrates our continuous commitment to developing and using technologies that optimise our processes in a social and environmentally-friendly way, but also because it means great gains in the usage of water resources in a hydro-stressed region such as the Atacama."

Seawater is captured in a catchment tower, located 300 m from the shore, where it begins a filtration and purification process that extracts residue and salt. This water can then be used by the Mantoverde operation, which comprises an open pit mine, crushing plants and facilities for processing oxide ores.

During the water treatment, all emissions are highly controlled.

Natural elements, such as salt, that are extracted from the seawater to transform it into fresh, neutral and clean water during the desalination process, are returned and dispersed in the sea.

The desalination plant consumes up to 30% less energy than equivalent plants worldwide, and has been conceived and designed with respect and protection for the environment as a priority. And that was achieved by establishing a permanent dialogue with surrounding communities.

The plant will be operated and maintained by Valoriza personnel for at least two years following its commissioning.

John Norrish, the desalination plant's project manager said: "The success of this project consisted not only in delivering a world class desalination facility. It was also based on our focus on safety, meeting environmental commitments, and building sustainable relationships with the authorities, local communities and fishermen through formal dialogue and open engagement processes."

Daniela Araya, environment advisor for the project agreed that partnership was key to Mantoverde's success. "The relationship with communities was outstanding. To achieve this there has been constant work throughout the time of construction of the plant."

The completion of Mantoverde's desalination plant is part of a company-wide effort to conduct

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responsible water stewardship in all countries of operation. Every operation works towards a water reduction target that was determined in 2011 using Anglo American's water-efficiency target tool (WETT). It forecasts the projected business-as-usual demand of individual operations and also registers water-savings projects.

By the end of 2013, the company had achieved an estimated 22% saving against its projected water usage.

Doosan Heavy Industries & Construction recently awarded a contract to Flowserve to supply pumps and an energy recovery system (ERS) for a SWRO desalination plant near Antofagasta, for Minera Escondida with a capacity of 216,000 m³/d.

Expected to be complete in 2017, the SWRO plant is an expansion of the existing 40,000 m³/d plant at the mine. When complete, it will be the largest desalination plant in the Western Hemisphere.

Doosan has purchased all 48 pumps for the plant from Flowserve, along with 27 dual work exchange energy recovery (DWEER) devices. The Flowserve DWEER offers, says the company, "one of the highest efficiencies of all energy recovery systems on the market today, since it minimises leakage and mixing of the brine."

Bechtel is providing EPCM services for the water supply to the Escondida copper mine. The project includes construction of the seawater desalination plant, to be supplied by Doosan, at the Caleta Coloso port and the piping and electrical infrastructure needed to transport the water to the mine, 185 km away and 3,100 m above sea level.

Bechtel will construct the 220,000 m³/d desalination plant and undertake the engineering and construction of two 1.07 m diameter pipelines that will run between the port and the mine and the related infrastructure, which includes four high-pressure pumping stations, associated electrical substations, and 114 km of high-voltage transmission lines along the pipeline route. It also will provide construction-management services for the marine works associated with the project.

Avoiding contamination

Membrane cleaning is essential for efficient plant operation. Genesys International's Stephen Chesters presented a paper RO membrane cleaning – explaining the science behind art at The International Desalination Association World Congress in Tianjin, China. See http://www.genesysro.com/download_docs/White_Paper_Aug_2014.pdf

"Genairclean™" is a unique method for cleaning spiral wound RO membranes. The method uses microbubbles combined with multiple chemical mechanisms to improve cleaning efficiency removing a wider range of

*Nuria Pena Genesys
Lab Manager
conducting an RO
membrane autopsy*

membrane foulants. The Genesol 700 range of membrane cleaning chemicals incorporate effervescent micro-bubble components with direct osmosis to enhance foulant removal and minimise membrane damage. The Genairclean system introduces air from the atmosphere via the "Genairator" microbubble generator. The pulsing stream of microbubbles when combined with Genesys chemicals creates shear forces and turbulence which disrupt foulants on the membrane surface. The system creates bubbles of the optimum size and volume to cover the entire membrane surface and penetrate the feed spacer. The system reduces cleaning frequency and operating pressures and has a positive effect on membrane life. The system has been extensively tested for membrane compatibility in the Genesys Autopsy Facility.

Leveraging its experience in cartridge filters, which it has supplied for many of the world's largest SWRO projects, Fluytec developed its own line of UF system products several years ago. In addition to the standard systems available with production capacities of up to 720 m³/h, the company has developed a new Continuous Ultrafiltration System (c-UF) technology, which provides continuous permeate production by individually cleaning each UF module, while the rest of the system remains online.

Water resources

FLSmidth has upgraded the latest generation of its Tailings Dewatering Press (TDP) technology

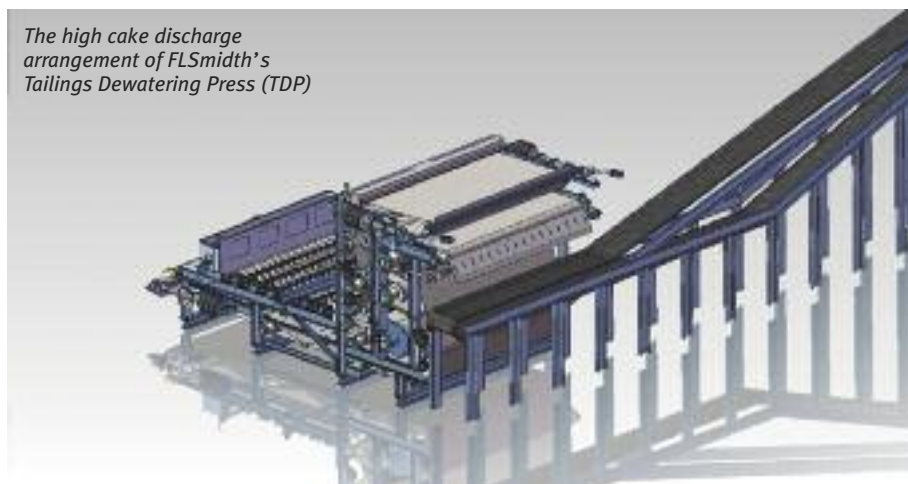


for coal tailings applications, Jeffrey Pilusa, Filtration Technology Specialist, FLSmidth, says. FLSmidth's experience with belt press equipment dates back to 1979 with its EIMCO® branded belt presses, which were instrumental in the original pioneering of this technology. "Combined with its long and successful track record in tailings management over many decades, we have now taken proven TDP technology to the next level," Pilusa says.

The TDP design includes several enhancements which recognise critical design considerations that make a positive difference to the belt press operation, performance and operating expenditure. For example, the design incorporates perforated S-rolls in key areas to double the filtration area and ensure more efficient dewatering of the cake, which means a greater drainage capacity compared to other belt press designs in the industry.

Pilusa says the most significant advantage of the TDP technology is that it offers maximum cake dryness due to the S-roll design. Traditional S-rolls are configured in a horizontal mounting arrangement, which leads to visually discernible water pooling between the S-rolls, resulting in rewetting of the filter cake. In order to avoid this issue, TDP S-rolls are configured in a vertical configuration. This means that the belt travels

The high cake discharge arrangement of FLSmidth's Tailings Dewatering Press (TDP)



upwards, with the filtrate (which is now removed from each S-roll) going into its own drip trays, thereby avoiding pooling and rewetting. “This produces consistently drier cake than horizontal designs,” Pilusa confirms.

Another significant advantage is increased safety and a more user friendly design due to the low location of the gravity drainage zone. “FLSmidth regards health and safety as one of its topmost priorities,” Pilusa says. The TDP design means it is no longer necessary to use a ladder or to build expensive platforms for the purpose of monitoring the gravity drainage zone – where 80% of the dewatering work happens – as was the case with traditional designs.

“This reduces working-at-height hazards by allowing operators to inspect and monitor such critical areas from a standing level,” Pilusa says. Furthermore, as with any belt press, if the solids are not properly gravity drained, the performance of the whole machine is degraded. “If the gravity drainage zone is ‘out of sight and of mind’, how can any operator do their job properly?”

Reducing operating costs is always a priority. “One of the ways of doing just that is to focus on increasing the life of the belts,” Pilusa says. The TDP design includes three unique features. First, a rack-and-pinion belt take-up arrangement ensures that each side of the belt travels the same distance each revolution so as to eliminate belt ‘biasing’ and belt misalignment problems

that lead to premature belt failures.

Second, each TDP frame is a built-in structure to insure that the frame remains true and square. Third, each bearing is located with locating stops to ensure that all rolls are parallel, both when leaving the factory and in the field when rolls are removed and reassembled. These features enhance belt life by eliminating belt ‘biasing’ and belt alignment problems, while reducing maintenance costs.

The TDP technology also features a high cake discharge, which reduces installation costs as the filter is placed on ground level along with the conveyor. Other designs call for special platforms for the filters and conveyors so as to accommodate any discharge below ground level. “The TDP technology obviates this additional capital expenditure, which lowers operating costs, as all areas of the filter and conveyor are easily accessible for any future planned maintenance,” Pilusa says.

Another advantage is that the TDP technology can be factory assembled and delivered to site as a single unit. “The frame provides a rigid structure that will withstand maximum anticipated stresses and provide the best geometry for cloth tracking, which extends cloth life,” Pilusa says. All support bearings are self-aligning and anti-friction, with triple-lip nitrile seals.

With FLSmidth’s ‘One Source’ approach, van

Reenen says it can provide automated solutions ranging from panels for controlling local dewatering equipment to large plant-wide control system solutions. “We deliver state-of-the-art technology solutions for cost effective operation and increased plant availability, accompanied by comprehensive modernisation, optimisation and maintenance services,” he concludes.

Genesis Water, pioneer of the Genesis Rapid Dewatering System™ (RDS), announced in December that the company’s dewatering technology has been granted European Patent No. 1286924. The patent, awarded for the “apparatus and method for high-speed dewatering of slurries,” covers a particular component of the company’s revolutionary RDS, according to Genesis Water’s Chief Technology Officer Michael Hodges. Specifically, Hodges said, the newly granted patent covers the shape of the riser, which moves the slurry to the top of the AquaScreen™ and helps enable even distribution across the screen. This is the first European patent issued for Genesis Water’s technology, and comes on the heels of a US Patent awarded earlier in 2014.

Hodges said. “We believe our technology is the best, most innovative method in the world of evenly distributing flocculated material, and it’s wonderful to have it validated by yet another patent.”

The AquaScreen instantly strips the free water

mwh



Solids can be channeled from the Genesis AquaScreen into a series of TerraCores for secondary or 'capillary' dewatering. In the TerraCores, specially designed porosity and drainage zones rapidly extract remaining moisture, producing stackable, truckable solids in hours. The speed and scalability of the process enables continuous operation, and the TerraCores immediately discharge clear water that meets project standards

phase from ultra-fine material, such as clays, silts, organics, and rock dust. The patented design allows for even distribution of the flocculated slurry, resulting in continuous operation at very high throughputs. Large volumes of clear water pass through the screens for immediate recovery or return to the waterway. Benefits include:

- Clear return water
- Instant separation of high volumes of water
- Continuous operation
- Unlimited scalability
- Small footprint
- No moving parts and low maintenance
- Low power requirement
- Noise abatement and odourless operation
- Isolates many contaminants
- Environmentally sustainable technology.

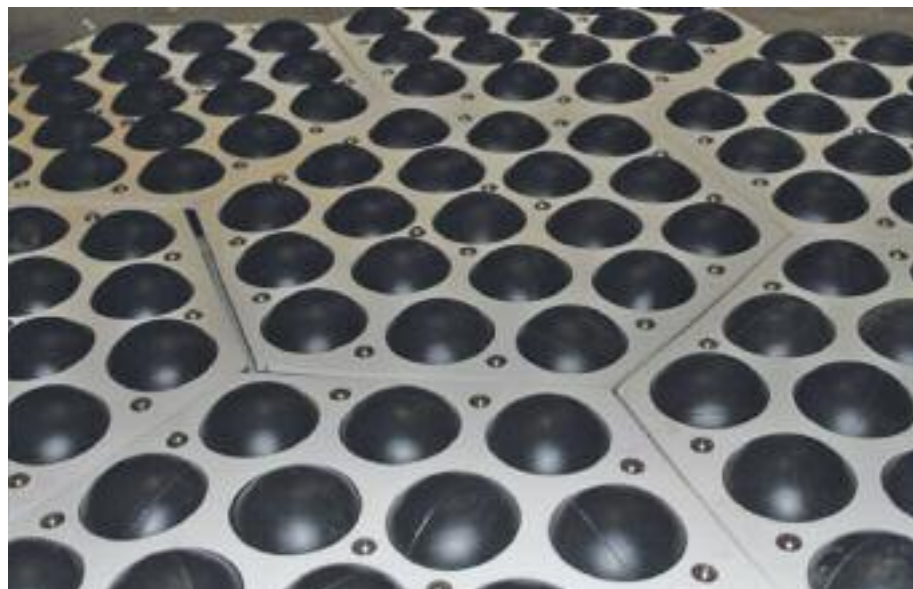
A new technology invented at the University of Arizona offers positive environmental impact by slowing the evaporation of water from bodies of water such as tailings ponds, while simultaneously generating solar energy. Hexocover plastic panels link together to form a cover to prevent evaporation. The panel design addresses the need for mobility through the inclusion of a propulsion system as well as GPS, so the panels can be built to be remotely configurable. Further, when configured with solar

Hexocover consists of floating hexagonal plastic panels that sandwich 645-mm balls linked together, forming a cover to prevent water evaporation

cells, the panels can generate electricity.

The cover minimises water evaporation, the high cost to replace that water and mine energy costs. And, in the end, it minimises the overall environmental impact of such operations. Developed by Moe Momayez in the Department of Mining and Geological Engineering in the UA College of Engineering and Nathan Barba, Managing Partner at RePower Design, Hexocover is the result of their effort to find ways to conserve water in mining tailings ponds.

RePower Design has the sole right to commercialise the technology, which includes both the floating panel design as well as the solar panel integration. According to Barba, Tucson has an evaporation rate of 2,769 mm per year. Water in storage facilities such as tailings ponds and reservoirs always needs replenishment. "We needed a way to prevent the evaporation of water, but we needed a system that could move out of the way when the tailings are being released into the ponds," Barba says.



"If we can cover them, we can help with the devastating water shortage problem here in the southwestern US and around the world."

A system was needed that would allow wind and rain to freely pass through.

For the past seven years, Momayez has been investigating the integration of photovoltaic, or PV, panel deployment with mining land reclamation processes, mining-specific environmental effects on PV output efficiency, and geotechnical considerations related to the installation of panels on tailing slopes.

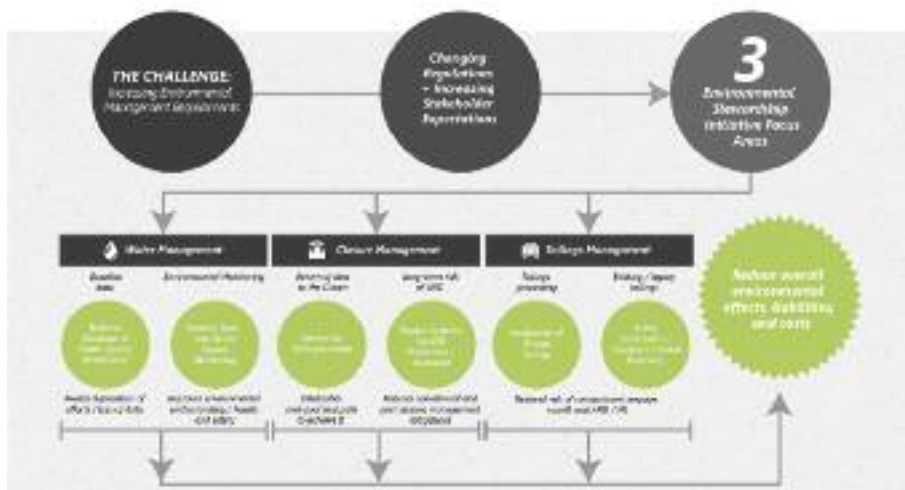
"The PV work on reclaimed mining lands has gained national recognition," Momayez says, "and the idea to control the evaporation of the supernatant water accumulating in the middle of tailing storage facilities was a natural extension of my research and a huge step forward to save water in arid climates worldwide."

"For someone who owns a water reservoir, like a mine, this invention provides a dual benefit and a dual revenue stream," Barba says.

UA Renewable Energy Network Director Ardeth Barnhart said of the project: "Mining activity typically requires a lot of energy, and this technology is a great example of how original ideas that develop the use of solar energy to transform industrial processes can have immediate and transformative effects on water and energy use, create positive environmental impact, and provide direct benefits to our economy."

Water from copper leaching

Dan Dupon and Andrew Watson of MWH global discuss here management of draindown solution from copper mine leach operations. "Water that is affected by mining activities can have diverse characteristics including a great variety of dissolved constituents. Removal of these constituents is achieved through a variety of



Last year the Canada Mining Innovation Council (CMIC) released two project pre-feasibility reports by the Closure Working Group (CWG) and the Water Working Group (WWG) of its Environmental Stewardship Initiative (ESI). The CWG conducted feasibility studies to the end of 2014 on, firstly, standardised closure criteria for mine site relinquishment to the Crown and secondly a national database/repository of water resources information. Another feasibility study is looking at remote, real-time sensors for water quality monitoring. Fourthly, more work is to be done on passive systems for managing acid rock drainage (ARD)

techniques ranging from treatments that are simple and safe enough to use in your home to highly sophisticated, multiple-step approaches.

Although treatment technologies are well developed for most mine water issues, water used in copper leaching remains one of the more challenging.

“Consider the leaching process: a solution of strong acid (pH = 1.5) is trickled through the heap. The acid leaches the copper and other metals from the ore and a portion of the acid reacts with the ore to produce sulphate and other salts. Copper is selectively extracted for sale, leaving the other constituents in solution. More acid is added to restore the leaching ability and the cycle repeated. With each repetition, the solution is enriched, resulting, over the life of the mine, in a solution that has extraordinarily

high concentrations of salts and a substantial mass of dissolved metals and minerals – up to 25% total dissolved solids (TDS) in some cases. When copper recoveries drop off and recirculating the leach solution is no longer profitable, the mine is obliged to address the remaining elements.

When copper heap leach solutions reach high levels of chemical complexity it is often easier and more economical, if conditions permit, to use evaporation as the management technique. This relies on passive solar energy and wind, and particularly in warm, dry climates will significantly reduce the amount of solution to be managed. The drawback is the time required to evaporate and recycle an ever more concentrated solution that becomes heavier and less volatile (so slower to evaporate) as water is removed. When combined with regrading and covering the heap leach pile (to physically stabilise and reduce inputs from precipitation), evaporation can reduce the volume of water to be treated, by concentrating the mass of solids.

Another evaporation challenge is the acidic solid salts that accumulate in the evaporation system. Removal and disposal are a concern because the material is not chemically compatible with standard equipment. Furthermore, the hazardous nature of the material limits the options for long-term disposal and the salts and solids are easily remobilised

genesys



The exotic cocktail of copper leach solutions that typically accumulate includes dissolved anions (sulphate, fluoride, phosphate, silica), metal cations (aluminium, beryllium, chromium, cobalt, copper, iron, manganese, nickel, thallium, titanium, uranium, zinc), and anionic metalloids (arsenate, molybdate, selenate, vanadate). Removal of each of these groups demands a distinct approach. To further complicate matters, some of the more exotic minerals can be toxic at extremely low concentrations, requiring the entire volume of water to be treated at considerable expense in order to meet discharge quality standards

should they come into contact with water. Evaporation also results in lost resources, raising sustainability and conservation concerns. Evaporation as a management technique is already frowned upon in jurisdictions where water is scarce.

Pressure on water supplies will cause a push for reuse. Treating the water to remove the constituents and make clean water available for reuse or discharge is the other management option. Copper leach solutions, usually require a highly complex process involving multiple steps to achieve the desired outcome. The high acidity almost always requires alkaline chemical precipitation, although some membranes are now, to some extent, acid resistant. Removal of a broad spectrum of dissolved constituents can be realised by applying lime as an alkalisng agent. Lime is the preferred reagent because it results in incremental removal of sulphate, which is typically present at extreme levels. The downside of this type of treatment process is the substantial amount of lime needed and the large mass of mineral solids that are generated as sludge.

While effluent from alkaline chemical treatment usually meets applicable water quality standards for most constituents, it is too common that a few elements require additional advanced treatment if all discharge criteria are to be met. Effluent standards for sulphate and TDS, for example, are becoming more stringent. In this situation, treatment technologies that apply to

seawater come into play because of their capacity to remove almost all contaminants from water with elevated concentrations of highly soluble salts. Examples are RO, ion exchange, and thermal technologies. To successfully implement an advanced technology, multiple pretreatment steps may be needed. The authors are aware of one treatment system that required eight (!) separate pretreatment steps to support application of the advanced technology.

The advantage of these advanced technologies is the consistent production of effluent suitable for reuse or discharge. On the other hand, high cost, intensive energy demand and large volumes of solid or concentrated liquid waste are negative attributes. Miners are often reluctant to employ advanced technologies because of the cost and complexity. In such cases the copper heap leach solution often ends up in a seemingly perpetual recirculation cycle that continues to mobilise contaminants and prevents closure of the facility: this is a tedious and costly approach that may be considered unacceptable in the near future.

Dupon and Watson conclude that “copper heap leach solution poses significant challenges for environmental management and mine closure. Current approaches, while technically feasible, come at significant cost and are not sustainable. New, more efficient approaches are needed, with an eye to rendering the removed constituents an insoluble solid and returning almost all the water, clean, to the environment. The best remedies will be found through taking a fresh look at what is in solution and extracting some residual value to contribute toward the cost of treatment.”

Water treatment

AngloGold Ashanti, one of the world's largest gold miners, has chosen Veolia to optimise, operate and maintain the water treatment plant of its Iduapriem open pit gold mine in the Tarkwa-Nsuaem Municipality of the Western-Region of Ghana.

Veolia, through its subsidiary Veolia Ghana Ltd, will operate and maintain, over the next two years, the existing water treatment facility at Iduapriem. Veolia will provide the best management and operational expertise to ensure proper water treatment and discharge.

“Veolia's global presence in mining and strong commitment with both the mining industry and Africa has given AngloGold Ashanti the confidence to outsource its water management to Veolia”, explains Patrice Fonlladosa, Executive Vice President Africa and Middle East for Veolia.

BioteQ is an innovative clean technology leader in global mine water treatment. Last June, it commenced operations at the Raglan mine site in Quebec, Canada using its proprietary nickel sulphide precipitation process. During Q3 it treated and discharged 743,000 m³ of water. BioteQ staff is also operating a lime treatment plant for water that is not treated by BioteQ's ChemSulphide® plant.

In China, BioteQ has a water treatment operation at the Dexing mine site, a joint venture with mine owner Jiangxi Copper Co (JCC). In Q3 2014, it treated 2.6 million m³ of water and recovered a total of 824,000 lb of copper compared to 2.4 million m³ of water treated and 478,000 lb of copper recovered, the previous quarter. The increase in copper recovery was largely due to significantly higher concentrations of copper available in the feed water compared to the prior year.

In 2014 BioteQ completed construction and commissioning of two new copper recovery plants in its Chinese joint venture. The plant at JCC's Yinshan mine site began operations in early June. During Q3, the plant processed 640,000 m³ of wastewater and recovered 138,000 lb of copper. The plant was expected to recover about 280,000 lb of copper for the year.

A second copper recovery plant at JCC's Dexing mine site was commissioned and began operations during Q3. During the quarter, the plant processed 447,000 m³ of wastewater and recovered 40,000 lb of copper. The plant was expected to recover approximately 240,000 lb of copper for the year.

In Q2 2014, BioteQ secured a contract with a Canadian company to conduct pilot scale testing of its newly patented Selen-IX™ technology for selenium removal. Under the terms of the agreement, BioteQ has deployed its mobile pilot plant. The pilot testing will demonstrate the capacity of the process to meet stringent discharge limits for selenium and provide engineering design data required for evaluating the overall capital and operating costs of a full scale plant that would treat up to 43,000 m³/d of wastewater.

To serve Africa's mining industry, Multotec has launched a water treatment and metals recovery

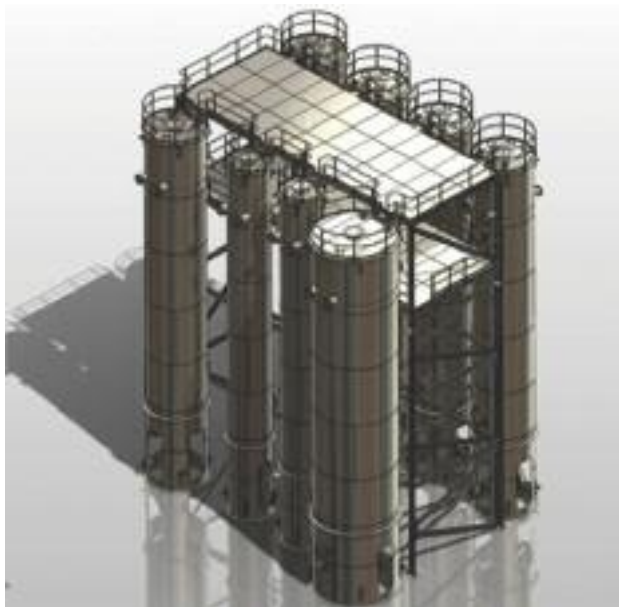
solutions and services division in partnership with Australian company, Clean TeQ. South Africa is another country of the world challenged to maintain sustainable water supplies. The difficulty is not necessarily the available storage space, but the contamination of the limited available water resources through mining pollution and acid mine drainage (AMD), along with other industrial operations.

CJ Liebenberg, Environmental Process Engineer at Multotec, says that the introduction of CIF® locally will have major benefits for the mining industry as a whole. "Our aim with CIF is to assist in the alleviation of water shortage issues and to encourage sustainable development in South Africa. Mining is often regarded as being a non-sustainable enterprise and we intend to be part of the solution," Liebenberg said.

CIF is based on the foundation of IX (ion exchange) technology, and has been likened to continuous sand filtration. The core differences being that in CIF charged resins are used as filtration media instead of sand, and in addition to removing suspended solids, CIF also 'filters' dissolved salts out of the solution.

Clean TeQ has developed three main processes based on CIF. These are single stage CIF for resource recovery and de-alkalisation applications, dual stage CIF (DeSALx) for desalination of water and high recovery reverse osmosis (HiROx), desalination using CIF on the front end of RO to remove scaling, improving the overall performance of RO, and re-using RO brine for resin regeneration for a chemical-free membrane system. All three systems can be adapted to produce a zero liquid discharge (ZLD) process.

The main features of CIF include a resin cleaning step to allow the system to operate in the presence of suspended solids, counter-current flow of aqueous and resin phases for high efficiency ion exchange and that there are minimal moving parts and no complicated



Clean TeQ is working with Carbine Resources on the use of the Clean-iX technology to recover copper resources at the historic Mount Morgan gold and copper mine in Queensland. It is planning to integrate the Clean-iX process into the flowsheet to reprocess gold, copper and pyrite tailings

internal structures. The plants can be containerised and be fully automated with remote access.

Water recoveries of around 95% have been made using this system, allowing the creation of either agricultural grade or ultra-pure water with TDS concentration reaching 50 mg/litre. The plant has minimal pre-treatment requirements and uses inexpensive chemicals for regeneration, as well as having low power requirements, all of which keep capital and operating costs competitive.

The mobility and automated nature of the CIF allows for water treatment in remote locations as well as enabling the system to be operated independently and to be controlled remotely.

Because CIF is based on IX technology; it is able to treat water originating from numerous sources and can remove a wide range of contaminants at various concentrations. The

technology has successfully been used in the treatment of coal seam gas associated water in Australia, and has the potential to be used in AMD and other mine water management processes.

Clean Teq's Clean-iX® Continuous Resin-In-Column (cLX) is a continuous counter-current process that extracts metals from clarified leach solutions. The cLX system uses moving packed bed resin columns, where the solution and resin are contacted in counter-current flows. The company says the system "is the most efficient method of direct adsorption available and is suitable for large and small flow rates. [The] systems have the following benefits:

- Optimised resin inventories, up to 25% less than fixed bed systems
- Simple to operate and maintain
- High turn-up and turn-down ratios to allow for fluctuations in feed grade
- Operates on solutions with up to 100 ppm TSS, minimising pre-filtration requirements."

Last year, Anglo American chose GE's Advanced Biological Metals removal process (ABMet) technology to remove nitrate and selenium from wastewater discharge at its Peace River coal mine in Tumbler Ridge, British Columbia. The project is the first installation of ABMet in Canada and will meet British Columbia's stringent standards for selenium and nutrient discharge limits.

The coal mine has been operating since 2006, and new regulations prompted Anglo American to build a new wastewater treatment plant to remove nitrate and selenium in the wastewater. The new facility is turnkey, providing a flexible solution for heavy metal removal.

ABMet is a patented biological water treatment system that uses naturally occurring microbes to reduce the amounts of selenium and other metals that can escape in discharge waters from coal mines and power plants. The process involves running wastewater through a

infomine

biologically active filter, which is 'seeded' with naturally occurring microbes that target selenium and other potentially toxic metals. While selenium is typically difficult to remove from wastewater, ABMet enables the metal to be captured and removed from the wastewater stream.

"Before selecting GE's ABMet technology for our new wastewater treatment plant, we commissioned a pilot study and competitive tender with multiple vendors. Ultimately, GE presented a turnkey water treatment solution allowing us to achieve compliance with nitrate and selenium discharge limits," said Brendan Crisp, Specialist Project Engineer at Peace River operations. "It also will be used as a demonstration plant to assess performance and develop the criteria for additional wastewater treatment plants at our operations."

The wastewater treatment plant has been designed to treat 24 litres/s of flow and to meet nitrate and selenium effluent targets. The targets reduce nitrates from 85 to 3 mg/litre and selenium from 130 to 5 µg/litre. The system is designed to achieve these limits at water temperatures of 4.4°C and warmer without the need for any post treatment.

GE worked in cooperation with Lockerbie Stanley (AECON) and Stantec for construction and engineering on the project. The plant entered commercial operation in the summer of 2014.

ABMet is a simple, reliable and low-energy system can achieve up to 99% removal of selenium and can discharge treated effluent containing 5 ppb or less of selenium, depending on wastewater makeup.

Saving water

A leading Australian dust management company Reynolds Soil Technologies (RST) has launching a revolutionary new dust solution, Zero, which requires no water and does not evaporate or freeze. The latest addition to RST's high-tech, problem-solving range of products, the Zero solution is the ultimate in spray-on long-term dust control where watering programs are not an option.

Zero requires no water for application, has a cumulative effect with maintenance applications, requires no ongoing watering program, and cures immediately – all while having no odour, no slipperiness and no effect to application equipment or the environment. RST Operations and Technical Director David Handel explained: "The Zero product's crystal clear, free flowing, odourless chemistry has been formulated to meet the highest standards of environmental regulations globally. It has penetrating and



Four of DeZURIK's knife gate valve product lines have earned Safety Integrity Level (SIL) Certification per the requirements of the IEC 61508:2010 standard. The IEC 61508 international standard on Functional Safety assures that safety-related systems provide the necessary risk reduction required to achieve safety for the equipment. The KGC Knife Gate Valves, KSV Severe Service Knife Gate Valves and KUL Urethane Knife Gate Valves have been certified as SIL 3 capable; KSV Double Block & Bleed Valves have been certified as SIL 2 capable. The SIL certification means that these valves styles are suitable for use in critical applications up to the SIL rating. The SIL rating reflects the level of risk reduction the device can provide when used as part of a safety instrumented system

aggregating properties that allow the solution to permeate into the individual fine particles, weighing them down so they are unable to be blown away as dust. The product's unique formula creates a long term, re-workable solution."

The longevity of the Zero solution can reach 18 months when heavier dosage rates are applied, RST reports. Maintenance reapplications only require 30% of the original application dosage rate.

Water delivery

Polypipe provides plastic pipe systems for a variety of gravity and pressurised applications, which provide solutions to a number of mining processes, including transport infrastructure, water delivery and distribution, de-watering and storage, processing, water treatment, as well as welfare infrastructure.

To meet the needs of any mining project, Polypipe is able to engage at an early stage to deliver technical support throughout the project, from concept development to installation, and customise its plastic pipe systems accordingly. Polypipe says it "is therefore able to meet the most challenging supply demands and minimise downtime, ensuring quality systems are delivered on time to customer specifications. Polypipe offers the widest plastic piping product range available."

The company explains the benefits of plastic

piping. Plastic products are light in weight which makes them easier to handle and work with, and faster to install. This reduces handling and transportation costs and has a big impact on health and safety whilst also reducing the use of heavy plant on site.

Plastic pipes and fittings are tough, durable and resistant to corrosion, providing reliable performance with long life expectancy. Below ground products can withstand ground settlement, and can be manufactured to different stiffness classifications.

Steel pipe producer Alvenius uses a similar approach, however, it offers a steel pipe system produced from high grade Swedish steel – resulting in a thin walled, lightweight system. The system is quick and easy to install with grooved or shouldered couplings.

One of Alvenius key mining market offerings is its plastic coated pipes. The TP-pipes combine the strength of steel with the resistance of plastic. The inside of the pipe is very smooth, resulting in low friction and less risk for build-up in the system. This system has been used in mining for transportation of a wide selection of corrosive and abrasive media such as water with salt, low pH, paste and chemicals.

In late 2013, Glencore's Nickel Rim South mine faced a challenge in pumping reclaim water from nearby Moose Pond to its distant smelter. The previously installed pumps were experiencing high maintenance costs and poor reliability brought on by vibrations in the setup. Lack of local support also made it problematic to source spare parts leading to extended downtime for the pumps. The mines operations staff approached Xylem's local Sudbury branch for a solution. The challenge involved not only developing a solution capable of pumping the reclaim water over 13.7 km away to the main nickel smelter but also overcoming over 2.8 bar of static head. In addition the proposed solution would need to be robust enough to stand up to the wear and tear of 24/7 operation of the pumping system.

After a thorough examination of what was causing the vibration problems and pump maintenance issues, the proposed Xylem solution consisted of a Goulds Water Technology vertical turbine pump (Model VIT-FFFM SIZE 12CHC: four stages with discharge, column and bowl in 316 SS) driven by a 75 kW premium efficiency motor. Vibration issues were addressed by modifications to the installation, including changes to the concrete base and sole plate. With the modification in place, the vertical turbine pump was placed into the well and secured. A trial period was agreed upon to test

the ability of the turbine pumps to stand up to the challenging conditions.

The VIT vertical turbine pump was installed as a trial and ran over a two-month period. The pump ran 24/7 to provide process water to the nickel smelter, achieving the desired flow with no service issued or call outs. The peace of mind achieved with the installed Xylem pump led to the mine adding another two pumps to provide additional flow and backup. The final system consisted of two pumps in service with one pump on standby. The Mine Superintendent Rodney Withers commented that “the pumps were virtually worry free and purring along smoothly”.

Tsurumi has recently launched 13 new pumps of which the new KTD series slurry pumps features two models – the KTD22.0 and the KTD33.0 – to complement Tsurumi’s existing KTZ range of submersible drainage pumps. The new KTZE series heavy duty dewatering pumps are equipped with an electrode control system that regulates pump operation. When the water level rises and reaches the electrode, the pump is activated; stopping one minute after the water once again drops below the level of the electrode.

The new LH4110W is an addition to the LH-W series slim design high-head pumps, offering a large delivery head of up to 216 m. Tsurumi has also added new models to the large pumping capacity GSZ series, equipped with a 75 kW motor and capable of transporting 17,500

litres/min. The company is also expanding the GPN series sand drainage pumps, adding the GPN 415 and GPN622 to its product offering.

At the Berlin water trade fair this March this year, pumps and valves manufacturer KSB’s central topic was improvement of energy efficiency of pump systems. With its FluidFuture campaign KSB will show the savings potential hidden in hydraulic systems.

The trade fair saw KSB debut its permanent magnet synchronous drive for 6-inch submersible borehole pumps. Unlike asynchronous motors, this motor type does not require any current in the rotor to generate torque as the rotor field is created by magnets. This eliminates heat energy losses in the rotor and makes the drive achieve much higher levels of efficiency than traditional asynchronous motors. Thanks to its high output per size, the drive features a very compact design. A frequency inverter is required for its operation.

To represent KSB’s range of submersible borehole pumps, UPA-150-C with its high-efficiency UMA-S150E synchronous motor was on display at the fair. It is designed for use in such as water supply, drawdown of groundwater levels and pressure boosting. The hydraulically favourable design enables the pump set to achieve high efficiencies, resulting in low operating costs over its entire service life. The maximum discharge head is 570 m and the maximum flow rate 79,000 litres/h. Fluid temperatures up to 50°C can be

handled depending on the motor selected. The standard pump set is entirely made of high-grade stainless steel. It is also available in higher grade CrNiMo steel for handling aggressive fluids.

KSB also showcased the series-produced synchronous reluctance motor SuPremE in its latest design. In contrast to asynchronous motors, this motor’s efficiency is still impressive even if it is not operated at full load. And this is exactly what is often found in an industrial setting since many drives are generally run at reduced speed. The motor was on display in combination with a dry-installed Sewatec wastewater pump and the PumpDrive variable speed system.

Variable speed systems make it possible to reduce energy costs by matching pump output to actual demand. All PumpDrive sizes have a harmonised design for motors with ratings up to 55 kW. They are available as motor-mounted, wall-mounted or control cabinet-mounted variants and are the only variable speed systems that can control asynchronous motors as well as synchronous reluctance motors. For higher ratings up to 1.4 MW, frequency inverters in book format with IP 20 enclosure are available for installation in a control cabinet.

One of this year’s highlights was a new variant of the high-efficiency AmaDS³ wastewater pump station. The station is a combination of a patented, dry-installed solids separation system and two wastewater pumps in back pull-out

global tailings

design. Having achieved substantial success on the market with this extremely energy-saving wastewater transport method in recent years, KSB has decided to further expand the type series. A unit designed for installation in confined spaces was showcased.

Pump testing

Integrated Pump Technology of South Africa has commissioned its new 90 kW test tank facility at its premises in Johannesburg, which includes a warehouse, rental division and full service and repair capability. "More and more customers are demanding test curves for their repaired pumps, which is critical for reliability. The issue is that while a pump can be repaired, you can only determine if it is operating at optimum efficiency by testing it," Lester Fine, Managing Director, says.

The company is the exclusive distributor in Southern Africa for Grindex, which Integrated Pump Technology says is "the world's third largest submersible pump manufacturer. The main innovation of the Grindex dewatering product family is the capability of the sub-18 kW range to run dry. This is due to a unique air valve integrated into the pump which allows the impeller to pass air instead of water past the motor in a dry run condition. A patented smart motor protector ensures thermal overload, phase loss and phase rotation protection.

"The Grindex sludge range has all the advantages of the dewatering range, coupled with a recessed vortex impeller and split hydraulics with replaceable rubber linings. This makes the sludge units capable of greater solids handling, with increased abrasion resistance. Lightweight aluminium construction means that these highly portable and robust pumps are ideal for underground face dewatering."

Grindex dewatering and sludge pumps are also available in 316 stainless steel, with a capacity of handling pH values between 2 and 13, which means they are ideal for process applications. Grindex also manufactures a range of pedigree slurry pumps. Boasting a total hard chrome construction, these units are designed to move medium to heavy slurries with high abrasive content without sacrificing efficiency, abrasion resistance or production downtime.

"Rental pumps are tested as soon as they are returned, and if they do not pump at about 90% of their performance, they are stripped, serviced and repaired," Fine explains. The new test facility is therefore essential to this rental offering, which is a growing trend in the market. In terms of general pump repairs, Fine says that the main benefit for the customer is receiving a pump back that is guaranteed to meet the original specifications. "All our repaired pumps are issued with a warranty certifying that they have been repaired to original standards," Fine says.



Discussing his technicians, he adds that "a particular skill set is required for pump repairs, which are not only about the hydraulics, but increasingly involve electrics as well, especially with submersible pumps." Fine says that while pump technology is advancing steadily in the pursuit of improved efficiencies, Grindex pumps are characterised by their ruggedness, 'plug-and-play' ease of operation and low maintenance requirements.

Integrated Pump Technology has just launched a campaign in order to gain a detailed understanding of the dewatering requirements of the South African mining industry. "Together with our new test facility, this will really give us an edge in the market," Fine concludes.

Weir Minerals offers two new configurations for its GEMEX belt-tensioning system, integrating the system with two more of its most popular pump ranges. The GEMEX tensioner has been incorporated into updated versions of the company's latest and most advanced heavy-duty slurry pump, the WARMAN WBH centrifugal slurry pump and the medium-duty WARMAN MU pump.

These are the first combined pump-and-tensioner packages to be added by Weir Minerals since the integrated package was designed for the company's best-selling pump, the WARMAN AH pump, in 2013.

By integrating a hydraulically-adjustable and mechanically-lockable motor platform onto the pumps' bearing assemblies, the system removes the need to realign the motor each time the drive belt needs to be replaced, reducing the downtime required from hours to minutes.

Tony Locke, Managing Director of Weir Minerals Europe, said: "All too often we see the performance of our pumps compromised by poorly-adjusted belt-drive systems. When properly tensioned and aligned, a belt system is one of the best ways to drive a pump. However,

Integrated Pump Technology's new 90 kW test tank facility. The 18,000 litre test tank measures 3.6 m by 2.4 m and is fully automated, with different programs for specific Grindex pumps, which are tested according to the OEM's pump curve

the need to replace the belt periodically is a major drawback, requiring downtime and increasing the possibility of incorrect tensioning or alignment, leading to poor performance.

"The GEMEX belt-tensioning system solves this problem associated with belt-driven systems by making belt replacement quick and easy and ensuring perfect tensioning and alignment every time. This means pumps run more efficiently, last longer and require less maintenance. While the system can be used with almost any belt-drive pump, the integrated packages we now offer for our most popular pumps provide a solution that works straight out of the box with no additional set-up work required."

Slurry pump repair

In Australia, a nickel and cobalt market leader in the mining industry needed a reliable restoration and efficiency enhancement solution for its refinery's centrifugal vertical slurry pumps. One of the most critical pumps there is the 12" Hazelton VDS slurry pump used to extract ore from the primary tailing sump and distribute it to the process units for refining. The slurry mixture contains approximately 60% solids by volume and has a temperature of 70-80°C. Since the pump runs 24 hours a day and due to extreme wear, a second pump is required as a standby unit. In order to guarantee operational security, a third pump is used as a spare rotatable unit. After 2,500 hours, the unit that has been running will be replaced by the second unit. This second standby unit will then be replaced by the third spare pump and the removed pump will be stripped and inspected.

On the basis of these criteria, a set of four erosion-corrosion resistant composite repair materials and protective coatings, Belzona 1812 (Ceramic Carbide FP), Belzona 1321 (Ceramic S-Metal), Belzona 1311 (Ceramic R-Metal) and Belzona 1391 (Ceramic HT), has been proven to fulfil the imperative abrasion and temperature resistance requirements.

Since the pumps are constructed of Ni-Hard, abrasive blasting of the substrate is conducted to Swedish Standard SA 2½ with aluminium oxide, a very hard and sharp ceramic aggregate, in order to achieve the required surface profile and avoid contamination of the substrate.

Customised templates are affixed to the impeller ring and discharge port openings of the casing to serve as a mould in order to restore the internal diameter and also to ensure correct alignment by enabling the applicator achieve an even coating thickness throughout the surface of the repair area. Once all arrangements are completed and prior to the application of the Belzona materials, the repair areas are thoroughly cleaned.

The extremely worn cutwaters that are commonly reduced by approximately 100 mm are repaired with Belzona 1311, a paste grade ceramic filled epoxy-based repair composite for rebuilding and re-profiling of damaged areas. Once cured, the cutwaters are shaped to the required dimensions using an angle grinder.

Belzona 1321, a ceramic-filled epoxy coating designed to protect against moderate abrasion, is applied to the entire casing internals as a priming coat to assist adhesion to the Ni-Hard substrate. Belzona 1321 exhibits excellent bonding to the cast iron surface and cures with no signs of shrinkage since the system is 100% solid.

Belzona 1812, an epoxy-based composite material that has been formulated with highly hard ceramic aggregates closely packed in a polymeric binder, is then applied at a thickness of about 6 mm using the templates previously installed.

A final layer of Belzona 1391, ideal for equipment that operates at high temperatures under immersion, will be also applied throughout the entire pump internals to provide additional heat resistance. Once the final coat is cured, the templates are removed using jacking bolts, and all extruded material is ground off. The pump externals are then coated with Belzona 5891 (HT



External surface protected against high temperature with Belzona

Immersion Grade) to protect the entire unit from the high temperature process fluids in the primary tailing sump.

“From start to finish, the application lasts less than a week and with simplified application techniques, the client can avoid replacement costs in excess of approximately \$15,000,” Belzona reports. “The repair solution, proven to be more durable than the Ni-hard substrate, cost approximately half of this amount and prevents downtime at approximately \$77,000/h. **IM**

EURO MINE EXPO