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Orion trials electrolysis water treatment at Prieska to produce valuable agri-nutrients for local communities

Outstanding new ESG initiative sees the application of a proprietary technology to harvest valuable minerals from mine water to deliver treated water to host communities for agricultural use

- ▶ **Innovative Electrosoftner/Rotowinner™ electrochemical water treatment and mineral extraction field trials commence at the Prieska Copper-Zinc Mine (PCZM) in South Africa's Northern Cape Province.**
- ▶ **The trials are a collaborative research and development initiative between Free Radicals Process Design and Orion Minerals Limited.**
- ▶ **The trials will confirm the capacity for the upcoming PCZM mine dewatering campaign to recover valuable 'green' agricultural nutrients and other products for use in chemical and other industries and discharge agricultural quality water.**
- ▶ **The Rotowinner™ water treatment technology will yield valuable mineral products such as sodium hydroxide and iron oxide, both of which are used in the chemical industry, as well as minerals such as calcium and magnesium as agricultural nutrients.**
- ▶ **Field trials of the Rotowinner™ technology, using their mobile pilot plant, will test the capacity to substitute and replace the higher cost reverse osmosis for water purification.**

Orion's Managing Director and CEO, Errol Smart, commented:

"As we prepare to start dewatering the underground mine at the Prieska Mine, we continually review engineering and technology solutions to find ways of reducing costs and maximising ESG outcomes at our operations. Any technology or new process that offers benefits to our key stakeholders and local host communities while supporting shareholder returns will always be prioritised in our operating plans.

"We are particularly pleased to have the opportunity to collaborate with South African technology developers, Free Radical Process Design, who have worked with The University of Pretoria to develop an innovative technology that could have a global impact in the treatment of contaminated mine water and which is directly applicable to our Prieska Mine dewatering challenge.

"We look forward to trialing the Rotowinner™ Technology to treat our Prieska Mine water while simultaneously recovering 'clean & green' agricultural nutrients and delivering treated water which would be available for community agriculture purposes.

"In addition to agricultural nutrients, other products can potentially be extracted using the Rotowinner™ Technology which are used in the chemical industry, opening up interesting future by-product sales opportunities."

Overview

Orion Minerals Limited (**ASX/JSE: ORN**) (**Orion** or the **Company**) is pleased to advise that it has commenced a series of field trials for the treatment of mine water at the Prieska Copper-Zinc Mine (**PCZM**) in South Africa's Northern Cape Province, using a proprietary electrolytic technology to produce saleable products.

The process has the potential to extract valuable products such as calcium and magnesium, for agri-nutrient use

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from water pumped out of the underground mine at Prieska. In addition, other products with potential for by-product sales in the chemicals industry will also be extracted by the process.

The trials have commenced as Orion prepares to commence dewatering of the underground mine and to implement other key elements of its Early Production Plan as it advances the PCZM towards production.

The water treatment trials are being undertaken in collaboration with Free Radical Process Design (**FRPD**), a South Africa-based technology company which has developed an innovative and proprietary process and equipment for the continuous extraction of metals and other valuable minerals from water using electrowinning via a rotating cathode (**Electrosoftner**).

The Electrosoftner has the potential to extract iron hydroxide, hydrogen, calcium, magnesium and base metals such as nickel, zinc and copper from contaminated mine waters. The ability to harvest the agri-nutrients at the Prieska Copper-Zinc Project (**Prieska Project**) – which is located in a region where renewable energy is abundant and where irrigation agriculture is a core industry – has the potential to offer important host-community development opportunities.

This will advance Orion's vision of establishing a 'green' footprint for the Prieska Project with broad stakeholder benefits as part of its objective to have a world-class ESG framework to support its operations.

The commencement of the field trials follows the success of laboratory scale test work, where water samples from PCZM were analysed and were passed through an Electrosoftner demonstration unit, producing precipitates of iron hydroxide, calcium hydroxide/carbonate and magnesium hydroxide while concentrating sodium hydroxide that can be bled off as a liquid from PCZM mine water.

Background

The extensive underground workings at Prieska hold approximately 9 million cubic metres of water, which has accumulated since the mine was closed by Anglovaal in 1991. While the quality of the mine water is relatively benign, with pHs ranging between 6.6 to 7.1 (neutral pH is 7.4), and total dissolved solids measured in the shaft water range between 6,000 and 11,000 mg/l, some water treatment is required if the water is to be considered for off-site discharge and subsequent agricultural or potable applications.

The dewatering setup which is being implemented, consists of pump sets and reticulation that will extract mine water from underground workings at a pumping rate that will build up from 120m³/hr to 500m³/hr. Once on the surface, some of the water will be treated by reverse osmosis (RO) while the balance will be treated by electrolysis. Some brine water will be retained in evaporation dams. The treated waters will be used for irrigation projects, planned to benefit local host communities.

Dewatering is planned to occur over a three-and-a-half-year period, during which time, mining is planned to commence in those parts of the Prieska deposit above the water level so that copper and zinc concentrate production can commence within less than three years, as scheduled in the original project development plan (BFS-20 Plan).

Rotowinner Metal Extraction Process

FRPD has patented technology for the continuous electrowinning of selected minerals from mineralised leachate using a rotating cathode (**Rotowinner™**). The Rotowinner™ consists of a rotating cathode, submerged in pregnant leachate with a scraper arrangement to remove the precipitation of minerals on the cathode. The scraped material is discharged into a collection launder and the spent leachate is collected to be recycled in the leach circuit (Figure 1). A mobile demonstration scale plant has been constructed that has been successfully used to produce base metals on a continuous basis.

The Rotowinner™ process offers the advantage over conventional electrowinning set-ups of:

- Being a continuous production process;
- Having a lower energy requirement than standard electrowinning;
- With built-in cathode stripping offering a simpler, safer and more cost-effective operation;
- Having no lifting equipment requirements during operation;
- Having smaller inter-electrode distances;

- Completely enclosed construction;
- Reduced acid mist generation;
- Modular set-up for versatility and easy scale-up or down;
- Robust design;
- Wider and more efficient operating ranges; and
- Significantly reduced capital cost for establishment.

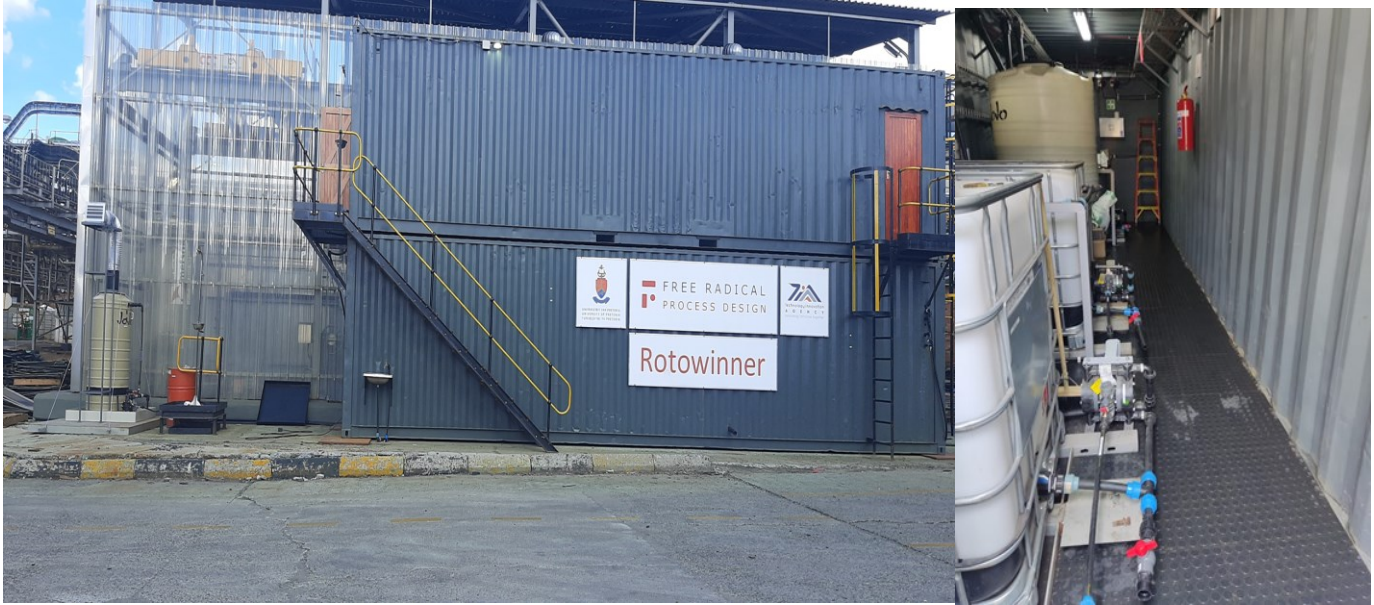


Figure 1: The Rotowinner™ modular pilot plant that is now commissioned at the Prieska Copper Zinc Mine for water treatment and minerals recovery trials.

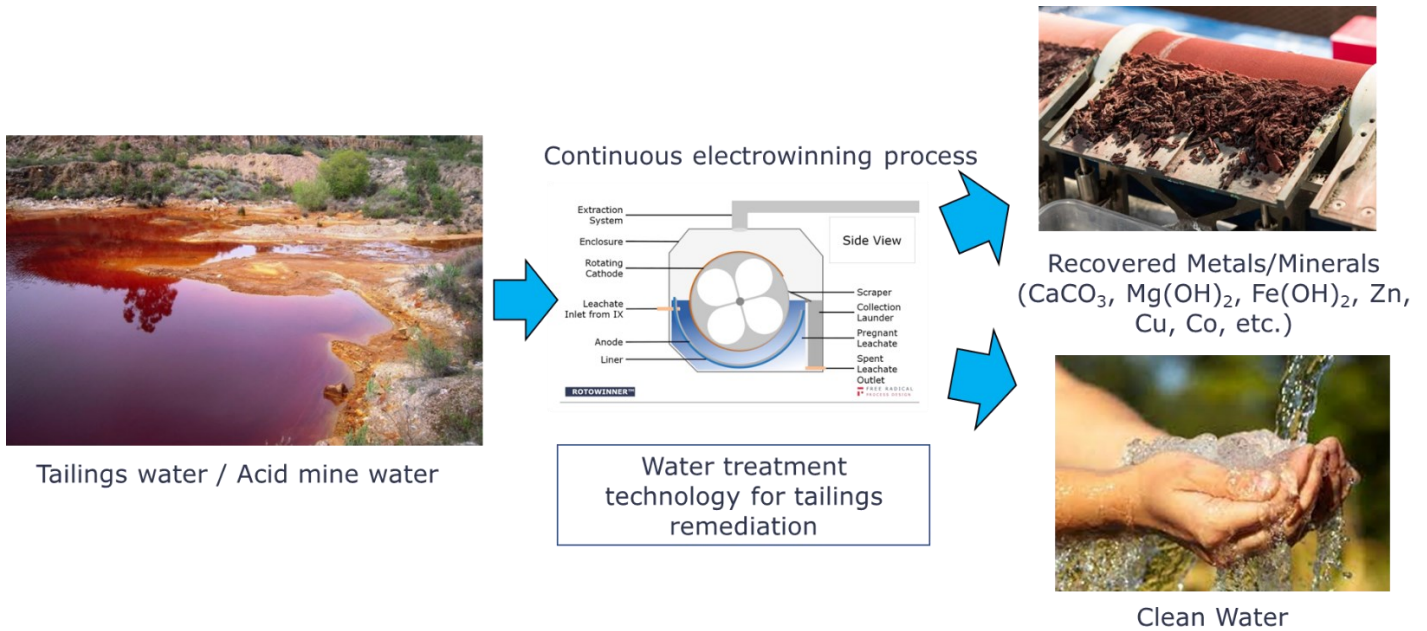


Figure 2: Tailings remediation application of the Rotowinner™ process.

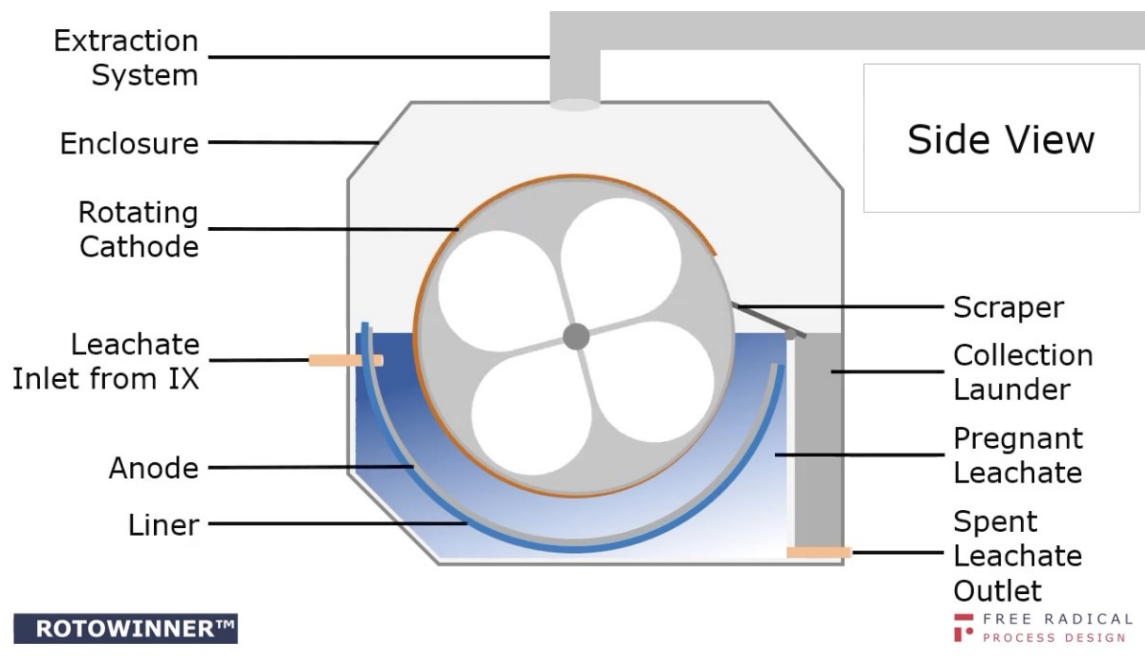


Figure 3: Cross-section through the Rotowinner™ illustrating how the continuous rotating cathode harvests minerals from pregnant leachate.

Application of the Rotowinner Water Treatment Process at Prieska

Following from laboratory-scale test work and water quality assessments of the Prieska Mine water, it is anticipated that the Rotowinner™ will be able to produce agricultural use water while extracting calcium, magnesium and iron as products, as well as generating hydrogen, oxygen and chlorine gases and with a sodium hydroxide solution residue (Figure 4). This would result in the whole water treatment stream having a valuable use.

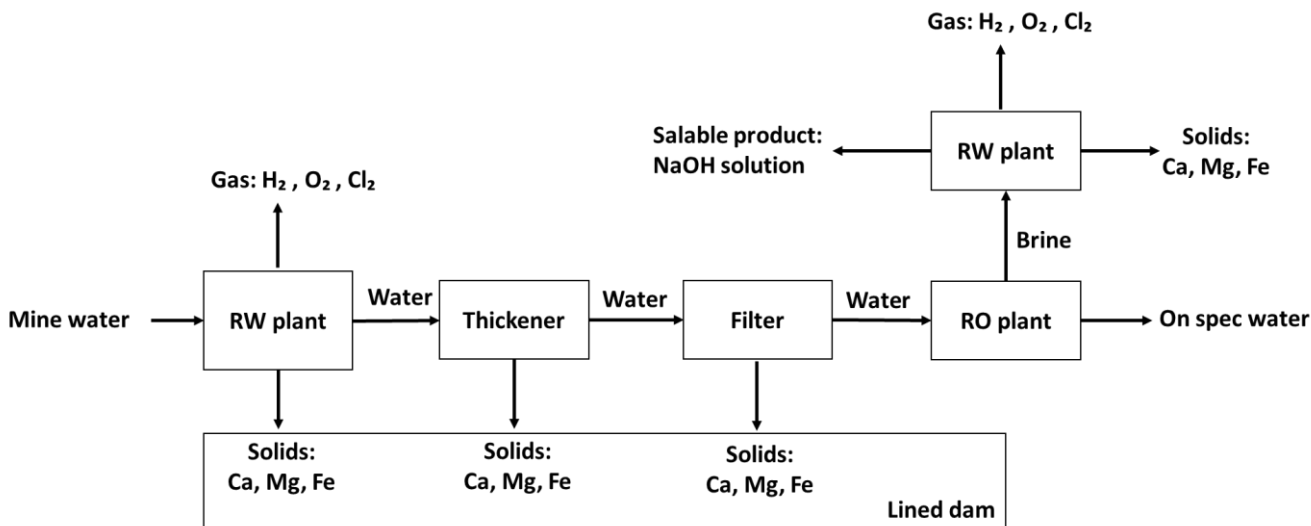


Figure 4: Water treatment and minerals recovery flowsheet for the Prieska dewatering program.

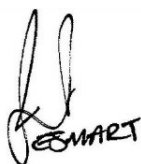
Field trials are expected to continue for six months. Subject to the success of these trials, implementation of a production-scale Rotowinner™ assembly will be undertaken.

The current dewatering infrastructure layout has made provision for incorporating the Rotowinner™ water treatment at the end of the trial period.

About Free Radical Process Design (FRPD)

Free Radical Process Design (FRPD) is a chemical process engineering consultancy company that provides process engineering services, specialising in process technology development and application of advanced technologies. FRPD has developed pilot plants for hydrometallurgy, rare earth manufacturing, fluorination chemistry, gas-gas engineering, gas-solid engineering and battery-grade materials. FRPD are specialist process engineering research and development professionals, focused on innovation in the application of advanced technologies in metal refining, electrolysis and scale up of technologies to commercial applications. FRPD was founded by Dr. Ryno Pretorius, who is a specialist in challenging, and high-risk process engineering.

For and on behalf of the Board.



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