U-pgrading uranium

Perth-based Marenica Energy has embarked on a strategy to commercialise its innovative beneficiation process, writes Roger Murray

Excavation of a test pit at the Marenica project

The key driver for developing the U-pgrade process evolved primarily from extensive test work undertaken on Marenica Energy's own low-grade Namibian yellowcake project.

Marenica owns a 75% interest in the project, which is located in the same province as Namibia's two operating yellowcake mines (Rössing and Langer Heinrich), and to the north of Areva's Trekkopje mine.

Earlier this year, Marenica applied for a five-year Mineral Deposit Retention Licence from Namibia's Ministry of Mines and Energy.

This followed the firm's determination at the end of 2012 that the project was "sub-economic at current and projected uranium prices" using conventional heap or tank leach processing, as originally proposed.

As with Marenica, the current low-price environment has left a number of yellowcake developers with low-grade deposits unable to move ahead. In this context, a beneficiation process that can reduce costs has obvious attractions to owners sitting on presently unproductive assets.

Marenica is confident that U-pgrade has broader applications and can add value to similar hard-rock, low-grade surficial deposits elsewhere.

"The process can potentially reduce operating costs by 50-70% and capital costs by 30-50%"

THE ROAD TO U-PGRADE

A metallurgical consulting group established in 2011 concluded that Marenica's calcrete-hosted carnotite mineralisation had unique characteristics that could be leveraged to upgrade the carnotite into a reduced-mass concentrate for tank leaching.

The concept was taken further with an assessment of new scoping-level capital and operating costs based on a proposed upgraded flowsheet. The outcome was encouraging with an expectation that the process could have a significant effect on project economics.

In 2012, Marenica initiated an R&D programme to develop a concentration process that could lower the extraction cost of uranium.

One of the metallurgical consultants, Murray Hill, believed so strongly in the success of the programme that he accepted the position as Marenica's CEO.

Detailed test work was initiated at the Australian government-owned Commonwealth Scientific and Industrial Research Organisation (CSIRO) on a representative composite from five drill holes. This work concluded that the mineralisation at Marenica has distinctive characteristics:

- Uranium occurs as a single mineral, carnotite, which is well liberated and occurs in a distinct size band;
- There are virtually no composites

One on one

Marenica CEO and professional metallurgist Murray Hill is leading the development of U-pgrade. MM *put some burning questions to him…*

MM: Is U-pgrade only applicable to surficial calcrete-type uranium deposits?

MH: U-pgrade was developed on Marenica's low-grade calcrete deposit, but subsequent work on other ores has confirmed that the necessary characteristics are present in secondary surficial deposits located in semi-arid to arid environments around the world.

MM: Is any special, non-standard plant and equipment required?

MH: U-pgrade utilises commonly used and well-understood units that you would find in many gold, mineral-sands and base-metal plants around the world.

The equipment is all standard, and for this reason we believe there is limited scale-up risk. The intellectual property is in the application of the units and the order in which they are included in the flowsheet.

MM: Does the present depressed price environment provide a better opportunity to commercialise U-pgrade than would be the case if prices were higher?

MH: Our new strategy is a direct response to the low uranium price and near-term negative outlook.

The directors believe that the strategy can be successful across all price ranges, especially at or below the current incentive prices for many of our target commercialisation partners.

The value of U-pgrade comes from an operating- and capital-cost reduction, which is compelling for producers across a range of uranium prices.

MM: Have discussions with potential investors led to any firm expressions of interest in UB at this stage? And are these likely to include Chinese

of carnotite and gangue minerals;
- With a specific gravity of 4.2, carnotite is heavier than the host rocks.

These presented an opportunity to concentrate the uranium into a high-grade, low-mass product, which, in turn, reduces the mass feeding the leach circuit, allowing a reduction in the size of the circuit and associated operating costs.

Marenica undertook considerable test work on 3t of its own project ore, resulting in the development of the U-pgrade process. The process was also successfully applied in bench-scale tests to seven other third-party ore types.

The results were consistent and confirmed that the process was capable of concentrating ore by a factor of up to 50 times.

The results showed that 1Mt of ore grading 100ppm would reduce to 13,000t grading 5,000ppm, with a small reduction in process recovery from 75% to 72% but a substantial reduction in operating costs from US$80/lb U_3O_8 to US$40/lb.

The process reduces the leach feed to about 1% of the beneficiation plant feed due to significant rejection of the major gangue mineral, calcite.

This also enabled the proposed leach circuit to be changed from an alkali leach (with higher operating temperatures and slower kinetics) to an acid leach (at ambient temperature and rapid kinetics), reducing expected capital and operating costs.

The process can potentially reduce operating costs by 50-70% and capital costs by 30-50% and the firm's board took the decision to lodge a patent for U-pgrade in 2013.

THE U-PGRADE OPPORTUNITY

Despite putting its mining project on hold in 2012, Marenica continued testing the U-pgrade process and the firm has decided on a strategy to commercialise the technology and vend/license it to uranium project developers worldwide.

Marenica believes that there are "multiple pathways" open to establish joint ventures with undeveloped uranium asset owners. In addition, it regards the current depressed uranium price as offering "low entry prices and very attractive upsides".

The firm has identified a number of companies waiting for a price increase to at least US$75/lb U_3O_8, before deciding to develop a mine. Using U-pgrade could greatly reduce the price threshold for these developments.

As a first step, Marenica has formed a special project vehicle called Uranium Beneficiation (UB) to which the proprietary technology has been transferred. Initially, UB is 100%-owned by Marenica, but the intention is to bring in new investors to secure the capital needed to build and operate a pilot plant. This would be used for processing ore from three uranium deposits other than Marenica, including Trekkopje and the Omahola project, also in Namibia. The third is an unidentified uranium firm in Australia.

The plant will enable UB to engage with yellowcake-resource owners with the aim of creating a portfolio of interests in operating mines (with a target of three to four in the first five years) with potential enterprise value estimated to be in excess of US$500 million.

Carnotite mineralisation

Carnotite in weathered bedrock

firms given the Sichuan Hanlong Group is the major shareholder in Marenica?

MH: The company is exploring a range of funding options. It has received positive responses from many investors who have been impressed by the body of work undertaken by Marenica in recent years in support of U-pgrade, the powerful but simple solution, and the relatively low scale-up risk present in this process relative to other mineral processing breakthroughs.

MM: Extensive test work has been conducted on Marenica ore samples at CSIRO in Perth. Can you confirm which other firms provided samples for testing?

MH: Areva and Deep Yellow have provided samples, whereas other companies wish to maintain anonymity.

MM: What is the estimated cost of a pilot plant and where would it be built?

MH: It is estimated to cost US$6 million (US$1 million capital cost, US$5 million to operate) and will be located at CSIRO's facility in Perth. CSIRO has been instrumental in the development of U-pgrade and is a valuable and obvious partner for operation of the pilot plant.

MM: What is the anticipated timeframe for constructing a pilot plant and completing test work to the commercialisation stage?

MH: The schedule is to complete three pilot plant runs inside 12 months from UB financing.

MM: How would Marenica aim to market U-pgrade via UB to uranium development firms?

MH: Marenica has looked at a number of commercialisation options including royalty, farm in, joint ventures or purchase of resources. Each case would be assessed individually and the most appropriate course of action taken with our development partner.